Verified Carbon Standard

VCS Module

# VMD0055

# ESTIMATION OF EMISSION REDUCTIONS FROM AVOIDING UNPLANNED DEFORESTATION

Version 1.1

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Sectoral Scope 14: Agriculture, Forestry and Other Land Use

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Verra prepared version 1.1 of this module.

# CONTENTS

# 1 SOURCES

This module is based on the following modules, tools, and methodologies:

- JNR Scenarios 1, 2, and 3 Requirements
- *VM0007 REDD+ Methodology Framework (REDD+ MF), v1.6*
- *VM0015 Methodology for Avoided Unplanned Deforestation, v1.1*

This module uses the latest versions of the following tools:

- *VT0007 Unplanned Deforestation Allocation (UDef-A)*
- CDM Methodological Tool: *Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization*

This module uses the procedures described in the following modules for estimating carbon stocks in relevant pools, leakage, direct emissions, and monitoring:[1]

- *VMD0001 Estimation of Carbon Stocks in the Above- and Belowground Biomass in Live Tree and Non-tree Pools (CP-AB)*
- *VMD0002 Estimation of Carbon Stocks in the Dead Wood Pool (CP-D)*
- *VMD0003 Estimation of Carbon Stocks in the Litter Pool (CP-L)*
- *VMD0004 Estimation of Carbon Stocks in the Soil Organic Carbon Pool (CP-S)*
- *VMD0005 Estimation of Carbon Stocks in the Long-term Wood Products Pool (CP-W)*
- *VMD0011 Estimation of Emissions from Market-effects (LK-ME)*
- *VMD0013 Estimation of Greenhouse Gas Emissions from Biomass and Peat Burning (E-BPB)*
- *VMD0014 Estimation of Emissions from Fossil Fuel Combustion (E-FFC)*
- *VMD0016 Methods for Stratification of the Project Area (X-STR)*

[1] Where these modules refer to external documents (e.g., IPCC guidelines) and such documents are updated, the most recent version of the document must be used.

# 2 SUMMARY DESCRIPTION OF THE MODULE

This module describes the procedures and methods for accounting for the greenhouse gas (GHG) emission reductions achieved by projects that aim to avoid unplanned deforestation. The module includes the following:

- Procedures for unplanned deforestation activity data (UDef AD) collection, construction of forest cover benchmark maps, and application of *VT0007 Unplanned Deforestation Allocation* (*UDef-A)*. These activities are carried out by Verra through third-party data service providers (DSPs) or by the jurisdictional proponent where a project is to be nested in a registered Jurisdictional and Nested REDD+ (JNR) Scenario 1 or 2 program.
- Procedures for estimating GHG baseline emissions from carbon stock changes resulting from unplanned deforestation in the project area (UDef PA). To establish carbon stock changes in the baseline, project proponents estimate emission factors and combine these with UDef AD generated by Verra for the UDef PA and leakage belt (UDef LB).
- Procedures for estimating the net GHG emissions from displacement of unplanned deforestation (leakage due to activity shifting) triggered by projects preventing unplanned deforestation. Leakage inside and beyond the area directly around the project (the UDef LB) caused by geographically unconstrained agents and by regional demand for wood products is assessed.
- Methods for ex post monitoring of GHG emissions in the UDef PA and UDef LB

# 3 DEFINITIONS AND ACRONYMS

## 3.1 Definitions

In addition to the definitions set out in the *VCS Program Definitions* and *VM0048 Reducing Emissions from Deforestation and Forest Degradation*, the following definitions are used in this module.

**Aquaculture**
Farming of aquatic organisms, including fish, mollusks, crustaceans, and aquatic plants

**Avoiding unplanned deforestation project area (UDef PA)**
The discrete parcel(s) which, at the start of the project, are under threat of unplanned deforestation and on which the project proponent will undertake the project activities (i.e., on which unplanned deforestation will be avoided)

**Avoiding unplanned deforestation project leakage belt (UDef LB)**
The discrete parcel(s) surrounding the UDef PA to which unplanned deforestation in the UDef PA may be potentially displaced as a consequence of implementing project activities aimed at avoiding unplanned deforestation

**Data service provider (DSP)**
Entities contracted by Verra to develop activity data and forest cover and deforestation risk maps

**Forest reference emission level (FREL)**
The amount of GHG emissions from deforestation and forest degradation from a geographic area

**Geographically constrained deforestation and degradation agents**
Agents that have generated their livelihood inside or near the UDef PA since the start of the project

**Geographically mobile deforestation agents**
Deforestation agents that, in the baseline scenario, are expected to migrate into or near the UDef PA and cause deforestation therein

**Historical reference period (HRP)**
A fixed period of time during which factors must be considered in order to make projections of future deforestation, the duration of which is set out in the *VCS Methodology Requirements*

**Project activities region**
The region in which the historical agents and drivers of deforestation are analyzed; it comprises the UDef PA, the UDef LB, and the surrounding deforested areas extending 10 km from the UDef PA.

**Ranching**
Raising herds of animals on large areas (greater than >1000 ha) of land

## 3.2 Acronyms

| | |
|---|---|
| **AD** | Activity data |
| **BVP** | Baseline validity period |
| **CHC** | Change categories |
| **DLF** | Displacement leakage factor |
| **DSP** | Data service provider |
| **FCBM** | Forest cover benchmark map |
| **FREL** | Forest reference emission level |
| **HRP** | Historical reference period |
| **SOP** | Standard operating procedure(s) |
| **UDef LB** | Avoiding unplanned deforestation leakage belt |

| | |
|---|---|
| **UDef PA** | Avoiding unplanned deforestation project area |

# 4 APPLICABILITY CONDITIONS

This module is applicable where all the following conditions are met:

1) The land use transition in the baseline scenario is forest land to non-forest land, meeting the definition of unplanned deforestation;

2) The project involves activities aimed at avoiding unplanned deforestation;

3) Where project activities include harvesting trees for wood products:

   a) Such activities only occur in degraded forests with carbon stock at least 20 percent lower than the average stock of the corresponding undegraded forest and whose stock has been historically (at least over the last ten years) reduced by anthropogenic activity including timber or fuelwood harvest, fire, or disease.

   b) These activities occur as part of a sustainable forest management plan duly certified by the competent local or national regulatory body or by internationally recognized schemes such as the Programme for the Endorsement of Forest Certification or the Forest Stewardship Council;

   c) Logging operations are limited to selective logging that ensures crown cover is maintained above the threshold stated in the definition of forest and do not include piling and/or burning of logging slash; and

   d) Wood extraction for production of fuelwood, charcoal, fiber, etc. is sustainable and responsible. That is, sustainable management practices are implemented in the extraction areas to ensure that carbon stocks do not decrease consistently over time (carbon stocks may temporarily decrease due to harvest) and all relevant national or regional forestry and nature conservation regulations are complied with.

4) Agents of deforestation in the baseline scenario clear the land for tree harvesting, settlements, roads, unsanctioned expansion of roads or other infrastructure, agricultural crop production, ranching, or aquaculture.

This module is not applicable under any of the following conditions:

5) More than 2 percent of the vegetation cover in the project area is peatland or tidal wetland vegetation;

6) Wetlands are being drained in the baseline scenario or wetland drainage occurs in the project scenario (including the use of trenches or ditches for the purpose of wetland drainage);

7) More than 10 percent of the vegetation cover in a 10-kilometer-wide buffer around the project area is peatland or tidal wetland vegetation; or

8) Implemented leakage mitigation measures include:

   a) Flooding agricultural lands to increase production (e.g., for rice paddies), or

   b) Intensifying livestock production through the use of feed-lots[2] and/or manure lagoons.[3]

# 5 PROCEDURES

## 5.1 Project Boundary

### 5.1.1 Jurisdiction Boundary

The jurisdiction of relevance to the project will be defined by Verra following the criteria described in Section A1.2.1 of Appendix 1 and will be provided to the project proponent.

### 5.1.2 Avoiding Unplanned Deforestation Project Area (UDef PA)

The entire UDef PA must be forest at the project start date and must only include land qualifying as forest for a minimum of 10 years prior to the project start date. The boundaries of the UDef PA remain fixed for the duration of the project crediting period, regardless of any land cover change after the start of the project.

The UDef PA may include different project activity instances, all of which must meet the above requirements.

Where a project activity instance (or equivalent) leaves the project (e.g., a landowner decides to leave a project) before the end of the crediting period:

1) The project must conservatively assume a loss of all previously verified emission reductions associated with the excluded area;

[2] Feedlots are defined as areas in which naturally grazing animals are confined to an area which produces no feed and are fed on stored feeds.

[3] Anaerobic lagoons that function as receptacles for animal waste flushed from animal pens. Anaerobic organisms present in the manure and the environment decompose the waste in the lagoon.

2) The project proponent must submit vectorized digital files (e.g., KML) to Verra that clearly differentiate the remaining UDef PA from the excluded instance; and

3) The baseline emissions must be recalculated by the project proponent to adjust to the revised UDef PA.

A project deviation detailing these changes must be introduced in the subsequent monitoring report and assessed by the validation/verification body (VVB).

### 5.1.3 Avoiding Unplanned Deforestation Project Leakage Belt (UDef LB)

The avoiding unplanned deforestation project leakage belt (UDef LB) is the forest area to which unplanned deforestation by geographically constrained agents may be displaced and is monitored.

The spatial extent of the UDef LB will be defined by Verra following the criteria described in Section A1.2.2 of Appendix 1 and will be provided to the project proponent. Baseline AD will be allocated by Verra to each project's UDef LB following Section A1.4.3 of Appendix 1.

The project proponent must subtract from the project's baseline UDef LB AD any activity data that is allocated to other VCS AFOLU PAs that intersect with the project's UDef LB. The subtraction enters into force once the intersecting VCS AFOLU projects have submitted an initial validation report to the Verra Registry and no sooner than the intersecting projects' start date. The onus is on the project proponent to demonstrate this and on the VVB to confirm it. Once the UDef LB AD allocated to the intersecting VCS AFOLU PAs has been excluded from the project's baseline, the project may stop monitoring the UDef LB AD in the intersecting area and related leakage emissions may be omitted.

Leakage emissions associated with other overlapping VCS REDD[4] project leakage belt(s) may be omitted by a project where:

1) A leakage belt agreement is signed between project proponents that clearly defines the location of the boundaries of the different leakage belt areas overlapping with UDef LB, as well as the related monitoring responsibilities; and

2) All of the VCS REDD projects that are party to the agreement have submitted verification reports in the five years prior to the date on which the project requested verification.

When requesting verification, a project must demonstrate that parties to the leakage belt agreement have verified in the last five years.[5] Where any party to the agreement terminates its activities or fails to present a verification report for more than five consecutive years, the excluded areas and discounted AD are reintroduced to the UDef LB of the relevant projects during the first subsequent monitoring period.

[4] Limited to projects that use this module.

[5] This may be demonstrated using the Verra Registry or any other evidence showing that the other project has initiated verification.

The omission only applies to the UDef LB portions that will be monitored by the other project, as per the leakage belt agreement. Where leakage emissions are omitted, the project must discount the corresponding allocated baseline AD, reducing the baseline AD by the amount of baseline deforestation allocated to the area monitored by the other project. The project description must clearly describe the excluded areas and the related discounting calculations. Post-validation changes must be described and assessed by the VVB as project description deviations.

Unless the conditions above are met, both projects will be allocated AD for the overlapping UDef LB against which they will monitor deforestation, as per the process detailed in this module.

### 5.1.4 Land Available for Activity-Shifting Leakage

Geographically mobile agents may displace their activities outside the UDef PA and beyond the UDef LB. The area available for this kind of activity shifting corresponds to all potentially arable,[6] physically accessible, and unprotected land in the country.

The spatial extent of land available for geographically mobile activity shifting will be defined by Verra following the criteria and procedures described in Section A2.1 of Appendix 2. This will be provided by Verra to the project proponent upon receipt of the *AD Baseline Allocation Request Form*.

### 5.1.5 Leakage Management Zones

Leakage management zones are part of the overall project design. These are areas under the control of the project, and where the project proponent intends to implement activities to minimize the risk of activity-shifting leakage, such as afforestation, reforestation, sustainable forest management, enhanced cropping or grazing land management. Leakage management zones may overlap with another VCS AFOLU project. Emissions associated with the implementation of leakage mitigation measures (see Section 5.3.4.7) may be omitted for portions of leakage management zones that fall within another VCS AFOLU project when these emissions are accounted for by the other project. For example, agroforestry activities implemented to reduce deforestation may be registered as a separate project (or as an ARR component of the same project) and related emissions omitted because they are accounted for in the framework of this other project (or other component of a multiple activity project).

### 5.1.6 Project Activities Region

The project activities region comprises the UDef PA, the UDef LB, and the surrounding deforested areas extending 10 km from the UDef PA. This is the region in which the historical agents and drivers of deforestation are analyzed to determine the most plausible baseline scenario.

[6] Land considered available for activity shifting leakage beyond the UDef LB comprises arable land (i.e., land used for crop production) rather than all agricultural land (i.e., land used for crop production or ranching) due to the challenge of accurately identifying areas that are potentially suitable for ranching across an entire country.

## 5.2 Description of Baseline Scenario

Projects must determine the most plausible baseline scenario following Section 6 of *VM0048*. Quantification of baseline emissions is described in Section 5.3.2.

Once determined, the baseline scenario must be described through a detailed analysis of the agents, proximate causes, drivers, and underlying causes of deforestation in the project activities region. Understanding "who" is deforesting and what drives their decision is necessary to understand the risk of activity-shifting leakage and to design effective measures to address deforestation. All the analysis described in this section must be summarized in the project description.

The baseline scenario description must be supported by evidence such as existing studies, maps (including the jurisdictional forest cover benchmark map (FCBM) and risk map), expert consultations, field surveys (such as participatory rural appraisal), and other verifiable sources of information.

Notwithstanding other rules and requirements, the most plausible baseline scenario described in this section must at minimum be consistent with and referred to when:

1) Describing the conditions prior to project initiation;
2) Identifying the stakeholders to be engaged and consulted;
3) Selecting carbon pools and estimating the post-deforestation carbon stocks (Section 5.3.2.3);
4) Assessing and quantifying the risk of leakage by geographically constrained and geographically mobile agents (Section 5.2.1);
5) Estimating ex ante project effectiveness at reducing deforestation (Section 5.3.3.1);
6) Creating the Forest Stratification Map (Section 5.3.2.1); and
7) Assessing the internal and external risks of non-permanence following the most recent version of the *VCS AFOLU Non-Permanence Risk Tool*.

### 5.2.1 Identification and Characterization of Deforestation Agents

Identify the main groups of deforestation agents (e.g., farmers, ranchers, loggers) that would deforest the project activities region in the absence of project implementation. Describe how they contribute to deforestation and their relative importance to historical land use and land cover change.

For each identified group, provide the following information:

1) Name of the group of deforestation agents;
2) Brief description of the related deforestation activity (e.g., slash and burn agriculture, unsustainable logging) and the main social, economic, and cultural features that are

relevant to understand why the agent group is deforesting (e.g., subsistence versus commercial activities);

3) Brief assessment of the agent population size (e.g., number of households, number of farmers) and its most likely change in the future. For groups of agents that are expected to increase in number, specify whether the increase will be due to migration from outside the UDef PA and UDef LB.

4) For each identified group, describe the alternative and/or mitigation activities that will be facilitated by the project, where applicable.

An avoiding unplanned deforestation project, by protecting the UDef PA, may cause some portion of deforestation agents to relocate their activities to another location (i.e., be "displaced" from the UDef PA). Two types of deforestation agents may be displaced, as described below and summarized in Table 1. As part of the analysis of the deforestation agents, assess whether each group of agents should be considered geographically constrained or whether they may shift their activity beyond the UDef LB.

The characterization must be based on the proportion of these agents that have migrated into the project activities region in the last five years and must be confirmed through local survey as described in Section 5.3.4.4.

**Table 1: Summary of activities of geographically constrained and geographically mobile agents of deforestation in the baseline and project scenarios**

| Unplanned Deforestation Agent Type | Residing Location at Start of the Baseline Validity Period | Impact in the UDef PA and UDef LB Under the Baseline Scenario | Evolution of Practices due to Project Implementation (Project Scenario) |
|---|---|---|---|
| Geographically constrained | Residing within or near the UDef PA | Causes deforestation in the UDef PA and in the UDef LB | Agents* may:<br>• Continue causing deforestation in the UDef PA (activities inefficient)<br>• Adopt new practices and stop deforesting (no leakage)<br>• Displace their activities to the nearest accessible forest represented as UDef LB (leakage) |

| Unplanned Deforestation Agent Type | Residing Location at Start of the Baseline Validity Period | Impact in the UDef PA and UDef LB Under the Baseline Scenario | Evolution of Practices due to Project Implementation (Project Scenario) |
|---|---|---|---|
| Geographically mobile | Residing anywhere in the country outside the UDef PA and UDef LB | Migrates into or near the UDef PA or UDef LB, and causes deforestation in the UDef PA or UDef LB | Agents* may:<br>• Migrate to the UDef PA or UDef LB and cause deforestation (activities inefficient)<br>• Migrate to an area other than the UDef PA or UDef LB without causing deforestation (no leakage)<br>• Migrate to an area other than the UDef PA or UDef LB and cause deforestation (leakage) |

*In most cases, the project scenario will result in a combination of the possibilities listed (i.e., a portion of the group of agents will stop deforesting or displace their activities to the UDef LB or beyond).

Note that in this context, the term "displacement" does not mean that deforestation agents living in or near the UDef PA or UDef LB are relocated to other areas through project implementation. It refers to the displacement of forecasted baseline activities (activities that have not occurred) into other locations. For geographically mobile deforestation agents, displacement means that deforestation agents and the activities they conduct are relocated from their point of origin outside the UDef PA and UDef LB to another location that is also outside the PA and LB. This movement outside of the UDef PA replaces migration into the PA, as originally projected in the baseline.

### 5.2.2 Identification of Drivers of Deforestation

Identify and analyze the factors that drive the land-use decisions of each group of deforestation agents in order to identify the proximate causes of deforestation. First describe and, where possible, quantify the deforestation drivers (e.g., prices of agricultural, mineral, timber or other commodities, costs of agricultural inputs, population density and growth and rural wages). Second, describe drivers that explain the location of deforestation (access to forests, slope, proximity to markets, proximity to existing industrial facilities or settlements, land management type).

For each of these two sets of deforestation drivers:

1. Provide evidence for one to five key variables indicating the presence of a driver of deforestation in the project activities region during the historical reference period (HRP); and
2. Briefly describe, for each main agent group identified in Section 5.2.1, how the key drivers have and will most likely impact the agents' decision to deforest; and

3. Provide information about likely future development of each deforestation driver (e.g., how a growing geographically constrained population might exert greater pressure on the forest through firewood collection or an increasing price for a mineral is likely to drive an increase in illegal mining).

### 5.2.3 Identification of the Underlying Causes of Deforestation

The agents' characteristics and decisions are themselves determined by the underlying causes of deforestation, such as land-use policies and their enforcement, population pressure, socioeconomic dynamics, war and other types of conflicts, systems of property ownership, and climate change. List one to five key underlying causes and cite any relevant source of information that provides evidence that the identified variables have been an underlying cause of deforestation during the HRP. Briefly describe how each underlying cause is impacting the decisions of the main agent groups to deforest. For each underlying cause, provide information about its likely future development.

### 5.2.4 Analysis of Chain of Events Leading to Deforestation

Based on the historical evidence collected, the project must determine the relationships between main agent groups, key drivers, and underlying causes and explain the sequence of events that typically has led and most likely will lead to deforestation.

## 5.3 Quantification of GHG Emission Reductions

### 5.3.1 Initial Project Baseline Validity Period (BVP) Under this Module

Where a project validates or transitions to *VM0048* and this module after the initial year of a jurisdictional BVP (e.g., BVP 1 in Figure 1 below), an initial baseline validity period will be applied. There are two options when moving to the jurisdictional BVP:

1) **Option 1**: The project proponent chooses to be allocated UDef AD from the subsequent jurisdictional BVP (e.g., BVP 2 in Figure 1) when that BVP begins; or

2) **Option 2**: The initial project BVP is extended into the subsequent jurisdictional BVP for the duration set out in the *VCS Standard*[7] or two years, whichever is shorter. After the initial project BVP ends, the project must adopt an allocation from the respective jurisdictional baseline. This option only applies where there has been no Verra-endorsed jurisdictional BVP for five years or more.

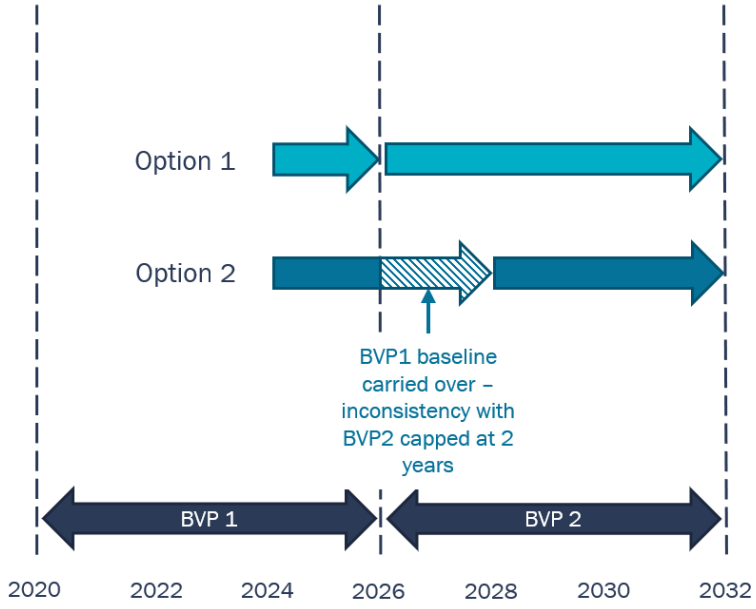
Subsequent project BVPs must be the same duration as the jurisdictional BVP.

In the example illustrated in Figure 1, the six-year jurisdictional BVP starts in 2020 and a project registers with a 2024 start date. In Option 1, the project would use the project-specific allocated AD

[7] This information may be found in the section of the *VCS Standard* related to baseline duration.

for two years, while in Option 2 the project-specific allocated AD would be used for four years. If the project selects Option 1, it transitions to jurisdictional BVP 2 in 2026 (i.e., when that BVP begins). If the project chooses Option 2, it transitions in 2028 – two years into the new BVP. The 2028 baseline is valid until the next jurisdictional BVP transition, in 2032, when the project is allocated AD for the next jurisdictional BVP.

**Figure 1: Potential options for projects' initial baseline validity period, including example dates**

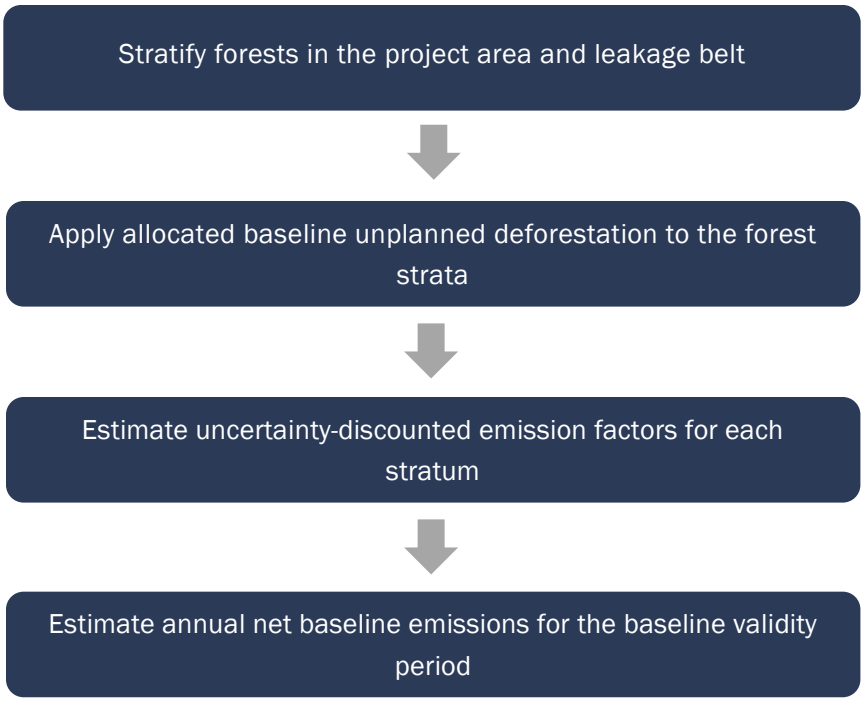



For projects that transition to *VM0048* and this module after being registered using *VM0006*, *VM0007*, *VM0009*, *VM0015,* or *VM0037*, the initial BVP (BVP 1 in Figure 1) starts on the date that the project first verifies using *VM0048*.

### 5.3.2 Baseline Emissions

The key steps to be undertaken by the project proponent to estimate the project baseline are described in Figure 2.

**Figure 2: Process for estimation of the project baseline**




#### 5.3.2.1 Creation of Forest Stratification Map

Project proponents must use *VCS Module VMD0016 Methods for Stratification of the Project Area (X-STR)* to define the forest strata to be used for calculating UDef PA and UDef LB emissions. Separate strata must be delineated for areas that exceed two hectares and meet any of the following criteria:

1) Forested wetland soils;[8]

2) Tree cover that is not considered under the relevant national forest definition (e.g., tree cover in agricultural landscapes); or

3) Areas of forest that were planted or reestablished within 30 years prior to the start of the project, wherever such forests may be unambiguously identified with readily available datasets or records.

A forest stratification map depicting strata and forest classes must be developed or adopted.

The map must:

a) Be identical to, or directly derived from, the spatial stratification used to estimate project carbon stocks from forest inventories (e.g., a map with a higher number of classes used for

[8] For guidance on identifying wetland soils, see Chapter 1.2 in Hiraishi et al. (2014).

forest inventory may be simplified by combining classes after the inventory analysis is complete); and

b) Encompass the UDef PA and UDef LB and use the same set of forest strata definitions in both areas.

The spatial accuracy of the forest stratification map will be reflected in the uncertainty of carbon stock estimates for each forest stratum.

Where, during monitoring, a natural disturbance[9] is identified to have impacted a contiguous area of 100 ha or greater within the UDef PA and/or UDef LB during the BVP, the disturbed area must be delineated and treated as a separate forest stratum. The new stratum must be described and baseline emissions must be updated through a project description deviation.

Where the event qualifies as a loss as per the *VCS Program Definitions*, applicable VCS rules and requirements will apply. After a loss, baseline emissions must be updated through a project description deviation.

#### 5.3.2.2 Estimation of Baseline Annual Unplanned Deforestation within the Project Boundary

Upon submission of the *AD Baseline Allocation Request Form*, Verra or a jurisdictional proponent will provide project proponents with the projected baseline annual area of unplanned deforestation in the UDef PA ($AD_{PA\text{-}UDef}$) and UDef LB ($AD_{LB\text{-}UDef}$).

To determine baseline emissions from unplanned deforestation, project proponents must use the following information from the *AD Baseline Allocation Report*:

1) Parameters $AD_{PA\text{-}UDef}$ and $AD_{LB\text{-}UDef}$;

2) The forest stratification map;

3) The portions of the jurisdictional deforestation risk map intersecting the UDef PA and UDef LB; and

4) Potential overlapping VCS AFOLU PAs and LBs (see Section 5.1.3).

Where other VCS AFOLU PAs or LBs are excluded from the UDef LB, as per Section 5.1.3, the forest stratification map must be adjusted to exclude any strata existing only in the intersecting areas, before AD allocation among the remaining strata.

The areas of forest stratum *i* in the UDef PA and UDef LB must be calculated using a spatial overlay of the following layers:

a) Digital maps of UDef PA boundaries;

[9] Such as tectonic activity (earthquake, landslide, volcano), extreme weather (hurricane), pest, drought, or fire that result in unavoidable degradation of forest carbon stocks

b) Digital maps of UDef LB boundaries;

c) Forest stratification map; and

d) Jurisdictional deforestation risk map.

The allocation of AD to forest strata in the project area is performed as a zonal sum of pixel values within the strata, described in Equation (1):

$$AD_{BSL,PA-UDef,i,t} = \sum_{x \in i} r_x \quad (1)$$

Where:

$AD_{BSL,PA-UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum *i* in the UDef PA for year *t* (ha)

*i* = 1, 2, 3, …, *M* forest stratum

$r_x$ = Quantified deforestation risk for pixel *x* in the UDef PA (ha)

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

The allocation of AD to forest strata in the leakage belt is described in Equation (2):

$$AD_{BSL,LB-UDef,i,t} = \sum_{x \in i} r_x \quad (2)$$

Where:

$AD_{BSL,LB-UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum *i* in the UDef LB for year *t* (ha)

*i* = 1, 2, 3, …, *M* forest stratum

$r_x$ = Quantified deforestation risk for pixel *x* in the UDef LB (ha)

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

**New Identified Exclusions**

Where, through project monitoring, a new identified excluded area of deforestation is detected (see Table 11 in Appendix 1 for a description of identified exclusions), such areas must be spatially delineated. For these areas, quantified deforestation risk is set to zero for all years of the monitoring period. Further detail is provided in Section 5.3.3.2 Step 1 below. Such areas must be recorded with description and supporting imagery as evidence of the reason for exclusion.

### 5.3.2.3 Estimation of Emissions from Carbon Stock Changes

The carbon stocks before and after deforestation for the forest strata within the UDef PA and UDef LB must be estimated to allow estimation of the change in carbon stocks resulting from deforestation within each forest stratum.

#### Step 1: Estimation of Carbon Stocks per Forest Stratum

**Estimation of Forest Carbon Stocks**

Carbon stocks in each of the pools selected for the project are estimated using VCS modules:

- *VMD0001 Estimation of Carbon Stocks in the Above- and Belowground Biomass in Live Tree and Non-tree Pools (CP-AB)*
- *VMD0002 Estimation of Carbon Stocks in the Dead Wood Pool (CP-D)*
- *VMD0003 Estimation of Carbon Stocks in the Litter Pool (CP-L)*
- *VMD0004 Estimation of Carbon Stocks in the Soil Organic Carbon Pool (CP-S)*
- *VMD0005 Estimation of Carbon Stocks in the Long-Term Wood Products Pool (CP-W)*.

The modules and derived parameters are listed in Table 2.

**Table 2: Carbon pools used in this module, with originating modules and resulting parameters**

| Pool | Module | Parameters | Parameter Description |
|---|---|---|---|
| Aboveground tree biomass | *VMD0001* | $C_{AB\_tree,i}$ | Mean carbon stock in the aboveground tree biomass pool in forest stratum *i* (t $CO_2e$/ha) |
| | | $C_{AB\_tree,post,i}$ | Mean carbon stock in the post-deforestation aboveground tree biomass pool in forest stratum *i* (t $CO_2e$/ha) |
| Belowground tree biomass | *VMD0001* | $C_{BB\_tree,i}$ | Mean carbon stock in the belowground tree biomass pool in forest stratum *i* (t $CO_2e$/ha) |
| | | $C_{BB\_tree,post,i}$ | Mean carbon stock in the post-deforestation belowground tree biomass pool in forest stratum *i* (t $CO_2e$/ha) |
| Aboveground non-tree biomass | *VMD0001* | $C_{AB\_nontree,i}$ | Mean carbon stock in the aboveground non-tree woody biomass pool in forest stratum *i* (t $CO_2e$/ha) |
| | | $C_{AB\_nontree,post,i}$ | Mean carbon stock in the post-deforestation aboveground non-tree woody biomass pool in forest stratum *i* (t $CO_2e$/ha) |

| Pool | Module | Parameters | Parameter Description |
|---|---|---|---|
| Belowground non-tree biomass | *VMD0001* | $C_{BB\_nontree,i}$ | Mean carbon stock in the belowground non-tree woody biomass pool in forest stratum *i* (t $CO_2e$/ha) |
| | | $C_{BB\_nontree,post,i}$ | Mean carbon stock in the post-deforestation belowground non-tree woody biomass pool in forest stratum *i* (t $CO_2e$/ha) |
| Dead wood | *VMD0002* | $C_{DW,i}$ | Carbon stock in the dead wood pool in forest stratum *i* (t $CO_2e$/ha) |
| | | $C_{DW,post,i}$ | Carbon stock in the post-deforestation dead wood pool in forest stratum *i* (t $CO_2e$/ha) |
| Litter | *VMD0003* | $C_{LI,i}$ | Carbon stock in the litter pool in forest stratum *i* (t $CO_2e$/ha) |
| | | $C_{LI,post,i}$ | Carbon stock in the post-deforestation litter pool in forest stratum *i* (t $CO_2e$/ha) |
| Soil organic carbon | *VMD0004* | $C_{SOC,i}$ | Mean carbon stock in the soil organic carbon pool in forest stratum *i* (t $CO_2e$/ha) |
| | | $C_{SOC,post,i}$ | Mean carbon stock in the post-deforestation soil organic carbon pool in forest stratum *i* (t $CO_2e$/ha) (parameter is $C_{SOC,PD-BSL,i}$ in *VMD0004*) |
| Harvested wood products | *VMD0005* | $C_{WP,i}$ | Mean carbon stocks entering the wood products pool at the time of deforestation from forest stratum *i* (t $CO_2e$/ha) |
| | | $C_{WP100,i}$ | Carbon stock entering the wood products pool from stratum *i* at the time of deforestation that is expected to be emitted over 100 years (t $CO_2e$/ha) |

In instances where the UDef LB contains forest strata not found within the UDef PA (and not expected to be found in the UDef PA under either the baseline or project scenarios), carbon pool estimates from a national dataset (e.g., forest reference emission level (FREL) or national forest inventory) or peer-reviewed published source may be used.

### Estimation of Non-Forest Carbon Stocks

The carbon stocks following deforestation are assumed to be the area-weighted average stocks of all post-deforestation land use classes present within a 10-km wide area surrounding the UDef PA, referencing the most current land use/land cover classification covering the jurisdiction. This area-weighted average stock of the post-deforestation land uses may be calculated for each forest stratum separately. Alternatively, a single area-weighted average stock of the post-deforestation land use class may be calculated and applied to all forest strata.

### Step 2: Estimation of Emissions from Carbon Stock Changes

Stock changes ($\Delta C_p$) in each carbon pool are calculated by subtracting the post-deforestation carbon stocks from forest carbon stocks. The stock changes are calculated for each pool in each forest stratum using Equation (3), which should be applied to all the parameters included in Table 2.

$$\Delta C_{p,i} = C_{p,i} - C_{p,post,i} \quad (3)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{p,i}$ | = | Estimated emissions from carbon stock change in pool *p* in forest stratum *i* (t $CO_2e$/ha) |
| $C_{p,i}$ | = | Estimated carbon stock in pool *p* of forest stratum *i* (t $CO_2e$/ha) |
| $C_{p,post,i}$ | = | Estimated carbon stock in post-deforestation pool *p* in forest stratum *i* (t $CO_2e$/ha) |
| *p* | = | Carbon pool: aboveground tree biomass (AB_tree), aboveground non-tree biomass (AB_nontree), belowground tree biomass (BB_tree), belowground non-tree biomass (BB_nontree), dead wood (DW), litter (LI), soil organic carbon (SOC), and harvested wood products (WP) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |

### Step 3: Evaluation of Uncertainty of Carbon Stock Estimates

Estimates of the carbon stocks in each carbon pool must be accompanied by an estimate of uncertainty. The percentage uncertainty of each carbon stock estimate is defined as the half width of the two-sided 90 percent confidence interval divided by the estimate. The following requirements apply:

1) Where carbon stock estimates are derived from sampling (e.g., measuring aboveground biomass or other carbon pools in sample plots), uncertainty must be at minimum derived from the sampling uncertainty.

2) Where literature sources (including IPCC guidance) are used for carbon stock estimates, these sources must also include an estimate of the uncertainty and/or data ranges (data ranges may be used as proxies of confidence intervals).

3) The project documentation must include a table of carbon stock estimates in each pool and forest stratum (mean and 90 percent confidence interval) and an indication of which sources of uncertainty were included.

4) The uncertainty of parameters used in the estimation of stocks (e.g., carbon fraction, wood density, soil organic carbon stock change factors, and root-to-shoot ratio) must be included and propagated.

The uncertainty derived from allometric equations for aboveground or belowground tree biomass, or from the variables used to parameterize the equations, is not included.

4. Estimating the uncertainty associated with measurement error (e.g., tree height or diameter measurements) is not required.

To evaluate uncertainty, the standard error of each estimate[10] must be calculated. The standard error of estimate *A* is denoted as *S*(*A*). The uncertainty of this estimate is evaluated in terms of the half-width of its two-sided 90 percent confidence interval and is denoted as $U(A) = t_{alpha=10\%} \times S(A)$, where $t_{alpha=10\%}$ is the t value for a two-sided 90 percent confidence interval. The percentage uncertainty is the uncertainty expressed as a percentage of the estimate and is denoted as $U\%(A) = 100 \times t_{alpha=10\%} \times S(A)/A$. Error propagation is necessary to track uncertainty through the various calculation steps involved in estimating carbon stocks. The equations in Table 3 summarize simplified rules of error propagation that must be used when carrying out summations, subtractions, multiplications and divisions of two variables *A* and *B*. Multiplication with an exactly known coefficient *c* is also shown.

**Table 3: Equations for error propagation**

| *f*(*A*,*B*,*c*) | Standard Error of Estimate | Percentage Uncertainty of Estimate |
|---|---|---|
| $A + B$ | $S(A+B) = \sqrt{S(A)^2 + S(B)^2}$ | $U\%(A+B) = 100 \times t_{alpha=10\%} \times \frac{S(A+B)}{A+B}$ |
| $A \times B$ | $S(A \times B) = \lvert A \times B \rvert \times \sqrt{\left(\frac{S(A)}{A}\right)^2 + \left(\frac{S(B)}{B}\right)^2}$ | $U\%(A \times B) = 100 \times t_{alpha=10\%} \times \frac{S(A \times B)}{A \times B}$ |
| $A - B$ | $S(A-B) = \sqrt{S(A)^2 + S(B)^2}$ | $U\%(A-B) = 100 \times t_{alpha=10\%} \times \frac{S(A-B)}{A-B}$ |
| $\frac{A}{B}$ | $S\left(\frac{A}{B}\right) = \left\lvert\frac{A}{B}\right\rvert \times \sqrt{\left(\frac{S(A)}{A}\right)^2 + \left(\frac{S(B)}{B}\right)^2}$ | $U\%\left(\frac{A}{B}\right) = 100 \times t_{alpha=10\%} \times \frac{S\left(\frac{A}{B}\right)}{\frac{A}{B}}$ |
| $c \times A$ | $S(c \times A) = c \times S(A)$ | $U\%(c \times A) = 100 \times t_{alpha=10\%} \times \frac{S(c \times A)}{c \times A}$ |

[10] It is important to distinguish between the standard deviation of a population parameter and the standard deviation of the estimator of that population parameter. For example, where a population mean is estimated from sample measurements, the estimator will be the sample mean. The standard deviation of the mean estimate (often referred to as standard error) will consider the number of sample units, *n*, and is calculated by dividing the standard deviation by the square root of ($n - 1$). For clarity, the term standard error is used in this module to refer to the standard deviation of an estimate.

### Estimation of Uncertainty for Each Pool and Stratum

The uncertainty of the estimated emissions from stock change in each carbon pool and stratum is calculated using the error propagation equation for subtraction from Table 3 as follows:

$$U(\Delta C_{p,i}) = U(C_{p,i} - C_{p,post,i}) = \sqrt{U(C_{p,i})^2 + U(C_{p,post,i})^2} \quad (4)$$

Where:

$U()$ = Uncertainty as half-width of the two-sided 90 percent confidence interval (t $CO_2e$/ha)

$\Delta C_{p,i}$ = Estimated emissions from carbon stock change in pool $p$ of forest stratum $i$ (t $CO_2e$/ha)

$C_{p,i}$ = Estimated carbon stock in pool $p$ of forest stratum $i$ (t $CO_2e$/ha)

$C_{p,post,i}$ = Estimated carbon stock in post-deforestation pool $p$ in forest stratum $i$ (t $CO_2e$/ha)

$p$ = Pool: aboveground tree biomass (AB_tree), aboveground non-tree biomass (AB_nontree), belowground tree biomass (BB_tree), belowground non-tree biomass (BB_nontree), dead wood (DW), litter (LI), soil organic carbon (SOC), and harvested wood products (WP)

$i$ = 1, 2, 3, …, $M$ forest stratum

## Step 4: Estimation of an Uncertainty Discount Factor

Conservative estimation of changes in carbon stocks is achieved by applying an uncertainty discount factor.

### Averaging Carbon Stock Changes Over Forest Strata and Carbon Pools

To establish the uncertainty discount factor, first stock changes are averaged over forest strata and carbon pools. The stock changes are averaged over the area of UDef AD within each forest stratum over the baseline period for each pool separately, using an area-weighted average. The area data to be used for averaging are those obtained in Section 5.3.2.2. The stock changes are calculated as follows:

$$W\Delta C_p = \frac{\sum_{i=1}^{M} AD_{BSL,PA-UDef,i,t} \times \Delta C_{p,i}}{\sum_{i=1}^{M} AD_{BSL,PA-UDef,i,t}} \quad (5)$$

Where:

$W\Delta C_p$ = UDef AD baseline weighted average emissions from carbon stock change in pool $p$ (t $CO_2e$/ha)

$AD_{BSL,PA\text{-}UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum *i* in the UDef PA for year *t* (ha)

$\Delta C_{p,i}$ = Estimated emissions from carbon stock change in pool *p* in forest stratum *i* (t $CO_2e$/ha)

*p* = Pool: aboveground tree biomass (AB_tree), aboveground non-tree biomass (AB_nontree), belowground tree biomass (BB_tree), belowground non-tree biomass (BB_nontree), dead wood (DW), litter (LI), soil organic carbon (SOC), and harvested wood products (WP)

*i* = 1, 2, 3, …, *M* forest stratum

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

The UDef AD baseline weighted stock changes are then summed across all relevant carbon pools. To establish the discount factor, this must be undertaken for all pools together, although soil organic carbon and carbon stocks entering the wood products pools are kept separate when emission factors are applied to AD. The soil organic pool is derived from *VMD0004* with $\Delta C_{SOC,i} = C_{SOC,i} - C_{SOC,post.i}$.

$$W\Delta C = W\Delta C_{AB_{tree}} + W\Delta C_{BB_{tree}} + W\Delta C_{AB_{nontree}} + W\Delta C_{BB_{nontree}} + W\Delta C_{DW} + W\Delta C_{LI} + W\Delta C_{SOC} - WC_{WP} + WC_{WP100} \quad (6)$$

Where:

$W\Delta C$ = Overall UDef AD baseline weighted average emissions from carbon stock changes (t $CO_2e$/ha)

$W\Delta C_{AB\_tree}$ = UDef AD baseline weighted average emissions from carbon stock change in the aboveground tree biomass pool (t $CO_2e$/ha)

$W\Delta C_{BB\_tree}$ = UDef AD baseline weighted average emissions from carbon stock change in the belowground tree biomass pool (t $CO_2e$/ha)

$W\Delta C_{AB\_nontree}$ = UDef AD baseline weighted average emissions from carbon stock change in the aboveground non-tree woody biomass pool (t $CO_2e$/ha)

$W\Delta C_{BB\_nontree}$ = UDef AD baseline weighted average emissions from carbon stock change in the belowground non-tree woody biomass pool (t $CO_2e$/ha)

$W\Delta C_{DW}$ = UDef AD baseline weighted average emissions from carbon stock change in the dead wood pool (t $CO_2e$/ha)

$W\Delta C_{LI}$ = UDef AD baseline weighted average emissions from carbon stock change in the litter pool (t $CO_2e$/ha)

$W\Delta C_{SOC}$ = UDef AD baseline weighted average emissions from carbon stock change in the soil organic carbon pool (t $CO_2e$/ha)

$WC_{WP}$ = UDef AD baseline weighted average carbon stock entering the wood products pool at the time of deforestation (t $CO_2e$/ha)

$WC_{WP100}$ = UDef AD baseline weighted average carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100 years (t $CO_2e$/ha)

Uncertainty must be propagated accordingly. In doing this, the AD area values are considered, for simplicity, as simple multiplication factors with no uncertainty.

$$U(W\Delta C_p) = \frac{\sqrt{\sum_{i=1}^{M}\left(AD_{BSL,PA-UDef,i,t} \times U\left(\Delta C_{p,i}\right)\right)^2}}{\sum_{i=1}^{M} AD_{BSL,PA-UDef,i,t}} \quad (7)$$

Where:

$U()$ = Uncertainty as half-width of the two-sided 90 percent confidence interval (t $CO_2e$/ha)

$W\Delta C_p$ = UDef AD baseline weighted average emissions from carbon stock change in pool $p$ (t $CO_2e$/ha)

$AD_{BSL,PA-UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum $i$ in the UDef PA for year $t$ (ha)

$\Delta C_{p,i}$ = Estimated emissions from carbon stock change in pool $p$ in forest stratum $i$ (t $CO_2e$/ha)

$p$ = Pool: aboveground tree biomass (AB_tree), aboveground non-tree biomass (AB_nontree), belowground tree biomass (BB_tree), belowground non-tree biomass (BB_nontree), dead wood (DW), litter (LI), soil organic carbon (SOC), and harvested wood products (WP)

$I$ = 1, 2, 3, …, $M$ forest stratum

$t$ = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

Further, uncertainty must be propagated using the equations for addition and subtraction from Table 3 per Equations (8) and (9).

$$U(W\Delta C) = \sqrt{\begin{matrix} U\left(W\Delta C_{AB_{tree}}\right)^2 + U\left(W\Delta C_{BB_{tree}}\right)^2 + U\left(W\Delta C_{AB_{nontree}}\right)^2 \\ + U\left(W\Delta C_{BB_{nontree}}\right)^2 + U(W\Delta C_{DW})^2 + U(W\Delta C_{LI})^2 \\ + U(W\Delta C_{SOC})^2 + U(WC_{WP})^2 + U(WC_{WP100})^2 \end{matrix}} \quad (8)$$

$$U\%(W\Delta C) = 100 \times \frac{U(W\Delta C)}{W\Delta C} \quad (9)$$

Where:

$U()$ = Uncertainty as half-width of the two-sided 90 percent confidence interval (t $CO_2e$/ha)

$U\%()$ = Percentage uncertainty (i.e., uncertainty expressed as a percentage of the estimate) (%)

$W\Delta C$ = Overall UDef AD baseline weighted average emissions from carbon stock changes (t $CO_2e$/ha)

$W\Delta C_{AB\_tree}$ = UDef AD baseline weighted average emissions from carbon stock change in the aboveground tree biomass pool (t $CO_2e$/ha)

$W\Delta C_{BB\_tree}$ = UDef AD baseline weighted average emissions from carbon stock change in the belowground tree biomass pool (t $CO_2e$/ha)

$W\Delta C_{AB\_nontree}$ = UDef AD baseline weighted average emissions from carbon stock change in the aboveground non-tree woody biomass pool (t $CO_2e$/ha)

$W\Delta C_{BB\_nontree}$ = UDef AD baseline weighted average emissions from carbon stock change in the belowground non-tree woody biomass pool (t $CO_2e$/ha)

$W\Delta C_{DW}$ = UDef AD baseline weighted average emissions from carbon stock change in the dead wood pool (t $CO_2e$/ha)

$W\Delta C_{LI}$ = UDef AD baseline weighted average emissions from carbon stock change in the litter pool (t $CO_2e$/ha)

$W\Delta C_{SOC}$ = UDef AD baseline weighted average emissions from carbon stock change in the soil organic carbon pool (t $CO_2e$/ha)

$WC_{WP}$ = UDef AD baseline weighted average carbon stock entering the wood products pool at the time of deforestation (t $CO_2e$/ha)

$WC_{WP100}$ = UDef AD baseline weighted average carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100 years (t $CO_2e$/ha)

### Estimation of an Uncertainty Discount Factor

The discount factor for emissions from carbon stock change, $DF_{W\Delta C,}$ is calculated based on the resulting uncertainty of the baseline UDef AD weighted average carbon stock change, $U\%(W\Delta C)$. Where the percentage uncertainty is less than or equal to 10 percent, the discount factor is zero, calculated using Equation (10). Where the percentage uncertainty is greater than 10 percent, the discount factor is calculated using Equation (11). In accordance with VCS requirements, uncertainty must remain below 100 percent. Where uncertainty is greater than 100 percent, additional sampling must be undertaken.

$$\text{If } U\%(W\Delta C) \leq 10\% \quad \text{then:} \quad DF_{W\Delta C} = 0 \tag{10}$$

$$\text{If } U\%(W\Delta C) > 10\% \quad \text{then:} \quad DF_{W\Delta C} = \frac{U\%(W\Delta C) \times t_{alpha=66.67\%}}{100 \times t_{alpha=10\%}} \tag{11}$$

Where:

| | | |
|---|---|---|
| $DF_{W\Delta C}$ | = | Uncertainty discount factor for stock changes |
| $U\%(W\Delta C)$ | = | Percentage uncertainty in emissions from carbon stock change (%) |
| $t_{alpha=10\%}$ | = | Value of the t distribution for a two-sided 90 percent confidence interval |
| $t_{alpha=66.67\%}$ | = | Value of the t distribution for a one-sided 66.67 percent confidence interval |

## Step 5: Conservative Estimation of Emissions from Carbon Stock Change

Conservative estimates of the emissions from carbon stock change in the UDef PA are calculated by summing over the carbon stock pools and applying the discount factor. This adjustment must be undertaken separately for each carbon pool: aboveground biomass, belowground biomass, litter and dead wood, soil organic carbon, and carbon stocks entering the wood products pool.

$$\Delta Cc_{AB-LI,i} = \left(\left(\Delta C_{AB_{tree},i} - C_{WP,i}\right) + \Delta C_{AB_{nontree},i} + \Delta C_{LI,i}\right) \times (1 - DF_{W\Delta C}) \tag{12}$$

Where:

| | | |
|---|---|---|
| $\Delta Cc_{AB\text{-}LI,i}$ | = | Conservatively estimated emissions from carbon stock change in the UDef PA in aboveground biomass and litter pools in forest stratum *i* (t $CO_2e$/ha) |
| $\Delta C_{AB\_tree,i}$ | = | Emissions from carbon stock change in the aboveground tree biomass pool in forest stratum *i* (t $CO_2e$/ha) |
| $\Delta C_{AB\_nontree,i}$ | = | Emissions from carbon stock change in the aboveground non-tree woody biomass pool in stratum *i* (t $CO_2e$/ha) |

$\Delta C_{LI,i}$ = Emissions from carbon stock change in the litter pool in forest stratum *i* (t $CO_2e$/ha)

$C_{WP,i}$ = Carbon stock entering the wood product pool in forest stratum *i* (t $CO_2e$/ha)

$DF_{W\Delta C}$ = Uncertainty discount factor for stock changes

*i* = 1, 2, 3, …, *M* forest stratum

$$\Delta Cc_{BB-DW,i} = \left(\Delta C_{BB_{tree},i} + \Delta C_{BB_{nontree},i} + \Delta C_{DW,i}\right) \times (1 - DF_{W\Delta C}) \quad (13)$$

Where:

$\Delta Cc_{BB\text{-}DW,i}$ = Conservatively estimated emissions from carbon stock change over a 10-year period in the UDef PA in belowground biomass and dead wood pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{BB\_tree,i}$ = Emissions from carbon stock change in the belowground tree biomass pool in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{BB\_nontree,i}$ = Emissions from carbon stock change in the belowground non-tree biomass pool in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{DW,i}$ = Emissions from carbon stock change in the dead wood pool in forest stratum *i* (t $CO_2e$/ha)

$DF_{W\Delta C}$ = Uncertainty discount factor for stock changes

*i* = 1, 2, 3, …, *M* forest stratum

$$\Delta Cc_{SOC-WP,i} = \left(\Delta C_{SOC,i} + C_{WP100,i}\right) \times (1 - DF_{W\Delta C}) \quad (14)$$

Where:

$\Delta Cc_{SOC\text{-}WP,i}$ = Conservatively estimated emissions from carbon stock change over a 20-year period in the UDef PA in the soil organic carbon and wood product pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{SOC,i}$ = Emissions from carbon stock change in the soil organic carbon pool in forest stratum *i* (t $CO_2e$/ha)

$C_{WP100,i}$ = Carbon stock entering the wood product pool at the time of deforestation that is expected to be emitted over 100 years in forest stratum *i* (t $CO_2e$/ha)

$DF_{W\Delta C}$ = Uncertainty discount factor for stock changes

*i* = 1, 2, 3, …, *M* forest stratum

Emissions from carbon stock change in the UDef LB are calculated similarly, but uncertainty is not quantified:

$$\Delta C_{LB,AB-LI,i} = \left(\Delta C_{AB_{tree},i} - C_{WP,i}\right) + \Delta C_{AB_{nontree},i} + \Delta C_{LI,i} \quad (15)$$

Where:

$\Delta C_{LB,AB\text{-}LI,i}$ = Estimated emissions from carbon stock change in the UDef LB in aboveground biomass and litter pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{AB\_tree,i}$ = Emissions from carbon stock change in the aboveground tree biomass pool in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{AB\_nontree,i}$ = Emissions from carbon stock change in the aboveground non-tree woody biomass pool in stratum *i* (t $CO_2e$/ha)

$\Delta C_{LI,i}$ = Emissions from carbon stock change in the litter pool in forest stratum *i* (t $CO_2e$/ha)

$C_{WP,i}$ = Carbon stock entering the wood product pool in forest stratum *i* (t $CO_2e$/ha)

*i* = 1, 2, 3, …, *M* forest stratum

$$\Delta C_{LB,BB-DW,i} = \Delta C_{BB_{tree},i} + \Delta C_{BB_{nontree},i} + \Delta C_{DW,i} \quad (16)$$

Where:

$\Delta C_{LB,BB\text{-}DW,i}$ = Estimated emissions from carbon stock change over a 10-year period in the UDef LB in belowground biomass and dead wood pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{BB\_tree,i}$ = Emissions from carbon stock change in the belowground tree biomass pool in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{BB\_nontree,i}$ = Emissions from carbon stock change in the belowground non-tree biomass pool in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{DW,i}$ = Emissions from carbon stock change in the dead wood pool in forest stratum *i* (t $CO_2e$/ha)

*i* = 1, 2, 3, …, *M* forest stratum

$$\Delta C_{LB,SOC-WP,i} = \Delta C_{SOC,i} + C_{WP100,i} \quad (17)$$

Where:

$\Delta C_{LB,SOC\text{-}WP,i}$ = Estimated emissions from carbon stock change over a 20-year period in the UDef LB in the soil organic carbon and wood product pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{SOC,i}$ = Emissions from carbon stock change in the soil organic carbon pool in forest stratum *i* (t $CO_2e$/ha)

$C_{WP100,i}$ = Carbon stock entering the wood products pool at the time of deforestation that is expected to be emitted over 100 years in forest stratum *i* (t $CO_2e$/ha)

*i* = 1, 2, 3, …, *M* forest stratum

### Step 6: Estimation of Annual Baseline Emissions from Carbon Stock Changes

The sum of emissions projected to take place in the UDef PA are estimated using the area of AD and the emissions from the carbon stock changes resulting from unplanned deforestation.

Stock changes in the aboveground and litter carbon pools are assumed to be emitted at the time of land use transition. Following the land use transition, emissions from the belowground, dead wood, soil organic carbon, and wood product pools are assumed to take place gradually over time; those from the belowground biomass and dead wood pools at an annual rate of 1/10 of the stock change, and those from soil organic carbon and wood products at an annual rate of 1/20 of the stock change. For a given year *t* (the year for which emissions are to be estimated), emissions from unplanned deforestation are summed from time *t* − 10 up to *t* (for belowground biomass and dead wood) and from time *t* − 20 up to time *t* (for soil organic carbon and wood products).

For carbon pools in the UDef PA strata:

$$\Delta C_{BSL,PA-UDef,i,t} = \left(AD_{BSL,PA-UDef,i,t} \times \Delta Cc_{\mathrm{AB-LI},i}\right) + \sum_{t-10}^{t}\left(AD_{BSL,PA-UDef,i,t}\right) \times \frac{\Delta Cc_{\mathrm{BB-DW},i}}{10} + \sum_{t-20}^{t}\left(AD_{BSL,PA-UDef,i,t}\right) \times \frac{\Delta Cc_{\mathrm{SOC-WP},i}}{20} \quad (18)$$

Where:

$\Delta C_{BSL,PA\text{-}UDef,i,t}$ = Total emissions from the baseline carbon stock change in all carbon pools in forest stratum *i* within the UDef PA in year *t* (t $CO_2e$)

$AD_{BSL,PA\text{-}UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum *i* in the UDef PA for year *t* (ha)

$\Delta Cc_{AB\text{-}LI,i}$ = Conservatively estimated emissions from carbon stock change in the UDef PA in aboveground biomass and litter pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta Cc_{BB\text{-}DW,i}$ = Conservatively estimated emissions from carbon stock change over a 10-year period in the UDef PA in belowground biomass and dead wood pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta Cc_{SOC\text{-}WP,i}$ = Conservatively estimated emissions from carbon stock change over a 20-year period in the UDef PA in the soil organic carbon and wood product pools in forest stratum *i* (t $CO_2e$/ha)

*i* = 1, 2, 3, …, *M* forest stratum

*t* = 1, 2, 3, …, *t** years elapsed since the start of the project

For carbon pools in UDef LB strata:

$$\Delta C_{BSL,LB-UDef,i,t} = (AD_{BSL,LB-UDef,i,t} \times \Delta C_{LB,AB-LI,i}) + \sum_{t-10}^{t} (AD_{BSL,LB-UDef,i,t}) \times \frac{\Delta C_{LB,BB-DW,i}}{10} + \sum_{t-20}^{t} (AD_{BSL,LB-UDef,i,t}) \times \frac{\Delta C_{LB,SOC-WP,i}}{20} \quad (19)$$

Where:

$\Delta C_{BSL,LB\text{-}UDef,i,t}$ = Total emissions from baseline carbon stock change in all carbon pools in forest stratum *i* within the UDef LB in year *t* (t $CO_2e$)

$AD_{BSL,LB\text{-}UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum *i* in the UDef LB for year *t* (ha)

$\Delta C_{LB,AB\text{-}LI,i}$ = Estimated emissions from carbon stock change in the UDef LB in aboveground biomass and litter pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{LB,BB\text{-}DW,i}$ = Estimated emissions from carbon stock change over a 10-year period in the UDef LB in belowground biomass and dead wood pools in forest stratum *i* (t $CO_2e$/ha)

$\Delta C_{LB,SOC\text{-}WP,i}$ = Estimated emissions from carbon stock change over a 20-year period in the UDef LB in soil organic carbon and wood product pools in forest stratum *i* (t $CO_2e$/ha)

*i* = 1, 2, 3, …, *M* forest stratum

*t* = 1, 2, 3, …, *t** years elapsed since the start of the project

#### 5.3.2.4 Estimation of Other Baseline GHG Emissions

Any other GHG emissions that would take place in the baseline scenario within the UDef PA must be estimated. See VCS modules *VMD0013 Estimation of Greenhouse Gas Emissions from Biomass*

*and Peat Burning (E-BPB)* and *VMD0014 Estimation of Emissions from Fossil Fuel Combustion (E-FFC)* for calculation of $E_{BSL,BiomassBurn,i,t}$ and $E_{BSL,FC,i,t}$, and *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization* for calculation of $N2O_{BSL,direct\text{-}N,i,t}$. The other GHG emissions within the UDef PA are estimated as:

$$GHG_{BSL_{PA-UDef},E,t} = \sum_{t=1}^{t*}\sum_{i=1}^{M}\left(E_{BSL,FC,i,t} + E_{BSL,BiomassBurn,i,t} + N2O_{BSL,direct-N,i,t}\right) \quad (20)$$

Where:

$GHG_{BSL\_PA\text{-}UDef,E,t}$ = Cumulative other GHG emissions in the baseline in year *t* resulting from unplanned deforestation within the UDef PA since the project start (t $CO_2e$)

$E_{BSL,FC,i,t}$ = Emissions from fossil fuel combustion in forest stratum *i* in the UDef PA in year *t* (t $CO_2e$)

$E_{BSL,BiomassBurn,i,t}$ = Non-$CO_2$ emissions due to biomass burning as part of unplanned deforestation activities in forest stratum *i* in year *t* (t $CO_2e$)

$N2O_{BSL,direct\text{-}N,i,t}$ = Direct $N_2O$ emission as a result of nitrogen application on an alternative land use in forest stratum *i* in year *t* (t $CO_2e$)

*i* = 1, 2, 3, …, *M* forest stratum

*t* = 1, 2, 3, …, *t** years elapsed since the start of the project

### 5.3.2.5 Estimation of Net Baseline Emissions

Net emissions under baseline conditions for UDef PA are calculated as:

$$\Delta C_{BSL,PA-UDef,t} = \left(\sum_{t=1}^{t*}\sum_{i=1}^{M}\Delta C_{BSL,PA-UDef,i,t}\right) + GHG_{BSL_{PA-UDef},E,t} \quad (21)$$

Where:

$\Delta C_{BSL,PA\text{-}UDef,t}$ = Cumulative net GHG emissions since the project start within the UDef PA in the baseline in year *t* (t $CO_2e$)

$GHG_{BSL\_PA\text{-}UDef,E,t}$ = Cumulative other GHG emissions in the baseline in year *t* resulting from unplanned deforestation within the UDef PA since the project start (t $CO_2e$)

$\Delta C_{BSL,PA\text{-}UDef,i,t}$ = Sum of the baseline emissions from carbon stock change in all carbon pools in forest stratum *i* within the UDef PA in year *t* (t $CO_2e$)

*i* = 1, 2, 3, …, *M* forest stratum

$t$ = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

Net emissions under baseline conditions for the UDef LB are calculated as:

$$\Delta C_{BSL,LB-UDef,t} = \sum_{t=1}^{t*} \sum_{i=1}^{M} \Delta C_{BSL,LB-UDef,i,t} \quad (22)$$

Where:

$\Delta C_{BSL,LB-UDef,t}$ = Cumulative net GHG emissions since the project start within the UDef LB in the baseline in year $t$ (t $CO_2e$)

$\Delta C_{BSL,LB-UDef,i,t}$ = Cumulative emissions from baseline carbon stock change in all carbon pools in forest stratum $i$ within the UDef LB in year $t$ (t $CO_2e$)

$i$ = 1, 2, 3, …, $M$ forest stratum

$t$ = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

### 5.3.2.6 Area Cap at Baseline Reassessment

Through the project lifetime, the sum of allocated deforestation in any given stratum must not exceed the total area of each stratum. Thus:

$\sum_{t=1}^{t*} AD_{BSL,PA-UDef,i,t}$ must be ≤ $A_i$

In any circumstance where:

$\sum_{t=1}^{t*} AD_{BSL,PA-UDef,i,t}$ is > $A_i$, baseline deforestation must be allocated to an alternative stratum with lower total emissions from the baseline carbon stock change in all carbon pools.

If at any time:

$\sum_{i=1}^{M} \sum_{t=1}^{t*} AD_{BSL,PA-UDef,i,t}$ > $A_{PA-UDef}$ (with the subtraction of any identified exclusions), then no further issuance of VCUs may occur.

Where:

$AD_{BSL,PA-UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum $i$ in the UDef PA for year $t$ (ha)

$A_i$ = Area of stratum $i$ (ha)

| | | |
|---|---|---|
| $A_{PA\text{-}UDef}$ | = | Area of project where activities aimed at avoiding unplanned deforestation will take place (ha) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, $t^*$ years elapsed since the start of the project |

Where baseline renewal represents the first use of this module after the project's prior use of *VM0006*, *VM0007*, *VM0009*, *VM0015*, or *VM0037*, the parameters in the expressions above should be replaced as detailed in Table 4.

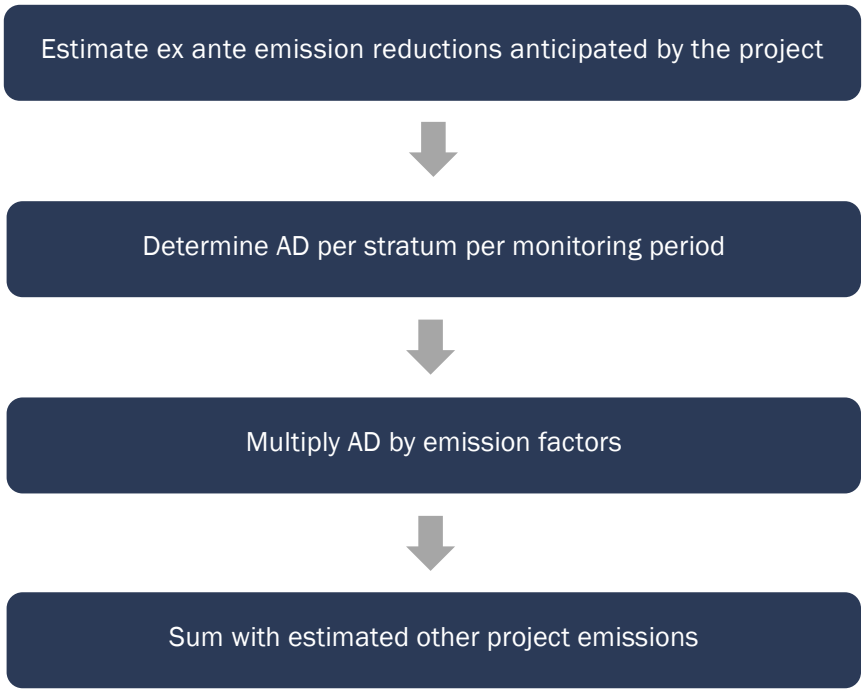
**Table 4: Parameters associated with the area cap and applicable parameters in prior REDD methodologies**

| Parameter in this module | Parameter in previously valid REDD methodology |
|---|---|
| $AD_{BSL,PA\text{-}UDef,i,t}$ | VM0006: $D_{projectArea,baselineScenario,DF}(t)$<br>VM0007 (VMD0007): $A_{BSL,PA,unplanned,t}$<br>VM0009: $A_{B\Delta PAA}^{[m]}$<br>VM0015: $ABSLPA_{i,t}$<br>VM0037: $(LT(1-2)_{y2-y1,rate}) \times S_{REDD,i}$ |
| $A_i$ | VM0006: $area(t, CSi)$<br>VM0007 (VMD0007): $Aunplanned,i,t$<br>VM0009: $A_k$<br>VM0015: $ABSLPA_i$<br>VM0037: $S_{REDD,i}$ |
| $A_{PA\text{-}UDef}$ | VM0006: $size_{projectArea}$<br>VM0007: $PA$<br>VM0009: $A_{PAA}$<br>VM0015: $PA$<br>VM0037: $\sum_{i=1} S_{REDD,i}$ |

### 5.3.3 Project Emissions

The key steps undertaken by the project proponent to estimate project emissions are summarized in Figure 3.

**Figure 3: Steps to estimate project emissions**




#### 5.3.3.1 Ex Ante Estimations of Emission Reductions

Ex ante estimates must use the baseline deforestation allocation provided by Verra and emission factors as calculated in Section 5.3.2.3. Emission reductions may be projected over the entire crediting period but only for planning purposes; in such a case, the annual emission reductions projected beyond the initial BVP must not increase and instead must be held constant (or decrease). A value for ex ante effectiveness ($EA_{EF,t}$) must be detailed for each year, reflecting the percentage by which the project expects to reduce deforestation against the baseline. $EA_{EF,t}$ should be applied to estimate annual emission reductions throughout the project lifetime. Estimated ex ante effectiveness must be consistent with the analysis of agents and drivers of deforestation (Sections 5.2.1–5.2.2), as well as with the measures implemented to reduce deforestation. It must not include ex ante leakage which is calculated separately (see Section 5.2.1).

Where the project includes harvesting trees to generate wood products (timber, fiber, or fuel), the areas (polygons) within the UDef PA that will be subjected to such planned harvesting activities during the project crediting period must be clearly identified and delineated, and measured on maps. The forest classes located within each of these polygons must be clearly identified and the activity data (e.g., volume of timber extraction per year) planned for each forest class per type of planned intervention on each polygon must be recorded.

#### 5.3.3.2 UDef PA and UDef LB Deforestation Data for the Monitoring Period

Monitoring period[11] AD must be estimated using a sample-based approach that uses human interpretation of high-resolution imagery (10 m or finer spatial resolution) within sample plots[12] distributed in a representative manner across the project activities region. Where available, in situ observations may be used to supplement visual interpretation of sample plots. Other spatial data may be used to increase the sampling design efficiency or aid interpretation of the images. The AD must be conservatively inflated based on the estimated statistical uncertainty, following Steps 3–4 below. A stratified sampling design must be employed that accounts for each location's baseline risk of deforestation, forest carbon stocks, and inclusion in either the UDef PA or UDef LB.

### Step 1: Develop a Land Cover/Land Cover Change Dataset

The sample-based method yields an estimate of the area of unplanned deforestation occurring during the monitoring period. Standard operating procedures (SOPs) must be developed and used by the project proponent and must include, at a minimum: sample design, response design, and data sources, data collection, and data analysis. The SOPs should include detailed guidance on quality management during all of these steps.

Collected sample data are used to identify land cover conditions at the start and end dates of the monitoring period within the UDef PA and UDef LB and to assign a change (deforestation or forest regrowth) or no change (stable forest or stable non-forest) result to each observation.

#### Sample Design

**Project sampling frame**

Sampling takes place within the project sampling frame. The project sampling frame encompasses both the UDef PA and UDef LB, minus any areas mapped as identified exclusions in the most recent jurisdictional map of identified exclusions. The area of the project sampling frame is denoted $A_{PSF}$.

Where additional areas of "identified exclusion – natural disturbance" or "identified exclusion – planned deforestation" are detected as having occurred during the monitoring period, those areas may be spatially delineated and removed from the project sampling frame. For project monitoring, an identified exclusion must meet a minimum contiguous size of 100 ha (as opposed to 1000 ha for the jurisdiction). Descriptions of identified exclusions are provided in Table 11 of Appendix 1. Wherever such areas are delineated, the allocation of baseline AD must be set to zero (see Section 5.3.2.2).

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[11] Project proponents should align monitoring periods with the start and end dates of the BVP. Where a monitoring period must extend over multiple BVPs, all baseline and monitoring calculations must be undertaken and presented separately for the portions of the monitoring period that fall into each BVP.

[12] For a fuller treatment of best practices regarding plot-based AD development, see Section 4.2 of GFOI (2020).

Any GHG emission reductions generated in these areas and claimed from previous monitoring periods must be accounted for as a reversal.

### Estimation of Project Emissions through Forest Degradation in the UDef PA

The UDef PA must be monitored for evidence of anthropogenic forest degradation. Degradation monitoring must include two components:

1) Full evaluation of the UDef PA for the presence of new roads (defined here as continuous bare ground at least 2 m wide); and

2) Examination in stratified samples for sample sites with a decrease in canopy cover of 50 percent or more that do not qualify as deforestation.

Where such areas are recorded, new degradation impact areas must be determined and delineated:

4) Identified new roads must be delineated in a supplementary vectorial digital file (e.g., KML) of the UDef PA. The digital file of new roads must be submitted as part of the monitoring report. Such new roads must be excluded from the subsequent risk mapping process.

5) For new roads, degradation impact areas must be determined and delineated in all instances equal to an expanse of 500 m either side of the new road.

a) For recorded decreases in canopy cover of 50 percent or more that do not qualify as deforestation, the area immediately surrounding the sampling point must be examined in imagery with a resolution of 10 m or finer. Where the area over which canopy cover has decreased is equal to or greater than 1 ha, this area must be delineated as a degradation impact area. A decrease in canopy cover is calculated as the difference between canopy cover at the start and end of the monitored period.

These delineated areas must be withdrawn from REDD reporting for the monitored period, which involves temporarily treating forest carbon stocks as zero. The areas must be treated as new strata and reincorporated once field measurement has occurred with new (decreased) emission factors for recording project emissions and future avoided unplanned deforestation emissions. When these areas are reincorporated in a subsequent monitoring period, both baseline and monitored emissions must be recalculated beginning from the first year in which the new forest stratum was defined, taking into account the revised emission factor and the UDef AD originally allocated to the stratum in the associated BVP.

### Stratification

The sampling design must ensure that sample plots yield a representative sample of the UDef PA and UDef LB. A stratified sample design is required for monitoring. The following stratifications of the project sampling frame must be included:

1) Aboveground carbon stock of forests (forest strata);

2) Carbon accounting area (UDef PA or UDef LB[13]); and

3) Likelihood of observing deforestation.

Each forest stratum used by the project for project emissions accounting must also be used as a sampling stratum. Note that Section 5.3.3.3 refers to cases where new forest strata may be defined within the UDef PA due to degradation events that occurred after the beginning of the monitored period. Natural (but not anthropogenic) large-scale degradation may be similarly delineated in the UDef LB. Such forest strata must be incorporated in the sampling design for monitoring deforestation area, but the strata are omitted from emissions accounting until revised carbon stocks are estimated.

Sample plots must be stratified by their anticipated likelihood of observing deforestation to ensure that areas of higher deforestation risk are subject to sufficient sampling intensity. Projects should use a minimum of three sampling strata representing expected differences in the likelihood of observing deforestation. These sampling strata may be defined by allocated baseline deforestation risk (as defined by the jurisdictional deforestation risk map), by project-generated land cover change maps of the monitoring period or by other factors that the project proponent justifies as being associated with deforestation risk.

The number of sample observations in each sampling stratum should be sufficient such that the final estimate of deforestation has an uncertainty (defined as a half-width of the 90 percent confidence interval) that is within ±10 percent of the estimate of the mean; otherwise the estimate will be subject to conservative adjustment. Projects should demonstrate that the sampling results in a minimum number of observations collected from each sampling stratum, and that sample plots are allocated (either randomly or systematically, demonstrating no bias) to strata proportionally to the total area of deforestation anticipated from each sampling stratum (area of stratum multiplied by anticipated percentage of deforestation over the monitoring period).

### Data Sources

Sample data are developed through the interpretation of high-resolution imagery.[14] Maps may be employed in the design of efficient sampling strategies. Other data sources, such as airborne and spaceborne active and passive remote sensing, and ground observation, may also be used to supplement the interpreters' observation of high-resolution imagery.

### Data Collection

Visual interpretation is used to assign each sample unit to a change or no-change classification. Each sample plot observation is recorded with reference to the sampling stratum (ss), forest

[13] Where overlaps exist between the leakage belts of different projects and/or where leakage belt exclusions have occurred due to the agreed partition of the leakage belt (Section 5.1.3), this must be clearly identified in the stratification of UDef LB.

[14] Unless otherwise stated, high-resolution imagery in this module means 10 m or finer.

stratum (*i*), and project accounting area (UDef PA or UDef LB) in which the sample plot is located. Note that while project accounting areas and forest strata must be used as sampling strata, each retains a separate subscript in several parameters to facilitate estimation of different rates for accounting areas and forest strata (see Table 5).

**Table 5: Example of stratum naming convention**

| Accounting Area | Forest Strata (*i*) | Risk Class | Sampling Strata (*ss*) |
|---|---|---|---|
| PA | Forest type A | 1 | PA-A-1 |
| PA | A | 2 | PA-A-2 |
| PA | A | 3 | PA-A-3 |
| PA | B | 1 | PA-B-1 |
| PA | B | 2 | PA-B-2 |
| PA | B | 3 | PA-B-3 |
| LB | A | 1 | LB-A-1 |
| LB | A | 2 | LB-A-2 |
| LB | A | 3 | LB-A-3 |
| LB | B | 1 | LB-B-1 |
| LB | … | … | … |

Detailed procedures for quality management during the interpretation process must be formulated and described in the SOP for image interpretation. Typically, these procedures will include cross-validation among interpreters, at least for a subset of sample units assessed by all interpreters, and rules for dealing with disagreements on class identification between analysts. Such SOPs must include:

1) Sample plot design and spatial plot allocation to the sampling frame;
2) Data sourcing and pre-processing;
3) Visual interpretation of forest and non-forest land covers;
4) Recording dates of imagery collection;
5) Minimum qualifications of analysts, including familiarity with jurisdiction-specific land cover interpretation; and
6) Cross-checks among analysts and rules for resolving disagreements.

### Data Analysis

The sample-based approach produces counts of observations of sample units within each sampling stratum (*ss*). Note that forest strata (*i*) and project accounting areas (UDef PA and UDef LB) are

used as mandatory sampling stratification and are accounted for within the ss subscript in Equations (23) and (26).

Such sample unit counts are denoted as $Count_{CHC,ss}$ for change categories (*CHC*) deforestation, regrowth, stable forest, and stable non-forest observed in the ss sampling strata. The total count of sample units in sampling stratum ss ($Count_{ss}$) must be summarized following the format of Table 6.

**Table 6: Format for recording plot observations, with reference to associated parameter names**

| Sampling Stratum (*ss*) | Change Categories (CHC) | | | | Stratum Total |
|---|---|---|---|---|---|
| | Unplanned Deforestation (UDef) | Stable Forest (SF) | *CHC* | *CHC* | |
| ss = 1 | $Count_{UDef,ss=1}$ | $Count_{SF,ss=1}$ | … | … | $Count_{ss=1}$ |
| ss = 2 | $Count_{UDef,ss=2}$ | $Count_{SF,ss=2}$ | … | … | $Count_{ss=2}$ |
| ss = 3 | $Count_{UDef,ss=3}$ | $Count_{SF,ss=3}$ | … | … | $Count_{ss=SS}$ |

Sampling stratum weights $ws_{ss}$ must be calculated for the 1, 2, 3, …, SS sampling strata by dividing the mapped area of each stratum ($A_{ss}$) by the total area of the sampling frame ($A_{PSF}$, Table 7). Note that areas of identified exclusions are not considered part of the project sampling frame, so $A_{ss}$ should not reflect any sampling strata portions that would otherwise extend into the identified excluded areas.

**Table 7: Calculation of sample stratum weights**

| Sampling Stratum (*ss*) | Sampling Stratum Area (ha) | Sampling Stratum Weight (ratio) |
|---|---|---|
| ss = 1 | $A_{ss=1}$ | $ws_{ss=1} = A_{ss=1} / A_{PSF}$ |
| ss = 2 | $A_{ss=2}$ | $ws_{ss=2} = A_{ss=2} / A_{PSF}$ |
| ss = SS | $A_{ss=SS}$ | $ws_{ss=SS} = A_{ss=SS} / A_{PSF}$ |
| **Sampling strata total (*SS*)** | $A_{PSF}$ | **1** |

Where:

$A_{ss}$ = Area of sampling stratum ss in the project sampling frame (ha)
$A_{PSF}$ = Area of project sampling frame (ha)
ss = 1, 2, 3, …, SS sampling stratum

The counts of sample units of change classes *CHC* (unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), and regrowth (Reg)) observed within each sampling stratum ss

($Count_{CHC,ss}$) and the strata weights ($ws_{ss}$) are used to estimate the proportion of the area classified as each change category *CHC* ($Prop_{CHC,ss}$).

For each sampling stratum, the area-weighted proportion of the total area of each change category *CHC* must be calculated by multiplying the weight of the stratum ($ws_{ss}$) by the number of observations of *CHC* per sampling stratum, and then dividing by the total observation count for the respective stratum, as follows:

$$Prop_{CHC,ss} = ws_{ss} \times \frac{Count_{CHC,ss}}{Count_{ss}} \quad (23)$$

Where:

| | | |
|---|---|---|
| $Prop_{CHC,ss}$ | = | Weighted proportion of the $A_{PSF}$ that falls into sampling stratum ss and is classified as change category *CHC* (dimensionless) |
| $ws_{ss}$ | = | Weight of sampling stratum ss (dimensionless) |
| $Count_{CHC,ss}$ | = | Number of observations of change category *CHC* in sampling stratum ss (sample units) |
| $Count_{ss}$ | = | Total count of sample units in sampling stratum ss (sample units) |
| *CHC* | = | Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg) |
| ss | = | 1, 2, 3, …, SS sampling strata |

The resulting proportions must be summarized as illustrated in Table 8.

**Table 8: Format for recording estimated jurisdiction proportions, with reference to associated parameter names**

| Sampling Stratum (*ss*) | Change Category (*CHC*) | | | Stratum Total |
|---|---|---|---|---|
| | Deforestation (UDef) | Stable Forest (SF) | Change Category | |
| Stratum 1 | $Prop_{UDef,ss=1}$ | $Prop_{SF,ss=1}$ | … | $ws_{ss=1}$ |
| Stratum 2 | $Prop_{UDef,ss=2}$ | $Prop_{SF,ss=2}$ | … | $ws_{ss=2}$ |
| Stratum SS | $Prop_{UDef,ss=SS}$ | $Prop_{SF,ss=SS}$ | … | $ws_{ss=3}$ |
| *CHC* total | $Prop_{UDef}$ | $Prop_{SF}$ | … | 1 |

## Step 2: Calculate Total Area of Each AD Category

Estimate the area within the project sampling frame (for the project scenario) classified under each change category *CHC*. Summation of $Prop_{CHC,ss}$ occurs across sampling strata ss, except those that represent either forest strata (*i*) or project accounting areas (UDef PA or UDef LB). Note that

subscripts PA/LB and *i* are excluded from previous steps in this section for clarity but are added here to facilitate disaggregation by project accounting area and forest strata.

For UDef PA:

$$A_{PA,CHC,i} = A_{PSF} \times \sum_{ss=1}^{SS} Prop_{PA,CHC,i,ss} \quad (24)$$

Where

$A_{PA,CHC,i}$ = Area of the UDef PA in stratum *i* classified as change category *CHC* over the monitoring period (ha)
$Prop_{PA,CHC,i,ss}$ = Weighted proportion of $A_{PA,i}$ that falls into sampling stratum ss and is classified as change category *CHC* (dimensionless)
$A_{PSF}$ = Area of project sampling frame (ha)
*CHC* = Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg)
*i* = 1, 2, 3, …, *M* forest stratum
ss = 1, 2, 3, …, SS sampling stratum

For UDef LB:

$$A_{LB,CHC,i} = A_{PSF} \times \sum_{ss=1}^{SS} Prop_{LB,CHC,i,ss} \quad (25)$$

Where

$A_{LB,CHC,i}$ = Area of the UDef LB in stratum *i* classified as change category *CHC* over the monitoring period (ha)
$Prop_{LB,CHC,i,ss}$ = Weighted proportion of $A_{LB,i}$ that falls into sampling stratum ss and is classified as change category *CHC* (dimensionless)
$A_{PSF}$ = Area of project sampling frame (ha)
*CHC* = Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg)
*i* = 1, 2, 3, …, *M* forest stratum
ss = 1, 2, 3, …, SS sampling strata

Estimated areas of deforestation must be conservatively inflated based on their assessed uncertainty (see Steps 3–4 below).

## Step 3: Calculate the Uncertainty of the Estimated Areas of Each Change Category

Calculate the standard error of the proportions:

$$S(Prop_{CHC}) = \sqrt{\sum_{ss=1}^{SS} \frac{ws_{ss}{}^2 \times \frac{Count_{CHC,ss}}{Count_{ss}} \times \left(1 - \frac{Count_{CHC,ss}}{Count_{ss}}\right)}{Count_{ss} - 1}} \quad (26)$$

Where:

| | | |
|---|---|---|
| $S(Prop_{CHC})$ | = | Standard error of the proportion of the project sampling frame in change category *CHC* (dimensionless) |
| $Prop_{CHC}$ | = | Proportion of the project sampling frame in change category *CHC* (dimensionless) |
| $ws_{ss}$ | = | Weight of sampling stratum ss (dimensionless) |
| $Count_{CHC,ss}$ | = | Number of observations of change category *CHC* in sampling stratum ss (sample units) |
| $Count_{ss}$ | = | Total count of sample units in sampling stratum ss (sample units) |
| *CHC* | = | Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg) |
| ss | = | 1, 2, 3, …, SS sampling stratum |

Calculate the standard error of the areas:

$$S(A_{CHC}) = S(Prop_{CHC}) \times A_{PSF} \quad (27)$$

Where:

| | | |
|---|---|---|
| $S(A_{CHC})$ | = | Standard error of the estimated area of change category *CHC* within the project sampling frame over the monitoring period (ha) |
| $S(Prop_{CHC})$ | = | Standard error of the proportion of the project sampling frame in change category *CHC* (dimensionless) |
| $A_{PSF}$ | = | Area of project sampling frame (ha) |
| *CHC* | = | Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg) |

Calculate the percentage uncertainty of the estimated area. The percentage uncertainty is defined as the half-width of the two-sided 90 percent confidence interval, expressed as a percentage of the estimated area.

$$U\%(A_{CHC}) = t_{alpha=10\%} \times \frac{S(A_{CHC})}{\sum_{i=1}^{M} A_{PA,CHC,i} + \sum_{i=1}^{M} A_{LB,CHC,i}} \times 100 \quad (28)$$

Where:

| | | |
|---|---|---|
| $U\%(A_{CHC})$ | = | Percentage uncertainty of the estimated area of change category *CHC* within the project sampling frame over the monitoring period (%) |
| $S(A_{CHC})$ | = | Standard error of the estimated area of change category *CHC* within the project sampling frame over the monitoring period (ha) |

$A_{PA,CHC,i}$ = Area of the UDef PA classified as change category *CHC* in stratum *i* over the monitoring period (ha)

$A_{LB,CHC,i}$ = Area of the UDef LB classified as change category *CHC* in stratum *i* over the monitoring period (ha)

$t_{alpha=10\%}$ = Value of the t distribution for a two-sided 90 percent confidence interval (a value of 1.6449 may be used for UDef AD analyses)

*CHC* = Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg)

*i* = 1, 2, 3, …, *M* forest stratum

## Step 4: Conservatively Inflate the Estimated Area of Unplanned Deforestation

The estimated total area of unplanned deforestation (*CHC* = UDef) within the project sampling frame is inflated based on its uncertainty level. Where the percentage uncertainty of the estimated unplanned deforestation area is less than or equal to 10 percent, the estimate may be used without modification, and the inflation factor is zero. Where the percentage uncertainty is greater than 10 percent,[15] the area estimate must be scaled up by inflation factor $IF_{UDef}$.

The inflation factor, $IF_{UDef}$ is calculated as follows:

$$IF_{UDef} = \frac{U\%(A_{UDef})}{100 \times t_{alpha=10\%}} \times t_{alpha=66.67\%} \quad (29)$$

Where:

$IF_{UDef}$ = Inflation factor for area of unplanned deforestation (unitless)

$U\%(A_{UDef})$ = Percentage uncertainty of the estimated area of unplanned deforestation (where *CHC* = UDef) within the project sampling frame over the monitoring period (%)

$t_{alpha=10\%}$ = Value of the t distribution for a two-sided 90 percent confidence interval (a value of 1.6449 may be used for AD analyses)

$t_{alpha=66.67\%}$ = Value of the t distribution for a one-sided 66.67% confidence interval (a value of 0.4307 may be used for AD analyses)

Using the estimated area and the inflation factor, calculate the final AD values for UDef PA:

$$A_{PA,inflated,UDef,i} = A_{PA,UDef,i} \times \left(1 + IF_{UDef}\right) \quad (30)$$

Where:

$A_{PA,inflated,UDef,i}$ = Area of unplanned deforestation within forest stratum *i* of the UDef PA over the monitoring period, conservatively inflated for uncertainty (ha)

$A_{PA,UDef,i}$ = Uninflated area of unplanned deforestation (where *CHC* = UDef) within forest stratum *i* within the UDef PA over the monitoring period (ha)

$IF_{UDef}$ = Inflation factor for area of unplanned deforestation (unitless)

*i* = 1, 2, 3, …, *M* forest stratum

[15] Uncertainty must not exceed the maximum acceptable uncertainty set out in the *VCS Methodology Requirements*.

Using the estimated area and the inflation factor, calculate the final AD values for UDef LB:

$$A_{LB,inflated,UDef,i} = A_{LB,UDef,i} \times \left(1 + IF_{UDef}\right) \quad (31)$$

Where:

$A_{LB,inflated,UDef,i}$ = Area of unplanned deforestation within forest stratum *i* in the UDef LB over the monitoring period, conservatively inflated for uncertainty (ha)

$A_{LB,UDef,i}$ = Uninflated area of unplanned deforestation (where *CHC* = UDef) within forest stratum *i* within the UDef LB over the monitoring period (ha)

$IF_{UDef}$ = Inflation factor for area of unplanned deforestation (unitless)

*i* = 1, 2, 3, …, *M* forest stratum

## Step 5: Determine the AD for Unplanned Deforestation

The annualized activity data per stratum in the UDef PA and UDef LB are equal to AD calculated for the monitoring period divided by the number of years in the monitoring period.

For UDef PA:

$$AD_{MP,PA-UDef,i,t} = \frac{A_{PA,inflated,UDef,i}}{MPL} \quad (32)$$

Where:

$AD_{MP,PA-UDef,i,t}$ = UDef AD in the UDef PA in forest stratum *i* in year *t* (ha)

$A_{PA,inflated,UDef,i}$ = Area of unplanned deforestation within forest stratum *i* of the UDef PA over the monitoring period, conservatively inflated for uncertainty (ha)

*MPL* = Length of monitoring period (years)

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

*i* = 1, 2, 3, …, *M* forest stratum

For UDef LB:

$$AD_{MP,LB-UDef,i,t} = \frac{A_{LB,inflated,UDef,i}}{MPL} \quad (33)$$

Where:

$AD_{MP,LB-UDef,i,t}$ = UDef AD in the UDef LB in forest stratum *i* in year *t* (ha)

$A_{LB,inflated,UDef,i}$ = Area of unplanned deforestation within forest stratum *i* of the UDef LB over the monitoring period, conservatively inflated for uncertainty (ha)

*MPL* = Length of monitoring period (years)

*i* = 1, 2, 3, …, *M* forest stratum

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

### 5.3.3.3 Estimation of Annual Emissions Caused by Unplanned Deforestation

Annual emissions resulting from changes in carbon stocks caused by unplanned deforestation in the project scenario must be estimated using the same estimates of carbon stock differences that were established for the baseline (Section 5.3.2.3), paired with the conservatively inflated annualized UDef AD obtained in Equations (32) (for the UDef PA) and (33) (for the UDef LB). In the event of natural disturbance impacting 100 contiguous hectares or more that does not result in a transition to non-forest, additional forest strata must be defined.

For carbon pools in the UDef PA strata:

$$\Delta C_{MP,PA-UDef,i,t} = (AD_{MP,PA-UDef,i,t} \times \Delta Cc_{AB-LI,i}) + \sum_{t-10}^{t} (AD_{MP,PA-UDef,i,t}) \times \frac{\Delta Cc_{BB-DW,i}}{10} + \sum_{t-20}^{t} (AD_{MP,PA-UDef,i,t}) \times \frac{\Delta Cc_{SOC-WP,i}}{20} \quad (34)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{MP,PA-UDef,i,t}$ | = | Total emissions from carbon stock change in all carbon pools in forest stratum *i* in the UDef PA in year *t* (t $CO_2e$) |
| $AD_{MP,PA-UDef,i,t}$ | = | UDef AD in the UDef PA in forest stratum *i* in year *t* (ha) |
| $\Delta Cc_{AB-LI,i}$ | = | Conservatively estimated emissions from carbon stock change in the UDef PA in aboveground biomass and litter pools in forest stratum *i* (t $CO_2e$/ha) |
| $\Delta Cc_{BB-DW,i}$ | = | Conservatively estimated emissions from carbon stock change over a 10-year period in the UDef PA in belowground biomass and dead wood pools in forest stratum *i* (t $CO_2e$/ha) |
| $\Delta Cc_{SOC-WP,i}$ | = | Conservatively estimated emissions from carbon stock change over a 20-year period in the UDef PA in the soil organic carbon and wood product pools in forest stratum *i* (t $CO_2e$/ha) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, $t^*$ years elapsed since the start of the project |

For carbon pools in UDef LB strata:

$$\Delta C_{MP,LB-UDef,i,t} = (AD_{MP,LB-UDef,i,t} \times \Delta C_{LB,AB-LI,i}) + \sum_{t-10}^{t} (AD_{MP,LB-UDef,i,t}) \times \frac{\Delta C_{LB,BB-DW,i}}{10} + \sum_{t-20}^{t} (AD_{MP,LB-UDef,i,t}) \times \frac{\Delta C_{LB,SOC-WP,i}}{20} \quad (35)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{MP,LB-UDef,i,t}$ | = | Total emissions from carbon stock change in all carbon pools in forest stratum *i* in the UDef LB in year *t* (t $CO_2e$) |
| $AD_{MP,LB-UDef,i,t}$ | = | UDef AD in the UDef LB in forest stratum *i* in year *t* (ha) |
| $\Delta C_{LB,AB-LI,i}$ | = | Estimated emissions from annual carbon stock change in the UDef LB in aboveground biomass and litter pools in forest stratum *i* (t $CO_2e$/ha) |
| $\Delta C_{LB,BB-DW,i}$ | = | Estimated emissions from carbon stock change over a 10-year period in the UDef LB in belowground biomass and dead wood pools in forest stratum *i* (t $CO_2e$/ha) |
| $\Delta C_{LB,SOC-WP,i}$ | = | Estimated emissions from carbon stock change over a 20-year period in the UDef LB soil organic carbon and wood product pools in forest stratum *i* (t $CO_2e$/ha) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, $t^*$ years elapsed since the start of the project |

For total emissions from carbon stock change in the UDef PA:

$$\Delta C_{MP,PA-UDef,t} = \sum_{i=1}^{M} \Delta C_{MP,PA-UDef,i,t} \quad (36)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{MP,PA-UDef,t}$ | = | Total emissions from carbon stock change in all pools in the UDef PA in year *t* (t $CO_2e$) |
| $\Delta C_{MP,PA-UDef,i,t}$ | = | Total emissions from carbon stock change in all pools in forest stratum *i* in the UDef PA in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, $t^*$ years elapsed since the start of the project |

For total emissions from carbon stock change in the UDef LB:

$$\Delta C_{MP,LB-UDef,t} = \sum_{i=1}^{M} \Delta C_{MP,LB-UDef,i,t} \quad (37)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{MP,LB-UDef,t}$ | = | Total emissions from carbon stock change in all pools in the UDef LB in year *t* (t $CO_2e$) |
| $\Delta C_{MP,LB-UDef,i,t}$ | = | Total emissions from carbon stock change in all pools in forest stratum *i* in the UDef LB in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, $t^*$ years elapsed since the start of the project |

### 5.3.3.4 Estimation of Other GHG Emissions From Project Activities Due to Avoid Unplanned Deforestation

Any other GHG emissions that occur due to project activities designed to avoid unplanned deforestation in the UDef PA must be estimated using the following equation:

$$GHG_{MP,PA-UDef,E,t} = \sum_{t=1}^{t*} \sum_{i=1}^{M} \left( E_{MP,FC,i,t} + E_{MP,BiomassBurn,i,t} + N2O_{MP,direct-N,i,t} \right) \quad (38)$$

Where:

| | | |
|---|---|---|
| $GHG_{MP,PA-UDef,E,t}$ | = | Cumulative other GHG emissions as a result of project activities to avoid unplanned deforestation in the UDef PA in year *t* (t $CO_2e$) |
| $E_{MP,FC,i,t}$ | = | Emissions from fossil fuel combustion in forest stratum *i* in year *t* (t $CO_2e$) |
| $E_{MP,BiomassBurn,i,t}$ | = | Non-$CO_2$ emissions due to biomass burning as part of project activities in forest stratum *i* in year *t* (t $CO_2e$) |
| $N2O_{MP,direct-N,i,t}$ | = | $N_2O$ emissions resulting from nitrogen application on an alternative land use in forest stratum *i* in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, $t^*$ years elapsed since the start of the project |

### 5.3.3.5 Estimation of Annual Emissions Caused by Planned Harvesting Activities in the Project Scenario

Projects that include selective logging and/or extraction of trees for sustainable, responsible collection of fuelwood, fiber, or charcoal production in the project scenario must monitor the emissions that such activities cause in the UDef PA.

The monitoring process must yield an estimate of any reduction in forest carbon stocks that occurs in forest management stands within the UDef PA due to such planned activities. The ensuing GHG emissions must be discounted from the project's net emission reductions.

The net GHG emissions resulting from planned harvesting activities in the UDef PA are estimated ex post as the sum of the changes in carbon stocks caused by:

1) Selective logging and/or
2) Extraction of trees for fuelwood collection, fiber, or charcoal production.

$$\Delta C_{PA,P-Deg,t} = \Delta C_{PA,SelLog,t} + \Delta C_{PA,DegFW,t} \quad (39)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{PA,P-Deg,t}$ | = | Total GHG emissions caused by planned harvesting activities in the UDef PA in year *t* (t $CO_2e$) |
| $\Delta C_{PA,SelLog,t}$ | = | GHG emissions from selective logging in the UDef PA in year *t* (t $CO_2e$) |
| $\Delta C_{PA,DegFW,t}$ | = | GHG emissions caused by fuelwood collection and wood extraction for charcoal and fiber production in the UDef PA in year *t* (t $CO_2e$) |
| *t* | = | 1, 2, 3, …, *t** years elapsed since the start of the project |

## Emissions from Selective Logging

GHG emissions from selective timber harvesting, $\Delta C_{PA,SelLog}$, are estimated ex post by summing the estimated emissions from:

1) Decomposition of all the dead wood generated, directly or incidentally, in the process of timber harvest and establishment of forestry infrastructure;
2) Production and subsequent retirement of wood products derived from timber harvesting (including timber harvested for forestry infrastructure); and
3) Combustion of fossil fuels in forestry machinery including mechanized felling, skidding/forwarding/hauling, loading, and transporting inside the project area, and processing.

For simplicity, emissions from soil are not included as selective logging has been shown to have no or little impact on soil carbon over large concessions because of the relatively small area impacted, the short duration of impact, and the retention of vegetative cover (Johnson and Curtis 2001). Carbon dioxide removals through regrowth following degradation are conservatively not included.

The volume of timber harvested must be measured, recorded, and monitored. Forest management operation records and monitoring reports must yield data on the extracted volume of merchantable timber per species from each stratum in the UDef PA in each year ($V_{EX,j,i,t}$), the extracted volume of

timber harvested for the purpose of building logging infrastructure (i.e., infrastructure for removing logs from the forest, encompassing skidding trails, logging decks or landings, and logging roads used by motor vehicles) per species from each stratum in each year ($V_{EX,INF,j,i,t}$), and the volume of timber that is cleared during the process of forestry infrastructure establishment but not extracted for wood processing per species in each stratum in each year ($V_{notEX,INF,j,i,t}$).

Volume values are multiplied by wood density to convert them to dry-weight biomass and then multiplied by the corresponding biomass expansion factor for wood removals, $BEF_R$, to account for non-merchantable components of the tree (e.g., leaves, smallest twigs/branches, and debris from felling activity). The expanded biomass values are multiplied by the carbon fraction corresponding to the species and locality to estimate the carbon stock of the wood extracted. These values are then converted to $CO_2e$ by applying the $CO_2$:C molecular ratio.

The carbon stock of total harvested timber (including timber harvested during the clearing of roads, skid trails, and log landings) from species *j* in stratum *i* is estimated as:

$$C_{HB,j,i,t} = \left(V_{EX,j,i,t} + V_{EX,INF,j,i,t}\right) \times D_j \times BEF_R \times CF_j \times \frac{44}{12} \quad (40)$$

Where:

| | | |
|---|---|---|
| $C_{HB,j,i,t}$ | = | Carbon stock of harvested biomass of species *j* in stratum *i* in year *t* (t $CO_2e$) |
| $V_{EX,j,i,t}$ | = | Extracted volume of merchantable timber of species *j* in stratum *i* in year t ($m^3$) |
| $V_{EX,INF,j,i,t}$ | = | Extracted volume of timber of species *j* harvested for forestry infrastructure in stratum *i* in year *t* ($m^3$) |
| $D_j$ | = | Basic wood density of species *j* (t d.m./$m^3$) |
| $BEF_R$ | = | Biomass expansion factor applicable to wood removals from the UDef PA (dimensionless) |
| $CF_j$ | = | Carbon fraction of biomass of species *j* (t C/t d.m.) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *j* | = | 1, 2, 3, …, *J* tree species |
| *t* | = | 1, 2, 3, …, *t** years since the start of the project |

Only part of the harvested biomass is removed from the forest to the market (extracted timber) while the remainder is left as dead wood on the forest floor. The carbon stock of extracted timber of species *j* in stratum *i* in year *t* is estimated as:

$$C_{EX,j,i,t} = \left(V_{EX,j,i,t} + V_{EX,INF,j,i,t}\right) \times D_j \times CF_j \times \frac{44}{12} \quad (41)$$

Where:

| | | |
|---|---|---|
| $C_{EX,j,i,t}$ | = | Carbon stock of extracted timber of species *j* in stratum *i* in year *t* (t $CO_2e$) |
| $V_{EX,j,i,t}$ | = | Extracted volume of merchantable timber of species *j* in stratum *i* in year *t* ($m^3$) |

| | | |
|---|---|---|
| $V_{EX,INF,j,i,t}$ | = | Extracted volume of timber of species *j* harvested for forestry infrastructure in stratum *i* in year *t* ($m^3$) |
| $D_j$ | = | Basic wood density of species *j* (t d.m./$m^3$) |
| $CF_j$ | = | Carbon fraction of biomass of species *j* (t C/t d.m.) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *j* | = | 1, 2, 3, …, *J* tree species |
| *t* | = | 1, 2, 3, …, *t** years since the start of the project |

### Emissions at the Felling Location (Logging Gap)

Emissions occur at the location at which trees are felled due to decomposition of the dead wood produced as a result of felling the trees. This includes the biomass in the stump and top of the harvested trees that are left in the forest, trees incidentally killed or severely damaged (i.e., uprooted or snapped), and large branches broken off from surviving trees during tree felling.

The change in dead wood stock in logging gaps is estimated as the sum of the carbon stock of the harvested biomass that is not removed from the forest, the residual stand damage, and biomass left to decay as a result of forestry infrastructure establishment. For simplicity, emissions from the decomposition of dead wood left on the forest floor is assumed to occur over time at an annual rate of 1/10 of the stock change.

$$\Delta C_{DW,i,t} = \frac{1}{10}\sum_{j}^{J}\left(C_{HB,j,i,t} - C_{EX,j,i,t} + C_{RSD,j,i,t} + C_{notEX,INF,j,i,t}\right) \quad (42)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{DW,i,t}$ | = | Change in dead wood carbon stock in logging gaps in stratum *i* in year *t* (t $CO_2e$) |
| $C_{HB,j,i,t}$ | = | Carbon stock of harvested biomass of species *j* in stratum *i* in year *t* (t $CO_2e$) |
| $C_{EX,j,i,t}$ | = | Carbon stock of extracted timber of species *j* in stratum *i* in year *t* (t $CO_2e$) |
| $C_{RSD,j,i,t}$ | = | Carbon stock of wood of species *j* exposed to residual stand damage in stratum *i* in year *t* (t $CO_2e$) |
| $C_{notEX,INF,j,i,t}$ | = | Carbon stock of biomass of species *j* that is cleared but not extracted during the establishment of forestry infrastructure in stratum *i* in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *j* | = | 1, 2, 3, …, *J* tree species |
| *t* | = | 1, 2, 3, …, *t** years since the start of the project |

The carbon stock of wood exposed to residual stand damage is estimated as:

$$C_{RSD,j,i,t} = C_{EX,j,i,t} \times F_{RSD} \quad (43)$$

Where:

| | | |
|---|---|---|
| $C_{RSD,j,i,t}$ | = | Carbon stock of wood of species *j* exposed to residual stand damage in stratum *i* in year *t* (t $CO_2e$) |
| $C_{EX,j,i,t}$ | = | Carbon stock of extracted timber of species *j* in stratum *i* in year *t* (t $CO_2e$) |
| $F_{RSD}$ | = | Factor for residual stand damage (dimensionless) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *j* | = | 1, 2, 3, …, *J* tree species |
| *t* | = | 1, 2, 3, …, *t** years since the start of the project |

The carbon stock of biomass that is cleared but not extracted during the establishment of forestry infrastructure is estimated as:

$$C_{notEX,INF,j,i,t} = V_{notEX,INF,j,i,t} \times D_j \times BEF_R \times CF_j \times \frac{44}{12} \quad (44)$$

Where:

| | | |
|---|---|---|
| $C_{notEX,INF,j,i,t}$ | = | Carbon stock of biomass of species *j* that is cleared but not extracted during the establishment of forestry infrastructure in stratum *i* in year *t* (t $CO_2e$) |
| $V_{notEX,INF,j,i,t}$ | = | Volume of timber of species *j* that is cleared during the process of forestry infrastructure establishment but not extracted for wood processing in stratum *i* in year *t* ($m^3$) |
| $D_j$ | = | Basic wood density of species *j* (t d.m./$m^3$) |
| $BEF_R$ | = | Biomass expansion factor applicable to wood removals from the UDef PA (dimensionless) |
| $CF_j$ | = | Carbon fraction of biomass of species *j* (t C/t d.m.) |
| *i* | = | 1, 2, 3, …, M forest stratum |
| *j* | = | 1, 2, 3, …, *J* tree species |
| *t* | = | 1, 2, 3, …, *t** years since the start of the project |

### Emissions From Wood Products

For simplicity, carbon stored in the wood-waste and the short-lived fractions of wood products (which would decay within approximately three years after harvest) is assumed to be emitted at the time of harvest. Carbon contained in long-lived wood products is assumed to be emitted gradually over time at an annual rate of 1/20 of the stock change.

The carbon stock of extracted timber across all species is calculated as:

$$C_{EX,i,t} = \sum_{j}^{J} C_{EX,j,i,t} \quad (45)$$

Where:

| | | |
|---|---|---|
| $C_{EX,i,t}$ | = | Carbon stock of extracted timber of all species in stratum *i* in year *t* (t $CO_2e$) |

| | | |
|---|---|---|
| $C_{EX,j,i,t}$ | = | Carbon stock of extracted timber of species *j* in stratum *i* in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *j* | = | 1, 2, 3, …, *J* tree species |
| *t* | = | 1, 2, 3, …, *t** years since the start of the project |

Use these $C_{EX,i,t}$ values to estimate carbon stock in the wood products pool for each stratum, using the most recent version of *VMD0005*. This will yield estimates for $C_{wp,i,t}$, the amount of carbon entering the wood product pool from forest stratum *i* and $C_{wp100,i,t}$, the amount of carbon entering the wood product pool from forest stratum *i* that is expected to be emitted over 100 years.

Emissions from the decomposition of wood products extracted from forest stratum *i* in year *t* are given by:

$$\Delta C_{WP,i,t} = \left(C_{wp,i,t} - C_{wp100,i,t}\right) + \frac{C_{wp100,i,t}}{20} \quad (46)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{WP,i,t}$ | = | GHG emissions from the decomposition of wood products extracted from forest stratum *i* in year *t* (t $CO_2e$) |
| $C_{wp,i,t}$ | = | Amount of carbon entering the wood product pool from forest stratum *i* in year *t* (t $CO_2e$) |
| $C_{wp100,i,t}$ | = | Amount of carbon entering the wood product pool from forest stratum *i* in year *t* that is expected to be emitted over 100 years (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, *t** years since the start of the project |

### Emissions From Fossil Fuel Combustion

Selective logging entails the use of forestry and wood processing machinery (including mechanized felling, skidding/forwarding/hauling, loading, and transporting inside the project area, and processing), which leads to GHG emissions from fossil fuel combustion.

Emissions from fossil fuel combustion during logging operations in the UDef PA in year *t* are given by:

$$E_{FC,SelLog,t} = \sum_{i}^{M} \left(E_{FC,Harvest,i,t} + E_{FC,Hauling,i,t} + E_{FC,Transport,i,t} + E_{FC,Processing,i,t}\right) \quad (47)$$

Where:

| | | |
|---|---|---|
| $E_{FC,SelLog,t}$ | = | Emissions from fossil fuel combustion during logging operations in the UDef PA in year *t* (t $CO_2e$) |

| | | |
|---|---|---|
| $E_{FC,Harvest,i,t}$ | = | Emissions from fossil fuel combustion due to harvesting operations (e.g., felling, snigging) in stratum *i* in year *t* (t $CO_2e$) |
| $E_{FC,Hauling,i,t}$ | = | Emissions from fossil fuel combustion due to log hauling in stratum *i* in year *t* (t $CO_2e$) |
| $E_{FC,Transport,i,t}$ | = | Emissions from fossil fuel combustion due to transport of logs from stratum *i* from collection site to processing plant in year *t* (t $CO_2e$) |
| $E_{FC,Processing,i,t}$ | = | Emissions from fossil fuel combustion due to processing operations (e.g., saw mill) for wood from stratum *i* in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, *t** years elapsed since the start of the project |

Use *VMD0014* to estimate the relevant $E_{FC}$ values.

Total GHG emissions from selective logging in the UDef PA in year *t* are then estimated as:

$$\Delta C_{PA,SelLog,t} = \sum_{i}^{M} \Delta C_{DW,i,t} + \sum_{i}^{M} \Delta C_{WP,i,t} + E_{FC,SelLog,t} \quad (48)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{PA,SelLog,t}$ | = | GHG emissions from selective logging in the UDef PA in year *t* (t $CO_2e$) |
| $\Delta C_{DW,i,t}$ | = | Change in dead wood carbon stock in logging gaps in stratum *i* in year *t* (t $CO_2e$) |
| $\Delta C_{WP,i,t}$ | = | GHG emissions from the decomposition of wood products extracted from stratum *i* in year *t* (t $CO_2e$) |
| $E_{FC,SelLog,t}$ | = | Emissions from fossil fuel combustion during logging operations in the UDef PA in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, *t** years elapsed since the start of the project |

## Emissions From Fuelwood Collection and Wood Extraction for Charcoal and Fiber Production

Annual emissions arising from the sustainable, responsible collection of fuelwood and wood extraction for charcoal or fiber production from the UDef PA are calculated from the annual biomass of wood of species *j* in stratum *i* removed from the UDef PA for these purposes at time *t*, $B_{EX,FW,j,i,t}$. The amount of wood harvested must be measured, recorded, monitored, and accurately reported in forest management operation records and monitoring reports.

Biomass values are multiplied by the corresponding biomass expansion factor for wood removals, $BEF_R$, to account for non-merchantable components of the tree (e.g., leaves, smallest twigs/branches, and debris from felling activity). The expanded biomass values are multiplied by the carbon fraction corresponding to the species and locality to estimate the carbon stock of the wood

extracted. These values are then converted to $CO_2e$ by applying the $CO_2$:C molecular ratio. Other GHG emissions resulting from wood extraction operations are added.

Total GHG emissions arising from fuelwood collection and wood extraction for charcoal and fiber production are then estimated as:

$$\Delta C_{PA,DegFW,t} = \sum_{i}^{M} \left[ \left( B_{EX,FW,j,i,t} \times BEF_R \times CF_j \times \frac{44}{12} \right) + GHG_{PA,DegFW,i,t} \right] \quad (49)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{PA,DegFW,t}$ | = | GHG emissions from fuelwood collection and wood extraction for charcoal and fiber production in the UDef PA in year *t* (t $CO_2e$) |
| $B_{EX,FW,j,i,t}$ | = | Biomass of wood of species *j* extracted for fuelwood, charcoal, or fiber in stratum *i* of the UDef PA at time *t* (t d.m.) |
| $BEF_R$ | = | Biomass expansion factor applicable to wood removals from the UDef PA (dimensionless) |
| $CF_j$ | = | Carbon fraction of biomass of species *j* (t C/t d.m.) |
| $GHG_{PA,DegFW,i,t}$ | = | Other greenhouse gas emissions from wood extraction operations in stratum *i* in the UDef PA in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *j* | = | 1, 2, 3, …, *J* tree species |
| *t* | = | 1, 2, 3, …, *t** years elapsed since the start of the project |

Carbon dioxide removals from regrowth following degradation are conservatively excluded.

Other GHG emissions from wood extraction operations in the UDef PA are estimated as:

$$GHG_{PA,DegFW,i,t} = E_{FC,DegFW,i,t} + E_{BiomassBurn,DegFW,i,t} \quad (50)$$

Where:

| | | |
|---|---|---|
| $GHG_{PA,DegFW,i,t}$ | = | Other greenhouse gas emissions from wood extraction operations in stratum *i* in the UDef PA in year *t* (t $CO_2e$) |
| $E_{FC,DegFW,i,t}$ | = | Emissions from fossil fuel combustion from fuelwood collection and wood extraction for charcoal and fiber production in stratum *i* in the UDef PA in year *t* (t $CO_2e$) |
| $E_{BiomassBurn,DegFW,i,t}$ | = | Non-$CO_2$ emissions due to biomass burning as part of fuelwood collection and wood extraction for charcoal and fiber production in stratum *i* in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, *t** years elapsed since the start of the project |

$E_{BiomassBurn,DegFW,i,t}$ and $E_{FC,DegFW,i,t}$ are estimated using *VMD0013* and *VMD0014*, respectively. Emissions from fossil fuel combustion arising from harvesting operations, log hauling and transport, and processing must be included.

### 5.3.3.6 Estimated Net Project Emissions

The net project emissions for UDef PA are calculated as:

$$\Delta C_{MP,PA-UDef,t} = \sum_{t=1}^{t*}\sum_{i=1}^{M}\left(\Delta C_{MP,PA-UDef,i,t}\right) + GHG_{MP,PA-UDef,E,t} + \sum_{t=1}^{t*}\Delta C_{PA,P-Deg,t} \quad (51)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{MP,PA-UDef,t}$ | = | Cumulative net GHG emissions in the UDef PA in year *t* (t $CO_2e$) |
| $\Delta C_{MP,PA-UDef,i,t}$ | = | Total emissions from carbon stock change in all pools in forest stratum *i* in the UDef PA in year *t* (t $CO_2e$) |
| $GHG_{MP,PA-UDef,E,t}$ | = | Cumulative other GHG emissions as a result of project activities in the UDef PA in year *t* (t $CO_2e$) |
| $\Delta C_{PA,P-Deg,t}$ | = | Total GHG emissions caused by planned harvesting activities in the UDef PA in year *t;* where project activities do not include planned harvesting, this is equal to zero (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, $t^*$ years elapsed since the start of the project |

The net project emissions for UDef LB are calculated as:

$$\Delta C_{MP,LB-UDef,t} = \sum_{t=1}^{t*}\sum_{i=1}^{M}\left(\Delta C_{MP,LB-UDef,i,t}\right) \quad (52)$$

Where:

| | | |
|---|---|---|
| $\Delta C_{MP,LB-UDef,t}$ | = | Cumulative GHG emissions in the UDef LB in year *t* (t $CO_2e$) |
| $\Delta C_{MP,LB-UDef,i,t}$ | = | Total emissions from carbon stock change in all pools in forest stratum *i* in the UDef LB in year *t* (t $CO_2e$) |
| *i* | = | 1, 2, 3, …, *M* forest stratum |
| *t* | = | 1, 2, 3, …, $t^*$ years elapsed since the start of the project |

### 5.3.4 Leakage

Four types of leakage must be assessed:

1) Activity shifting by geographically constrained agents;
2) Activity shifting by geographically mobile agents;
3) Market-effects leakage; and
4) Leakage mitigation emissions.

Emissions from these sources are summed to yield an estimate of the total leakage emissions for the project activities over the monitoring period.

**Leakage due to activity shifting by geographically constrained agents** is monitored within the UDef LB. Baseline unplanned deforestation allocated within the UDef LB is compared to the deforestation monitored ex post.

**Leakage due to activity shifting by geographically mobile agents** is estimated on the basis of:

a) The net reduction (displacement) of deforestation from the baseline to the end of the monitoring period within the combined area of the UDef PA and UDef LB;
b) The proportion of geographically mobile agents of deforestation projected in the baseline; and
c) Area-weighted emission factors for areas accessible to geographically mobile deforestation agents outside of the UDef LB.

**Market-effects leakage** occurs where in the baseline case commodities were produced for regional, national or international markets. Market-effects leakage is estimated using *VMD0011 Estimation of Emissions from Market-effects (LK-ME)*.

**Emissions due to leakage mitigation measures** correspond to non-$CO_2$ GHG emissions from biomass burning or fertilizer use, and must be quantified.

#### 5.3.4.1 Roles in Development of Leakage Estimates

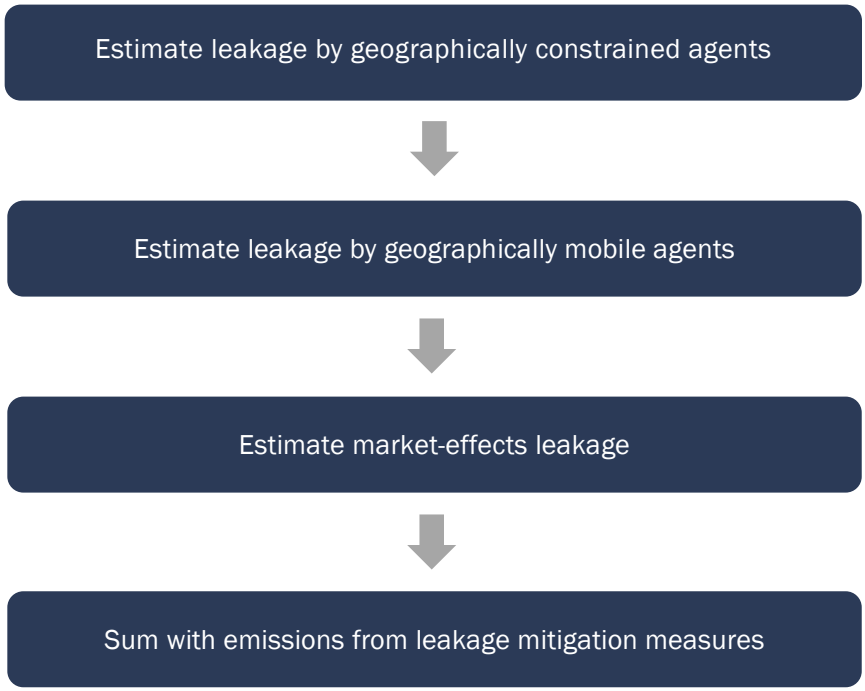
The procedures to estimate leakage rely on a combination of data and steps to be taken by Verra and the project proponent. Processes and criteria to develop jurisdictional data are described in Appendix 1.

**Table 9: Roles in development of leakage estimate**

| Step | Responsible party | Frequency |
|---|---|---|
| Definition of UDef LB boundaries | Verra (UDef LB to be adjusted by the project proponent where applicable – see Section 5.1.3) | Once prior to start of each jurisdictional BVP |
| Definition of jurisdictional emission factor for areas outside the UDef LB subject to deforestation from activity shifting by geographically mobile agents | Verra | Once prior to start of each jurisdictional BVP |
| Assessing emissions from activity shifting due to displacement of unplanned deforestation to the UDef LB | Project proponent | Once per monitoring event |
| Assessing emissions from activity shifting due to displacement of unplanned deforestation to areas outside the UDef LB | Project proponent | Once per monitoring event |
| Assessing emissions from leakage mitigation measures | Project proponent | Once per monitoring event |
| Estimation of total leakage due to the displacement of unplanned deforestation | Project proponent | Once per monitoring event |

Figure 4 summarizes the key leakage estimation steps to be undertaken by the project proponent.

**Figure 4: Leakage estimation steps**




#### 5.3.4.2 Ex Ante Estimation of Leakage

Ex ante, activity displacement leakage may only be estimated based on the anticipated combined effectiveness of the proposed leakage mitigation measures and project activities.

This must be done by multiplying the estimated baseline carbon stock changes for the UDef PA by a "displacement leakage factor" (DLF) representing the percentage of deforestation expected to be displaced outside the project boundary. Where deforestation agents identified in Section 5.2.1 do not participate in and/or benefit from leakage mitigation measures, the displacement factor is 100 percent. Where leakage mitigation measures are implemented, the factor is equal to the proportion of the baseline agents estimated to not be given the opportunity to participate in leakage mitigation measures and project activities.

Where emissions from forest fires have been included in the baseline, the ex ante emissions from forest fires due to activity displacement leakage will be calculated by multiplying baseline forest fire emissions in the UDef PA by the same DLF used to estimate the decrease in carbon stocks.

Ex ante estimates of leakage emissions do not contribute to estimates of ex post monitored project leakage emissions. Monitored leakage emissions are described in Sections –.

#### 5.3.4.3 Emissions From Displacement of Geographically Constrained Activities in the UDef LB

##### Net Carbon Stock Difference in the UDef LB During the Monitoring Period Versus the Baseline Scenario

The difference in carbon stocks between the baseline scenario and the monitoring period within the UDef LB since the project start date to year *t* is calculated as $\Delta C_{LK\text{-}net\text{-}LB,t}$.

Note that $\Delta C_{LK\text{-}net\text{-}LB,t}$ may be less than zero at this step, where forest carbon stocks in the monitoring period are greater than projected under the baseline. Negative values are accounted for in a later step such that positive leakage is never attributed to the project.

$$\Delta C_{LK-net-LB,t} = \Delta C_{BSL,LB-UDef,t} - \Delta C_{MP,LB-UDef,t} \quad (53)$$

Where:

$\Delta C_{LK\text{-}net\text{-}LB,t}$ = Difference in cumulative net GHG emissions between the baseline and monitoring period within the UDef LB due to unplanned deforestation in year *t* (t $CO_2e$)

$\Delta C_{BSL,LB\text{-}UDef,t}$ = Cumulative net GHG emissions in the baseline in year *t* within the UDef LB since the project start (t $CO_2e$)

$\Delta C_{MP,LB\text{-}UDef,t}$ = Cumulative net monitored GHG emissions in year *t* within the UDef LB since the project start (t $CO_2e$)

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

##### Other Deforestation Emissions Within the UDef LB During the Monitoring Period

Where significant (as determined following Appendix 1 of *VM0048*), fossil-fuel related and non-$CO_2$ GHG emissions occurring in the UDef LB must be evaluated. For example, where deforestation occurs in the UDef LB and fire is used as a means of forest clearance, the non-$CO_2$ emissions may be significant.

Fossil-fuel related and non-$CO_2$ GHG emissions per unit area resulting from land cover transition in the UDef LB are assumed to equal those estimated for the baseline period in the UDef PA. These emissions are calculated by summing the total emissions over the baseline period for each forest stratum across the UDef PA and then dividing this by the sum of AD per forest stratum over the baseline period using Equation (54). These average emissions per unit area are then applied to the difference in AD between the baseline and monitoring period within the UDef LB in Equation (55).

$$GHG_{LB,E,i,t} = \frac{\sum_{t=1}^{t^*}\left(E_{BSL,FC,i,t} + E_{BSL,BiomassBurn,i,t} + N2O_{BSL,direct-N,i,t}\right)}{\sum_{t=1}^{t^*} AD_{BSL,PA-UDef,i,t}} \quad (54)$$

Where:

$GHG_{LB,E,i,t}$ = Annual per hectare other GHG emissions in the UDef LB as a result of deforestation activities in forest stratum *i* in year *t* (t $CO_2e$/ha)

$E_{BSL,FC,i,t}$ = Emissions from fossil fuel combustion in forest stratum *i* in year *t* (t $CO_2e$)

$E_{BSL,BiomassBurn,i,t}$ = Non-$CO_2$ emissions due to biomass burning as part of project activities in forest stratum *i* in year *t* (t $CO_2e$)

$N2O_{BSL,direct\text{-}N,i,t}$ = Direct $N_2O$ emissions as a result of nitrogen application on an alternative land use in forest stratum *i* in year *t* (t $CO_2e$)

$AD_{BSL,PA\text{-}UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum *i* in the UDef PA for year *t* (ha)

*i* = 1, 2, 3, …, *M* forest stratum

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

$$GHG_{MP,LK-UDef,E,t} = \sum_{t=1}^{t*}\sum_{i=1}^{M}\left(\left(AD_{BSL,LB-UDef,i,t} - AD_{MP,LB-UDef,i,t}\right) \times GHG_{LB,E,i,t}\right) \quad (55)$$

Where:

$GHG_{MP,LK\text{-}UDef,E,t}$ = Cumulative other GHG emissions in year *t* as a result of unplanned deforestation within the UDef LB during the monitoring period (t $CO_2e$)

$AD_{BSL,LB\text{-}UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum *i* in the UDef LB for year *t* (ha)

$AD_{MP,LB\text{-}UDef,i,t}$ = UDef AD in the UDef LB in forest stratum *i* in year *t* (ha)

$GHG_{LB,E,i,t}$ = Annual per hectare other GHG emissions in the UDef LB as a result of deforestation activities in forest stratum *i* in year *t* (t $CO_2e$/ha)

*i* = 1, 2, 3, …, *M* forest stratum

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

### Net GHG Emissions Within the UDef LB During the Monitoring Period

The net GHG emissions are summed for the UDef LB as:

$$\Delta C_{LK,LB,t} = \Delta C_{LK-net-LB,t} + GHG_{MP,LK-UDef,E,t} \quad (56)$$

Where:

$\Delta C_{LK,LB,t}$ = Cumulative net GHG leakage emissions within the UDef LB during the monitoring period in year *t* (t $CO_2e$)

$\Delta C_{LK\text{-}net\text{-}LB,t}$ = Difference in cumulative net GHG emissions between the baseline and monitoring period within the UDef LB due to unplanned deforestation in year *t* (t $CO_2e$)

$GHG_{MP,LK\text{-}UDef,E,t}$ = Cumulative other GHG emissions in year *t* as a result of unplanned deforestation within the UDef LB during the monitoring period (t $CO_2e$)

*t* = 1, 2, 3, ..., $t^*$ years elapsed since the start of the project

#### 5.3.4.4 Emissions from Activity Shifting Due to Displacement of Unplanned Deforestation to Areas Outside the UDef LB

##### Estimation of the Proportion of Migrated Land Cover Transition Agents in the Baseline ($PROP_{MIG}$)

Randomly sample households located within the project activities region to determine the proportion that meets the following criteria:

1) Migrated into the area within the last five years; and

2) Engages in land use activities identified as a baseline driver of deforestation.

The proportion of sampled households meeting these criteria is termed $PROP_{MIG}$.

The minimum sample size must be at least 200 households. Where the total number of households is estimated to be less than 250, the minimum sample size may be reduced to 80 percent of the estimated number of households. For sampling requirements, refer to the latest version of *Guideline: Sampling and surveys for CDM project activities and programmes of activities*.[16]

This assessment must be repeated within two years prior to the start of each new BVP and the estimated proportions are assumed to remain constant for the BVP.

$PROP_{MIG}$ may always be assigned a conservative value of 1.0. Projects should describe how the definition of household applied in survey design is justified given local context, and demonstrate how it is consistently applied in survey administration.

##### Total Area of Activity Shifting to Outside the UDef LB

It is conservatively assumed that geographically mobile agents of unplanned deforestation recently settled in the UDef PA are primarily driven by a need to secure agricultural land. The amount of leakage to areas outside the UDef LB is taken as the total area of avoided land cover transition in the UDef PA, scaled by the proportion of recent migration ($PROP_{MIG}$).

$$AD_{AS-OLB,t} = PROP_{MIG,t} \times \sum_{t=1}^{t*} \sum_{i=1}^{M} \left( AD_{BSL,PA-UDef,i,t} - AD_{MP,PA-UDef,i,t} \right) \quad (57)$$

[16] Available at: https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20151023152925068/Meth_GC48_%28ver04.0%29.pdf

Where:

$AD_{AS\text{-}OLB,t}$ = Cumulative area outside the UDef LB experiencing land cover conversion due to activity shifting in year *t* (ha)

$PROP_{MIG,t}$ = Proportion of households living in the project activities region that are recent migrants and are engaging in land use activities identified as a baseline driver of unplanned deforestation, as calculated for year *t* (proportion)

$AD_{BSL,PA\text{-}UDef,i,t}$ = UDef AD in the baseline scenario allocated to forest stratum *i* in the UDef PA for year *t* (ha)

$AD_{MP,PA\text{-}UDef,i,t}$ = UDef AD in the UDef PA in forest stratum *i* in year *t* (ha)

*i* = 1, 2, 3, …, *M* forest stratum

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

Where, at any point in time, $AD_{AS\text{-}OLB,t} \geq A_{Available}$,[17] then $AD_{AS\text{-}OLB,t}$ will be equal to zero for the remainder of the BVP.

### Emissions from Activity Shifting to Areas Outside the UDef LB

The area of deforestation that is displaced from the UDef PA ($AD_{AS\text{-}OLB,t}$) is assumed to result in land cover conversion of an equal extent outside the UDef LB.

$$\Delta C_{LK,OLB,t} = AD_{AS-OLB,t} \times \Delta C_{OLB,t} \quad (58)$$

Where:

$\Delta C_{LK,OLB,t}$ = Cumulative total emissions from carbon stock change due to activity shifting to areas available outside the UDef LB in year *t* (t $CO_2e$)

$AD_{AS\text{-}OLB,t}$ = Cumulative area outside the UDef LB experiencing land cover transition due to activity shifting in year *t* (ha)

$\Delta C_{OLB,t}$ = Emissions from carbon stock change due to land cover transition in areas available for activity shifting outside the UDef LB, as calculated for year *t* (t $CO_2e$/ha)

*t* = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

[17] $A_{Available}$ is the area potentially available for activity shifting outside the UDef LB and is determined by Verra (see Appendix 2).

#### 5.3.4.5 Estimation of Total Leakage from Displacement of Unplanned Deforestation

Total activity-shifting leakage emissions are the sum of leakage from within and outside the UDef LB. Where total leakage is calculated to be less than zero, $\Delta C_{LK\text{-}AS,t}$ is assigned a value of zero.

$$\Delta C_{LK-AS,t} = \Delta C_{LK,LB,t} + \Delta C_{LK,OLB,t} \quad (59)$$

Where:

$\Delta C_{LK\text{-}AS,t}$ = Cumulative net GHG leakage emissions due to the displacement of unplanned deforestation activities in year *t* (t $CO_2e$)

$\Delta C_{LK,LB,t}$ = Cumulative net GHG leakage emissions within the UDef LB during the monitoring period in year *t* (t $CO_2e$)

$\Delta C_{LK,OLB,t}$ = Cumulative total emissions from carbon stock change due to activity shifting to areas available outside the UDef LB in year *t* (t $CO_2e$)

*t* = 1, 2, 3, ..., $t^*$ years elapsed since the start of the project

#### 5.3.4.6 Emissions from Market-Effects Leakage

Where deforestation in the baseline involves wood harvesting for commercial markets (timber, fuel wood or charcoal), emissions from market-effects leakage must be estimated using *VMD0011*, resulting in parameter $\Delta C_{LK\text{-}ME,t}$.

#### 5.3.4.7 Emissions from Leakage Mitigation Measures

Leakage mitigation measures must be implemented. Where such activities result in significant increases in emissions from carbon stock changes, biomass burning, and/or increased fertilizer usage, such emissions must be counted and conservatively included in their entirety as emissions caused by project implementation.

The project description must list the planned leakage mitigation measures, locate them (i.e., define leakage management zones), and identify areas where leakage mitigation measures will impact carbon stocks. For these areas, calculate the net carbon stock changes in above- and belowground tree biomass that the planned leakage mitigation measures are expected to cause during the fixed baseline period using conservative growth projections.

Where the net sum of carbon stock changes within the leakage management zones over the monitoring period is greater than zero, the net increase is conservatively ignored in the calculation of net GHG emission reductions of the project activity.

Where the net sum of carbon stock changes within the leakage management zones over the monitoring period is negative, significance must be tested following Appendix 1 of *VM0048*.

For emissions associated with biomass burning and fertilizer usage, significance must be tested following Appendix 1 of *VM0048*.

Where the emissions are significant, they must be accounted in the ex ante estimation of leakage, and emissions in the land units where leakage mitigation measures are implemented will be subject to monitoring, reporting, and verification (MRV). Where the emission is not significant, it may be excluded and carbon stock changes in the leakage management zone will not be subject to required MRV.

$$GHG_{LK,E,t} = \sum_{t=1}^{t^*} \left( E_{Cstocks,LMZ,t} + E_{MP,BiomassBurn,t} + N_2O_{MP,direct-N,t} \right) \quad (60)$$

Where:

$GHG_{LK,E,t}$ = Cumulative other GHG emissions as a result of leakage mitigation measures in year $t$ (t $CO_2e$)

$E_{Cstocks,LMZ,t}$ = Net $CO_2e$ emissions from carbon stock changes in live above- and belowground tree biomass in the leakage management zone resulting from implementation of leakage mitigation measures in year $t$ (t $CO_2e$)

$E_{MP,BiomassBurn,t}$ = Non-$CO_2$ monitored emissions due to biomass burning as part of project activities in year $t$ (t $CO_2e$)

$N_2O_{MP,direct-N,t}$ = Direct $N_2O$ monitored emissions as a result of nitrogen application on an alternative land use in year $t$ (t $CO_2e$)

$t$ = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

### 5.3.4.8 Estimation of Summed Leakage Emissions

Total leakage emissions are equal to the summed emissions from activity shifting, market-effects, and GHG emissions associated with leakage mitigation measures.

$$\Delta C_{LK-UDef,t} = \Delta C_{LK-AS,t} + \Delta C_{LK-ME,t} + GHG_{LK,E,t} \quad (61)$$

Where:

$\Delta C_{LK-UDef,t}$ = Cumulative net GHG emissions due to leakage from the project activity in year $t$ (t $CO_2e$)

$\Delta C_{LK-AS,t}$ = Cumulative net GHG leakage emissions due to the displacement of unplanned deforestation in year $t$ (t $CO_2e$)

$\Delta C_{LK-ME,t}$ = Cumulative net GHG emissions due to market-effects leakage in year $t$, from *VMD0011* (t $CO_2e$)

$GHG_{LK,E,t}$ = Cumulative other GHG emissions as a result of leakage mitigation measures in year $t$ (t $CO_2e$)

$t$ = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

### 5.3.5 Net GHG Emission Reductions

The project proponent must present conservative ex ante estimations of the total net GHG emissions reductions of the project activity.

For ex ante estimations of specific parameters, refer to the parameter tables in the appropriate modules.

The total net GHG emissions reductions of the avoiding unplanned deforestation project activity are calculated as follows:

$$NER_{UDef,t} = \Delta C_{BSL,PA-UDef,t} - \Delta C_{MP,PA-UDef,t} - \Delta C_{LK-UDef,t} \quad (62)$$

Where:

$NER_{UDef,t}$ = Cumulative total net GHG emission reductions of the project activity in year *t* (t $CO_2e$)

$\Delta C_{BSL,PA-UDef,t}$ = Cumulative net GHG emissions in the baseline within the UDef PA in year *t* (t $CO_2e$)

$\Delta C_{MP,PA-UDef,t}$ = Total emissions from carbon stock change in all pools in the UDef PA in year *t* (t $CO_2e$)

$\Delta C_{LK-UDef,t}$ = Cumulative net GHG emissions due to leakage from the UDef PA in year *t* (t $CO_2e$)

*t* = 1, 2, 3, …, *t** years elapsed since the start of the project

#### 5.3.5.1 Calculation of AFOLU Pooled Buffer Account Contribution

The number of credits to be held in the AFOLU pooled buffer account is determined as a percentage of the total carbon stock benefits. For avoiding unplanned deforestation project activities, this is calculated using Equation (63). Leakage emissions do not factor into the buffer calculations.

$$Buffer_{Total,t} = \left(\Delta C_{BSL,PA-UDef,t} - \Delta C_{MP,PA-UDef,t}\right) \times Buffer\% \quad (63)$$

Where:

$Buffer_{Total,t}$ = Cumulative total permanence risk buffer withholding in year *t* (t $CO_2e$)

$\Delta C_{BSL,PA-UDef,t}$ = Cumulative net GHG emissions in the baseline within the UDef PA in year *t* (t $CO_2e$)

$\Delta C_{MP,PA-UDef,t}$ = Total emissions from carbon stock change in all pools in the UDef PA in year *t* (t $CO_2e$)

*Buffer%* = Buffer withholding percentage, from *VCS AFOLU Non-Permanence Risk Tool* (%)

*t* = 1, 2, 3, …, *t** years elapsed since the start of the project

### 5.3.5.2 Calculation of Verified Carbon Units

To calculate the number of potential Verified Carbon Units (VCUs) for years in which monitoring has been conducted and submitted for verification, this module uses the following equation:

$$VCU_{AUDef,t} = \left(NER_{UDef,t} - NER_{UDef,t-1}\right) - \left(Buffer_{Total,t} - Buffer_{Total,t-1}\right) \quad (64)$$

Where:

$VCU_{AUDef,t}$ = Number of potential Verified Carbon Units generated in year $t$ (VCU)

$NER_{UDef,t}$ = Cumulative total net GHG emission reductions of the project activity in year $t$ (t $CO_2e$)

$NER_{UDef,t-1}$ = Cumulative total net GHG emission reductions of the project activity in year $t - 1$ (t $CO_2e$)

$Buffer_{Total,t}$ = Cumulative total permanence risk buffer withholding in year $t$ (t $CO_2e$)

$Buffer_{Total,t-1}$ = Cumulative total permanence risk buffer withholding in year $t - 1$ (t $CO_2e$)

$t$ = 1, 2, 3, …, $t^*$ years elapsed since the start of the project

Where this equation results in a decimal number, the number must be rounded down.

# 6 DATA AND PARAMETERS

## 6.1 Data and Parameters Available at Validation

| | |
|---|---|
| **Data/Parameter** | $A_{PA\text{-}UDef}$ |
| **Data unit** | ha |
| **Description** | Area of project where activities aimed at avoiding unplanned deforestation will take place |
| **Equations** | Section 5.3.2.6 |
| **Source of data** | Calculated within a GIS |
| **Value applied** | To be determined by project proponent |
| **Justification of choice of data or description of measurement methods and procedures applied** | Accuracy of mapped coordinates must be demonstrated. |
| **Purpose of data** | Calculation of project emissions |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | *AJ* |
| **Data unit** | ha |
| **Description** | Area of the jurisdiction |
| **Equations** | Section A1.4.1, (66), (68) |
| **Source of data** | Digital map of jurisdictional boundaries |
| **Value applied** | To be determined by Verra |
| **Justification of choice of data or description of measurement methods and procedures applied** | Prior to the start of each BVP |

| | |
|---|---|
| **Purpose of data** | Calculation of baseline emissions |
| **Comments** | *AJ* should be calculated using the same projected coordinate system as that used for the digital map of jurisdictional boundaries. |

| | |
|---|---|
| **Data/Parameter** | $BEF_R$ |
| **Data unit** | Dimensionless |
| **Description** | Biomass expansion factor for wood removals to convert biomass of extracted wood to aboveground biomass (including bark) |
| **Equations** | (40), (44), (49) |
| **Source of data** | Must be obtained from one or more of the following sources, listed in descending order of preference:<br>1) Estimates specific to the country and species (e.g., from a national GHG inventory)<br>2) Estimates specific to the country<br>3) Default IPCC (2003) estimates by forest type and climatic zone for use with the minimum diameter ranges indicated (Table 3A.1.10 in IPCC 2003) |
| **Value applied** | To be determined by project proponent |
| **Justification of choice of data or description of measurement methods and procedures applied** | Project proponent to determine based on the tree species and data availability |
| **Purpose of data** | Calculation of project emissions for projects that include selective logging and/or extraction of trees for sustainable, responsible collection of fuelwood, fiber, or charcoal production in the project scenario |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $D_j$ |
| **Data unit** | t d.m./m$^3$ |
| **Description** | Basic wood density of species *j* |
| **Equations** | (40), (41), (44), (49) |

| | |
|---|---|
| Source of data | Must be obtained from one or more of the following sources, listed in descending order of preference:<br>1) National values specific to the species or group of species (e.g., from a national GHG inventory)<br>2) Values from neighboring countries with similar conditions, specific to the species or group of species. Where species-specific data from neighboring countries is of higher quality and more representative of the species in the project scenario, it may be preferable to use these values rather than lower quality national data.<br>3) Global values specific to the species or group of species (e.g., Zanne, Amy E. et al. (2009). Data from: Towards a worldwide wood economics spectrum [Dataset]. *Dryad*. https://doi.org/10.5061/dryad.234; IPCC 2006 Vol. 4 Chapter 4 Tables 4.13 and 4.14)<br>Species-specific wood densities may not always be available and can be difficult to apply with certainty in the typically species-rich forests of the humid tropics, hence it is acceptable practice to use wood densities developed for forest types, plant families, or species groups. |
| Value applied | To be determined by project proponent |
| Justification of choice of data or description of measurement methods and procedures applied | Project proponent to determine based on the tree species and data availability |
| Purpose of data | Calculation of project emissions for projects that include selective logging and/or extraction of trees for sustainable, responsible collection of fuelwood, fiber, or charcoal production in the project scenario |
| Comments | None |

| | |
|---|---|
| Data/Parameter | *DLF* |
| Data unit | % |
| Description | Displacement leakage factor |
| Equations | Section 5.3.4.2 |
| Source of data | Estimated and justified by project proponent |
| Value applied | To be determined by project proponent |

| | |
|---|---|
| **Justification of choice of data or description of measurement methods and procedures applied** | Project proponent to determine based on the extent of implementation of deforestation mitigation activities and the expected impact of activities on leakage |
| **Purpose of data** | Calculation of leakage |
| **Comments** | Must be tied to $EA_{EF,t}$ |

| | |
|---|---|
| **Data/Parameter** | $EA_{EF,t}$ |
| **Data unit** | % |
| **Description** | Ex ante effectiveness of halting baseline emissions in year *t* |
| **Equations** | Section 5.3.3.1 |
| **Source of data** | Estimated and justified by project proponent |
| **Value applied** | To be determined by project proponent |
| **Justification of choice of data or description of measurement methods and procedures applied** | Project proponent to determine based on the extent of implementation of deforestation mitigation activities and the expected impact of activities on baseline deforestation |
| **Purpose of data** | Calculation of project emissions |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $t_{alpha=10\%}$ |
| **Data unit** | unitless |
| **Description** | Value of the Student's t distribution for a two-sided 90 percent confidence interval |
| **Equations** | Section 5.3.2.3, (11), (28), (29), (69), (70) |
| **Source of data** | Common statistical tables or software |
| **Value applied** | Determined by project proponent. A value of 1.6449 may be used for analyses involving 50 or more samples (e.g., AD estimates). The t value corresponding to the number of degrees of freedom must be used for cases involving less than 50 samples (e.g., carbon stock estimates). |

| | |
|---|---|
| Justification of choice of data or description of measurement methods and procedures applied | Based on the central limit theorem, sample estimates are assumed to approach a normal distribution, from which a confidence interval may be constructed. The Student's t distribution is used to allow for small sample sizes. |
| Purpose of data | Calculation of baseline emissions and project emissions |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $t_{alpha=66.67\%}$ |
| Data unit | unitless |
| Description | Value of the Student's t distribution for a one-sided 66.67 percent confidence interval |
| Equations | (11), (29), (70) |
| Source of data | Common statistical tables or software |
| Value applied | Determined by project proponent. A value of 0.4307 may be used for analyses with 50 or more samples (e.g., AD estimates). The t value corresponding to the number of degrees of freedom must be used for cases involving fewer than 50 samples (e.g., carbon stock estimates). |
| Justification of choice of data or description of measurement methods and procedures applied | Based on the central limit theorem, sample estimates are assumed to approach a normal distribution, from which a confidence interval may be constructed. The Student's t distribution is used to allow for small sample sizes. |
| Purpose of data | Calculation of baseline emissions and project emissions |
| Comments | None |

## 6.2 Data and Parameters Monitored

| | |
|---|---|
| Data/Parameter | $A_{Available}$ |
| Data unit | ha |
| Description | Area of jurisdiction mapped as available for activity shifting outside the UDef LB |
| Equations | Appendix 2 Section A2.1 |

| | |
|---|---|
| Source of data | Verra (Appendix 2) |
| Description of measurement methods and procedures to be applied | Digital map of land available for activity shifting |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of leakage emissions |
| Calculation method | In GIS |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $A_i$ |
| Data unit | ha |
| Description | Area of stratum *i* |
| Equations | Section 5.3.2.6 |
| Source of data | Project proponent (determined during spatial analysis) |
| Description of measurement methods and procedures to be applied | N/A |
| Frequency of monitoring/recording | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of project emissions |
| Calculation method | In GIS |

| | |
|---|---|
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $A_{PSF}$ |
| **Data unit** | ha |
| **Description** | Area of project sampling frame |
| **Equations** | Section 5.3.3.2, Table 7, (24), (25), (27) |
| **Source of data** | Project proponent (determined during spatial analysis) |
| **Description of measurement methods and procedures to be applied** | N/A |
| **Frequency of monitoring/recording** | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| **QA/QC procedures to be applied** | N/A |
| **Purpose of data** | Calculation of project emissions |
| **Calculation method** | In GIS |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $AD_{LB\text{-}UDef}$ |
| **Data unit** | ha |
| **Description** | Unplanned deforestation activity data allocated to the UDef LB |
| **Equations** | Section 5.3.2.2, Appendix 1 A1.4.3 Step 3 |
| **Source of data** | Verra (*VT0007* and Appendix 1) |
| **Description of measurement methods and procedures to be applied** | *VT0007* and Appendix 1 |

| | |
|---|---|
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section ; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of leakage emissions |
| Calculation method | Application of Appendix 1 and *VT0007* by Verra |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $A_{ss}$ |
| Data unit | ha |
| Description | Area of sampling stratum ss in the project sampling frame (ha) |
| Equations | Section |
| Source of data | Project (calculated in a GIS from spatial stratification of the project sampling frame) |
| Description of measurement methods and procedures to be applied | N/A |
| Frequency of monitoring/recording | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of project emissions |
| Calculation method | In GIS |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $AD_{PA\text{-}UDef}$ |
| Data unit | ha |

| | |
|---|---|
| **Description** | Unplanned deforestation activity data allocated to the UDef PA in the jurisdiction |
| **Equations** | Section , Section A1.4.3 Step 3 |
| **Source of data** | Verra (through the *AD Baseline Allocation Report* and *VT0007*) |
| **Description of measurement methods and procedures to be applied** | Approach to be determined and applied by DSP selected by Verra |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section ; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | N/A |
| **Purpose of data** | Calculation of baseline emissions |
| **Calculation method** | Application of Appendix 1 by Verra |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | *Buffer%* |
| **Data unit** | % |
| **Description** | Buffer withholding percentage |
| **Equations** | (63) |
| **Source of data** | *VCS AFOLU Non-Permanence Risk Tool* |
| **Description of measurement methods and procedures to be applied** | See *VCS AFOLU Non-Permanence Risk Tool* |
| **Frequency of monitoring/recording** | Every verification event |
| **QA/QC procedures to be applied** | N/A |

| | |
|---|---|
| **Purpose of data** | Calculation of VCUs |
| **Calculation method** | See Section  and the *VCS Standard* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{p,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Estimated carbon stock in pool *p* of forest stratum *i* |
| **Equations** | (3), (4) |
| **Source of data** | Project proponent (*VMD0001, VMD0002, VMD0003, VMD0004, VMD0005*) |
| **Description of measurement methods and procedures to be applied** | See *VMD0001, VMD0002, VMD0003, VMD0004, VMD0005* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0001, VMD0002, VMD0003, VMD0004, VMD0005* |
| **Purpose of data** | Calculation of baseline emissions, project emissions and leakage emissions |
| **Calculation method** | See *VMD0001, VMD0002, VMD0003, VMD0004, VMD0005* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{p,post,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Estimated carbon stock in post-deforestation pool *p* in forest stratum *i* |
| **Equations** | (3), (4) |

| | |
|---|---|
| **Source of data** | Project proponent<br>Published and/or peer-reviewed studies selected from the following, in descending order of preference:<br>1) Within 5 km of the project boundary<br>2) Subnational jurisdiction<br>3) National jurisdiction<br>4) National data from neighboring countries with similar conditions<br>5) Global<br>5. Where these data are inadequate or not appropriate, field sampling may take place within the jurisdiction. Field sampling design must result in an estimate that produces conservative estimates of the carbon stocks. |
| **Description of measurement methods and procedures to be applied** | See *VMD0001, VMD0002, VMD0003, VMD0004, VMD0005* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0001, VMD0002, VMD0003, VMD0004, VMD0005* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | Stock estimates of each non-forest land use class represented must be equal to the long-term average stocks (time-weighted average of stocks in cyclical post-deforestation land-use systems such as shifting agriculture with fallow). |
| **Comments** | Note that in Equation (3) $C_{p,post,i}$ is replaced by the parameters specific to individual pools as detailed in Table 2. |

| | |
|---|---|
| **Data/Parameter** | $C_{AB\_nontree,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Forest carbon stock in aboveground non-tree woody vegetation in stratum *i* |
| **Equations** | (3), (4) |

| | |
|---|---|
| **Source of data** | Project proponent (field measurements as delineated in *VMD0001*) |
| **Description of measurement methods and procedures to be applied** | See *VMD0001* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0001* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | See *VMD0001* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{AB\_nontree,post,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Post-land use transition carbon stock in aboveground non-tree woody vegetation in stratum *i* |
| **Equations** | (3), (4) |
| **Source of data** | Project proponent<br><br>Published and/or peer-reviewed studies selected from the following, in descending order of preference:<br><br>1) Within 5 km of the project boundary<br>2) Subnational jurisdiction<br>3) National jurisdiction<br>4) National data from neighboring countries with similar conditions<br>5) Global<br><br>6. Where these data are inadequate or not appropriate, field sampling may take place within the jurisdiction. Field sampling design must result in an estimate that produces conservative estimates of the carbon stocks. |

| | |
|---|---|
| Description of measurement methods and procedures to be applied | See *VMD0001* |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | See *VMD0001* |
| Purpose of data | Calculation of baseline emissions, project emissions, and leakage emissions |
| Calculation method | Stock estimates of each non-forest land use class represented must be equal to the long-term average stocks (time-weighted average of stocks in cyclical post-deforestation land-use systems such as shifting agriculture with fallow). |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $C_{AB\_tree,i}$ |
| Data unit | t $CO_2e$/ha |
| Description | Forest carbon stock in aboveground tree biomass in stratum *i* |
| Equations | (3), (4) |
| Source of data | Project proponent (as delineated in *VMD0001*) |
| Description of measurement methods and procedures to be applied | See *VMD0001* |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | See *VMD0001* |
| Purpose of data | Calculation of baseline emissions, project emissions, and leakage emissions |

| | |
|---|---|
| **Calculation method** | See *VMD0001* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{AB\_tree,post,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Post-land use transition carbon stock in aboveground tree biomass in stratum *i* |
| **Equations** | (3), (4) |
| **Source of data** | Project proponent<br>Published and/or peer-reviewed studies selected from the following, listed in descending order of preference:<br>1) Within 5 km of the project boundary<br>2) Sub-national jurisdiction<br>3) National jurisdiction<br>4) National data from neighboring countries with similar conditions<br>5) Global<br>7. Where these data are inadequate or not appropriate, field sampling may take place within the jurisdiction. Field sampling design must result in an estimate that produces conservative estimates of the carbon stocks. |
| **Description of measurement methods and procedures to be applied** | See *VMD0001* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0001* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |

| | |
|---|---|
| Calculation method | Stock estimates of each non-forest land use class represented must be equal to the long-term average stocks (time-weighted average of stocks in cyclical post-deforestation land-use systems such as shifting agriculture with fallow). |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $C_{BB\_nontree,i}$ |
| Data unit | t $CO_2e$/ha |
| Description | Forest carbon stock in the belowground non-tree woody biomass pool in stratum *i* |
| Equations | Section 5.3.2.3, (3), (4) |
| Source of data | Project proponent (field measurements as delineated in *VMD0001*) |
| Description of measurement methods and procedures to be applied | See *VMD0001* |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | See *VMD0001* |
| Purpose of data | Calculation of baseline emissions, project emissions, and leakage emissions |
| Calculation method | See *VMD0001* |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $C_{BB\_nontree,post,i}$ |
| Data unit | t $CO_2e$/ha |
| Description | Post land use transition carbon stock in the belowground non-tree woody biomass pool in stratum *i* |

| | |
|---|---|
| **Equations** | Section 5.3.2.3, (3), (4) |
| **Source of data** | Project proponent<br>Published and/or peer-reviewed studies selected from the following, in descending order of preference:<br>1) Within 5 km of the project boundary<br>2) Subnational jurisdiction<br>3) National jurisdiction<br>4) National data from neighboring countries with similar conditions<br>5) Global<br>8. Where these data are inadequate or not appropriate, field sampling may take place within the jurisdiction. Field sampling design must result in an estimate that produces conservative estimates of the carbon stocks. |
| **Description of measurement methods and procedures to be applied** | See *VMD0001* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0001* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | Stock estimates of each non-forest land use class represented must be equal to the long-term average stocks (time-weighted average of stocks in cyclical post-deforestation land-use systems such as shifting agriculture with fallow). |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{BB\_tree,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Forest carbon stock in belowground tree biomass in stratum *i* |

| | |
|---|---|
| **Equations** | Section 5.3.2.3, (3), (4) |
| **Source of data** | Project proponent (field measurements as delineated in *VMD0001*) |
| **Description of measurement methods and procedures to be applied** | See *VMD0001* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0001* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | See *VMD0001* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{BB\_tree,post,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Post land use transition carbon stock in belowground tree biomass in stratum *i* |
| **Equations** | Section 5.3.2.3, (3), (4) |
| **Source of data** | Project proponent<br>Published and/or peer-reviewed studies selected from the following, listed in descending order of preference:<br>1) Within 5 km of the project boundary<br>2) Subnational jurisdiction<br>3) National jurisdiction<br>4) National data from neighboring countries with similar conditions<br>5) Global<br>9. Where these data are inadequate or not appropriate, field sampling may take place within the jurisdiction. Field sampling design must result |

| | |
|---|---|
| | in an estimate that produces conservative estimates of the carbon stocks. |
| **Description of measurement methods and procedures to be applied** | See *VMD0001* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0001* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | Stock estimates of each non-forest land use class represented must be equal to the long-term average stocks (time-weighted average of stocks in cyclical post-deforestation land-use systems such as shifting agriculture with fallow). |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{DW,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Forest carbon stock in the dead wood pool in stratum *i* |
| **Equations** | Section 5.3.2.3, (3), (4) |
| **Source of data** | Project proponent (field measurements as delineated in *VMD0002*) |
| **Description of measurement methods and procedures to be applied** | See *VMD0002* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |

| | |
|---|---|
| QA/QC procedures to be applied | See *VMD0002* |
| Purpose of data | Calculation of baseline emissions, project emissions, and leakage emissions |
| Calculation method | See *VMD0002* |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $C_{DW,post,i}$ |
| Data unit | t $CO_2e$/ha |
| Description | Post-deforestation carbon stock in the dead wood pool in stratum *i* |
| Equations | Section 5.3.2.3, (3), (4) |
| Source of data | Project proponent<br>Published and/or peer-reviewed studies selected from the following, listed in descending order of preference:<br>1) Within 5 km of the project boundary<br>2) Subnational jurisdiction<br>3) National jurisdiction<br>4) National data from neighboring countries with similar conditions<br>5) Global<br>10. Where these data are inadequate or not appropriate, field sampling may take place within the jurisdiction. Field sampling design must result in an estimate that produces conservative estimates of the carbon stocks. |
| Description of measurement methods and procedures to be applied | See *VMD0002* |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | See *VMD0002* |

| | |
|---|---|
| Purpose of data | Calculation of baseline emissions, project emissions, and leakage emissions |
| Calculation method | Stock estimates of each non-forest land use class represented must be equal to the long-term average stocks (time-weighted average of stocks in cyclical post-deforestation land-use systems such as shifting agriculture with fallow). |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $C_{LI,i}$ |
| Data unit | t $CO_2e$/ha |
| Description | Forest carbon stock in the litter pool in stratum *i* |
| Equations | Section 5.3.2.3, (3), (4) |
| Source of data | Project proponent (field measurements as delineated in *VMD0003*) |
| Description of measurement methods and procedures to be applied | See *VMD0003* |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | See *VMD0003* |
| Purpose of data | Calculation of baseline emissions, project emissions, and leakage emissions |
| Calculation method | See *VMD0003* |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $C_{LI,post,i}$ |
| Data unit | t $CO_2e$/ha |
| Description | Post-deforestation carbon stock in the litter pool in stratum *i* |

| | |
|---|---|
| **Equations** | Section 5.3.2.3, (3), (4) |
| **Source of data** | Project proponent<br>Published and/or peer-reviewed studies selected from the following, listed in descending order of preference:<br>1) Within 5 km of the project boundary<br>2) Subnational jurisdiction<br>3) National jurisdiction<br>4) National data from neighboring countries with similar conditions<br>5) Global<br>11. Where these data are inadequate or not appropriate, field sampling may take place within the jurisdiction. Field sampling design must result in an estimate that produces conservative estimates of the carbon stocks. |
| **Description of measurement methods and procedures to be applied** | See *VMD0003* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0003* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | Stock estimates of each non-forest land use class represented must be equal to the long-term average stocks (time-weighted average of stocks in cyclical post-deforestation land-use systems such as shifting agriculture with fallow). |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{SOC,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Forest carbon stock in the soil organic carbon pool in stratum *i* |

| | |
|---|---|
| Equations | Section 5.3.2.3, (3), (4) |
| Source of data | Project proponent (field measurements as delineated in *VMD0004*) |
| Description of measurement methods and procedures to be applied | See *VMD0004* |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | See *VMD0004* |
| Purpose of data | Calculation of baseline emissions, project emissions, and leakage emissions |
| Calculation method | See *VMD0004* |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $C_{SOC,post,i}$ |
| Data unit | t $CO_2e$/ha |
| Description | Post-deforestation carbon stock in the soil organic carbon pool in stratum *i* |
| Equations | Section 5.3.2.3, (3), (4) |

| | |
|---|---|
| **Source of data** | Project proponent<br><br>Published and/or peer-reviewed studies selected from the following, listed in descending order of preference:<br><br>1) Within 5 km of the project boundary<br>2) Subnational jurisdiction<br>3) National jurisdiction<br>4) National data from neighboring countries with similar conditions<br>5) Global<br><br>12. Where these data are inadequate or not appropriate, field sampling may take place within the jurisdiction. Field sampling design must result in an estimate that produces conservative estimates of the carbon stocks. |
| **Description of measurement methods and procedures to be applied** | See *VMD0004* (equivalent to $C_{SOC,PD-BSL,i}$ in *VMD0004*) |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0004* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | Stock estimates of each non-forest land use class represented must be equal to the long-term average stocks (time-weighted average of stocks in cyclical post-deforestation land-use systems such as shifting agriculture with fallow). |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{WP,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Mean carbon stocks entering the wood product pool at the time of deforestation from forest stratum *i* |

| | |
|---|---|
| **Equations** | Section 5.3.2.3, (3), (4), (12), (15) |
| **Source of data** | Project proponent (as delineated in *VMD0005*) |
| **Description of measurement methods and procedures to be applied** | See *VMD0005* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0005* |
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | See *VMD0005* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $C_{WP100,i}$ |
| **Data unit** | t $CO_2e$/ha |
| **Description** | Carbon stock entering the wood products pool from forest stratum *i* at the time of deforestation that is expected to be emitted over 100 years |
| **Equations** | Section 5.3.2.3, (3), (4), (14), (17) |
| **Source of data** | Project proponent (as delineated in *VMD0005*) |
| **Description of measurement methods and procedures to be applied** | See *VMD0005* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0005* |

| | |
|---|---|
| **Purpose of data** | Calculation of baseline emissions, project emissions, and leakage emissions |
| **Calculation method** | See *VMD0005* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $E_{FC,DegFW,i,t}$ |
| **Data unit** | t $CO_2e$ |
| **Description** | Emissions from fossil fuel combustion from fuelwood collection and wood extraction for charcoal and fiber production in stratum *i* in the UDef PA in year *t* |
| **Equations** | (50) |
| **Source of data** | Estimated according to *VMD0014* using data from operation records and harvesting and monitoring reports. |
| **Description of measurement methods and procedures to be applied** | Estimated according to *VMD0014* using data from operation records and harvesting and monitoring reports. |
| **Frequency of monitoring/recording** | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| **QA/QC procedures to be applied** | N/A |
| **Purpose of data** | Calculation of project emissions |
| **Calculation method** | See *VMD0014* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $E_{BiomassBurn,DegFW,i,t}$ |
| **Data unit** | t $CO_2e$ |
| **Description** | Non-$CO_2$ emissions due to biomass burning as part of fuelwood collection and wood extraction for charcoal and fiber production activities in stratum *i* in year *t* |

| | |
|---|---|
| Equations | (50) |
| Source of data | Estimated according to *VMD0013* using data from operation records and harvesting and monitoring reports. |
| Description of measurement methods and procedures to be applied | Estimated according to *VMD0013* using data from operation records and harvesting and monitoring reports. |
| Frequency of monitoring/recording | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of project emissions |
| Calculation method | See *VMD0013* |
| Comments | None |

| | |
|---|---|
| Data/Parameter | *MPL* |
| Data unit | years |
| Description | Length of monitoring period |
| Equations | (32), (33) |
| Source of data | Project proponent (metadata of imagery used to undertake plot interpretation for project monitoring) |
| Description of measurement methods and procedures to be applied | N/A |
| Frequency of monitoring/recording | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of project emissions |

| | |
|---|---|
| Calculation method | Calculated as the difference between the average dates of imagery used to assess sample plots at the start and end of the monitored period. |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $\Delta C_{LK\text{-}ME,t}$ |
| Data unit | t $CO_2e$ |
| Description | Cumulative net GHG emissions due to market-effects leakage in year *t* |
| Equations | Section 5.3.4.6, (61) |
| Source of data | Project proponent (as delineated in *VMD0011*) |
| Description of measurement methods and procedures to be applied | See *VMD0011* |
| Frequency of monitoring/recording | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | See *VMD0011* |
| Purpose of data | Calculation of leakage |
| Calculation method | See *VMD0011* |
| Comments | Net GHG emissions due to market-effects leakage summed up to year *t* |

| | |
|---|---|
| Data/Parameter | $\Delta C_{OLB,t}$ |
| Data unit | t $CO_2e$/ha |
| Description | Emissions from carbon stock change due to land cover transition in areas available for activity shifting outside the UDef LB, as calculated for year *t* |
| Equations | (58) |

| | |
|---|---|
| Source of data | Verra (see Appendix 2 Section A2.2; derived by Verra from average carbon stocks in pixels available for deforestation from a global carbon stock map, where relevant with addition of belowground biomass from IPCC root-to-shoot ratios) |
| Description of measurement methods and procedures to be applied | See Appendix 2 A2.2 |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of leakage emissions |
| Calculation method | See Appendix 2 A2.2 |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $CountJ_{CHC,ss}$ |
| Data unit | Sampling units |
| Description | Total count of the sample units that fall into sampling stratum ss and change category *CHC* (UDef/SF/SNF/Reg) |
| Equations | (65), (67) |
| Source of data | Verra (interpretation of high-resolution satellite imagery and/or ground measurements) |
| Description of measurement methods and procedures to be applied | See Appendix 1 |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |

| | |
|---|---|
| QA/QC procedures to be applied | **Imagery Interpretation Method**<br>The interpretation and recordkeeping approach must be documented through SOPs, allowing the process to be reproduced by individuals not involved in initial data generation. The methods employed must meet the following minimum characteristics:<br>• The interpretation approach provides sufficient objective criteria to allow interpreters to independently and consistently produce similar interpretations for the same samples. Interpretation criteria should relate to the physical definitions of land cover classes, as far as those criteria may be interpreted from high-resolution imagery.<br>• Multiple analysts are employed to interpret each plot through blindly repeated observations or team-based interpretation.<br>• Observation focuses on identifying a sample's class at each of two single points in time, the beginning and end of the HRP. The change is determined as the difference between the start and end classes.<br>• Where there is analyst disagreement over the interpretation of a sample, an objective process is put in place to either adjudicate the dispute and resolve the plot to a single class, or reject the plot as unclear. Adjudication must always be attempted before rejection. Information on all rejected plots must be retained, and it must be demonstrated that the rejection of plots does not bias the results. |
| Purpose of data | Calculation of baseline emissions, project emissions, and leakage emissions |
| Calculation method | As above |
| Comments | *CHC* = UDef, SF, SNF, Reg (unplanned deforestation, stable forest, stable nonforest, regrowth) |

| | |
|---|---|
| Data/Parameter | $Count_{ss}$ |
| Data unit | Sample units |
| Description | Total count of sample units in sampling stratum ss |
| Equations | Table 6, (23), (26) |
| Source of data | Project proponent (interpretation of high-resolution satellite imagery and ground measurements) |

| | |
|---|---|
| **Description of measurement methods and procedures to be applied** | See Appendix 1 |
| **Frequency of monitoring/recording** | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| **QA/QC procedures to be applied** | As described in Standard Operating Procedures for Sample Plot Interpretation |
| **Purpose of data** | Calculation of project emissions and leakage emissions |
| **Calculation method** | Approach must comply with all relevant requirements of Appendix 1. |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $Count_{CHC,ss}$ |
| **Data unit** | Sample units |
| **Description** | Count of the sample units within the project sampling frame that fall into sampling stratum ss and are classified as change category *CHC* (UDef/SF/SNF/Reg) |
| **Equations** | Table 6, (23), (26) |
| **Source of data** | Project (interpretation of high-resolution satellite imagery and ground measurements) |
| **Description of measurement methods and procedures to be applied** | See Appendix 1 |
| **Frequency of monitoring/recording** | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| **QA/QC procedures to be applied** | As described in Standard Operating Procedures for Sample Plot Interpretation |
| **Purpose of data** | Calculation of project emissions and leakage emissions |
| **Calculation method** | Approach must comply with all relevant requirements of Appendix 1. |

| | |
|---|---|
| **Comments** | *CHC* = UDef, SF, SNF, Reg (unplanned deforestation, stable forest, stable nonforest, regrowth) |

| | |
|---|---|
| **Data/Parameter** | $E_{BSL,BiomassBurn,i,t}$ |
| **Data unit** | t $CO_2e$ |
| **Description** | Non-$CO_2$ emissions due to biomass burning as part of project activities in forest stratum *i* in year *t* |
| **Equations** | (20), (54) |
| **Source of data** | Project proponent (as delineated in *VMD0013*) |
| **Description of measurement methods and procedures to be applied** | See *VMD0013* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0013* |
| **Purpose of data** | Calculation of baseline emissions |
| **Calculation method** | See *VMD0013* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $E_{MP,BiomassBurn,i,t}$ |
| **Data unit** | t $CO_2e$ |
| **Description** | Non-$CO_2$ emissions due to biomass burning as part of project activities in forest stratum *i* in year *t*<br>*Note – in application in the leakage management zones, there are no strata and subscript* i *should be omitted.* |
| **Equations** | (38), (60) |
| **Source of data** | Project proponent (as delineated in *VMD0013*) |

| | |
|---|---|
| Description of measurement methods and procedures to be applied | See *VMD0013* |
| Frequency of monitoring/recording | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | See *VMD0013* |
| Purpose of data | Calculation of project emissions |
| Calculation method | See *VMD0013* |
| Comments | None |

| | |
|---|---|
| Data/Parameter | $E_{Cstocks,LMZ,t}$ |
| Data unit | t $CO_2e$ |
| Description | Net $CO_2e$ emissions from carbon stock changes due to the implementation of leakage mitigation measures in the leakage management zone in year *t* |
| Equations | (60) |
| Source of data | Project proponent (as delineated in *VMD0001*) |
| Description of measurement methods and procedures to be applied | See *VMD0001* |
| Frequency of monitoring/recording | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| QA/QC procedures to be applied | See *VMD0001* |
| Purpose of data | Calculation of leakage emissions |
| Calculation method | See *VMD0001* |

| | |
|---|---|
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $E_{BSL,FC,i,t}$ |
| **Data unit** | t $CO_2e$ |
| **Description** | Emissions from fossil fuel combustion in forest stratum *i* in year *t* of the baseline |
| **Equations** | (20), (54) |
| **Source of data** | Project proponent<br>Ex ante: default values from IPCC 2006 (including *2019 Refinement*) or peer reviewed literature<br>Ex post: as delineated in *VMD0014* |
| **Description of measurement methods and procedures to be applied** | See *VMD0014* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *VMD0014* |
| **Purpose of data** | Calculation of baseline emissions and leakage emissions |
| **Calculation method** | *VMD0014* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $E_{MP,FC,i,t}$ |
| **Data unit** | t $CO_2e$ |
| **Description** | Emissions from fossil fuel combustion in forest stratum *i* in year *t* |
| **Equations** | (38) |

| | |
|---|---|
| **Source of data** | Project proponent<br>Ex ante: default values from IPCC 2006 (including *2019 Refinement*) or peer reviewed literature<br>Ex post: as delineated in *VMD0014* |
| **Description of measurement methods and procedures to be applied** | See *VMD0014* |
| **Frequency of monitoring/recording** | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| **QA/QC procedures to be applied** | See *VMD0014* |
| **Purpose of data** | Calculation of project emissions |
| **Calculation method** | See *VMD0014* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $N2O_{BSL,direct\text{-}N,i,t}$ |
| **Data unit** | t $CO_2e$ |
| **Description** | Direct $N_2O$ emissions as a result of nitrogen application on an alternative land use in stratum *i* in year *t* of the baseline |
| **Equations** | (20), (54) |
| **Source of data** | Project proponent (as delineated in *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization*) |
| **Description of measurement methods and procedures to be applied** | See *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization* |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | See *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization* |

| | |
|---|---|
| **Purpose of data** | Calculation of baseline emissions and leakage emissions |
| **Calculation method** | See *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $N2O_{MP,direct\text{-}N,i,t}$ |
| **Data unit** | t $CO_2e$ |
| **Description** | $N_2O$ emissions resulting from nitrogen application on an alternative land use in stratum *i* in year *t*<br>*Note – in application in the leakage management zones, there are no strata and subscript* i *should be omitted.* |
| **Equations** | (38), (60) |
| **Source of data** | Project proponent (as delineated in *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization*) |
| **Description of measurement methods and procedures to be applied** | See *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization* |
| **Frequency of monitoring/recording** | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| **QA/QC procedures to be applied** | See *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization* |
| **Purpose of data** | Calculation of project emissions |
| **Calculation method** | See *CDM Methodological Tool: Estimation of Direct $N_2O$ Emissions from Nitrogen Fertilization* |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $PROP_{MIG}$ |
| **Data unit** | Proportion |

| | |
|---|---|
| **Description** | Proportion of households living in the project activities region that are recent migrants and are engaging in land use activities identified as a baseline driver of unplanned deforestation |
| **Equations** | Section 5.3.4.4, (57) |
| **Source of data** | Project proponent (through participatory rural appraisal) |
| **Description of measurement methods and procedures to be applied** | For sampling requirements refer to CDM *Guideline: Sampling and surveys for CDM project activities and programmes of activities*.<br>$PROP_{MIG}$ may always be assigned a conservative value of 1.0. |
| **Frequency of monitoring/recording** | Every six years at baseline renewal. Note that a project's initial BVP may be shorter than six years, as provided for in Section 5.3.1; subsequent baselines will be renewed every six years. |
| **QA/QC procedures to be applied** | For sampling requirements refer to CDM *Guideline: Sampling and surveys for CDM project activities and programmes of activities*. |
| **Purpose of data** | Calculation of leakage emissions |
| **Calculation method** | Survey |
| **Comments** | None |

| | |
|---|---|
| **Data/Parameter** | $t_{start,ss,s}$ |
| | $t_{end,ss,s}$ |
| **Data unit** | Decimal year |
| **Description** | Date of image used to interpret the start and end dates of sample s classified in sampling stratum ss |
| **Equations** | (72), (73) |
| **Source of data** | Project proponent (from metadata provided with high resolution imagery used in sample plot interpretation, or for ground observations, date of field visit) |
| **Description of measurement methods and procedures to be applied** | N/A |

| | |
|---|---|
| Frequency of monitoring/recording | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of project emissions and leakage emissions |
| Calculation method | N/A |
| Comments | For images that are composites of multiple imaging dates, the midpoint of the time period represented in the composite must be taken as the collection date. |

| | |
|---|---|
| Data/Parameter | $V_{EX,j,i,t}$ |
| Data unit | $m^3$ |
| Description | Extracted volume of merchantable timber of species *j* in stratum *i* in year t |
| Equations | (40) |
| Source of data | Project proponent, from forest management operation records and monitoring reports |
| Description of measurement methods and procedures to be applied | |
| Frequency of monitoring/recording | Operation records must be kept on an annual basis; monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | |
| Purpose of data | Calculation of project emissions |
| Calculation method | N/A |
| Comments | |

| | |
|---|---|
| Data/Parameter | $V_{EX,INF,j,i,t}$ |

| | |
|---|---|
| Data unit | $m^3$ |
| Description | Extracted volume of timber of species *j* harvested for forestry infrastructure in stratum *i* in year *t* |
| Equations | (40) |
| Source of data | Project proponent, from forest management operation records and monitoring reports |
| Description of measurement methods and procedures to be applied | |
| Frequency of monitoring/recording | Operation records must be kept on an annual basis; monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | |
| Purpose of data | Calculation of project emissions |
| Calculation method | N/A |
| Comments | |

| | |
|---|---|
| Data/Parameter | $B_{EX,FW,j,i,t}$ |
| Data unit | t d.m. |
| Description | Biomass of wood of species *j* extracted for fuelwood, charcoal, or fiber in stratum *i* of the UDef PA at time *t* |
| Equations | (49) |
| Source of data | Operation records and harvesting and monitoring reports. Reported values must not surpass the allowable mean extractable volume set in the timber harvest plan based on legal limits. |
| Description of measurement methods and procedures to be applied | N/A |

| | |
|---|---|
| Frequency of monitoring/recording | Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently. |
| QA/QC procedures to be applied | N/A |
| Purpose of data | Calculation of project emissions |
| Calculation method | N/A |
| Comments | |

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# APPENDIX 1: DETERMINATION OF JURISDICTIONAL DATA FOR PROJECT AD ALLOCATION

## A1.1 General

The AD baseline for unplanned deforestation is the jurisdictional average annual rate of unplanned deforestation. The jurisdictional baseline AD must be updated at the end of each BVP.

Verra will establish jurisdictional baselines and allocate them to projects; Verra is responsible for all of the actions in this Appendix 1.

Project allocations will be documented in an *AD Baseline Allocation Report,* which includes the following:

1) Definition of forest used in FCBM construction;
2) Definition of deforestation used in AD estimation;
3) Start and end date of the HRP;
4) Start and end date of the BVP;
5) Table of total AD allocation for the UDef PA and UDef LB over the BVP;
6) The portions of the jurisdictional FCBM intersecting the UDef PA and UDef LB;
7) The portions of the jurisdictional deforestation risk map intersecting the UDef PA and UDef LB – independently assessed for appropriateness and methodological soundness – including the name of the DSP that developed it, data layers and type of statistical model used, prediction ability statistics, and the relevant digital GIS files;
8) The spatial boundaries of any registered AFOLU carbon projects, associated leakage belts, and projects in the VCS project pipeline;[18] and
9) The jurisdictional emission factor due to land cover transition in areas available for activity shifting outside the UDef LB.

[18] Limited to projects that use this module.

The application of this procedure employs activity-based accounting.[19]

## A1.2 Boundaries

### A1.2.1 Jurisdictional Boundaries

The location description of the jurisdiction must include the following information:

1) Name of the jurisdiction;
2) Vectorized digital file (e.g., shapefile, kmz, geojson) of the jurisdiction boundaries, including information on the projection and datum used;
3) Geodetic coordinates of the vertices of the jurisdiction boundary, provided in the format specified in the *VCS Standard*; and
4) Total terrestrial area covered by the jurisdiction in hectares, calculated in a GIS program using an equal area projection in meters.

The jurisdictional boundary must be defined using one of the following cases:

- The national boundaries may always be used as the jurisdiction.
- Where there is a clear expression of government intent to use alternative boundaries in developing jurisdictional REDD+ programs,[20] the boundaries of a government's jurisdictional REDD+ program may be used. Only in this case may boundaries be defined using non-administrative boundaries (e.g., biomes, ecozones, watersheds).
- The boundaries of one or several contiguous jurisdictions at either second or third level (i.e., administrative level below the national level) may be used where these, taken together, cover at least 2.5 million hectares. Where the area amounts to more than half of the country area, the whole country must be included.

The jurisdiction may include forest and non-forest lands and must consist of the full spatial extent of the selected administrative unit. The boundaries of a jurisdiction must not spatially overlap with any other jurisdictional boundary defined by Verra or with any registered JNR jurisdictional FREL or program.

[19] The activity-based approach to emissions estimation consists of identifying specific activities occurring on the land that influence GHG fluxes and focusing on the project activities, allowing for differentiation between activities. See Iversen et al. (2014) for more information.

[20] For example, those included in a submission of a FREL to the UNFCCC or a submission to the Forest Carbon Partnership Facility's Carbon Fund, the BioCarbon Fund Initiative for Sustainable Forest Landscapes (ISFL) or the Architecture for REDD+ Transactions (ART) REDD+ Environmental Excellence Standard (TREES)

Where the above criteria defining jurisdictional boundaries are not achievable due to the presence of other jurisdictions for which a valid VCS jurisdictional AD baseline or JNR program and FREL exist, the jurisdiction must be defined as the remaining area within the national boundary.

Where an existing UDef PA or UDef LB intersects more than one administrative jurisdiction, an approved *AD Baseline Allocation Report* will be developed by Verra for the portion of the UDef PAs or UDef LBs outside the selected jurisdiction in case no valid BVP AD exists for such jurisdiction. AD must be allocated to the respective portion of the UDef PA from each jurisdiction.

### A1.2.2 UDef LB Boundaries

The spatial extent of each project's UDef LB must be delineated as the forest area (as depicted on the jurisdictional FCBM) within a 10 kilometer wide buffer around the UDef PA, excluding:

1) Areas that fall outside the national boundary; and

2) Areas mapped as identified exclusions (see Section A1.4.1 Step 1).

Where, following the aforementioned exclusions of forests, the remaining forest area within a 10 km wide buffer exceeds the extent of the UDef PA at the project start date, the buffer width must be reduced so that the area of forest in the UDef LB is equal to the extent of the UDef PA at the project start date. The minimum UDef LB buffer width must in all cases be 2 km.

Where the UDef PA includes non-contiguous forest patches or where a grouped project is composed of multiple project activity instances, each patch or project activity instance is considered as a separate "PA segment" for the purpose of UDef LB delineation. PA segments whose boundaries are separated by no more than 4 km must be grouped into a single PA segment prior to UDef LB delineation. Multiple small segments may thus be aggregated into one or a small number of PA segments and the UDef LB buffer width is determined based on the combined forest area within the aggregated segment.

As detailed in Section 5.1.3, further actions must be taken by project proponents to discount from UDef LB the overlapping PAs and LBs of other VCS AFOLU registered and active projects.

## A1.3 AD Categories for Which Historical AD Estimates Are Required

The following categories must be explicitly defined in the *AD Baseline Allocation Report*:

1) Forest to non-forest (deforestation);

2) Stable forest;

3) Non-forest to forest[21] (i.e., forest regrowth, which includes afforestation, reforestation, and natural regeneration of forests); and

[21] Where trees meeting the threshold parameters of the definition of "forest" appear on lands that were not "forest" in previous years, these lands should be considered "temporarily stocked" (i.e., not "forest"). It takes at

4) Stable non-forest.

Deforestation must be disaggregated into at least small-scale and large-scale unplanned deforestation. Other categories do not require disaggregation (see Table 10).

**Table 10: Change category inclusion criteria**

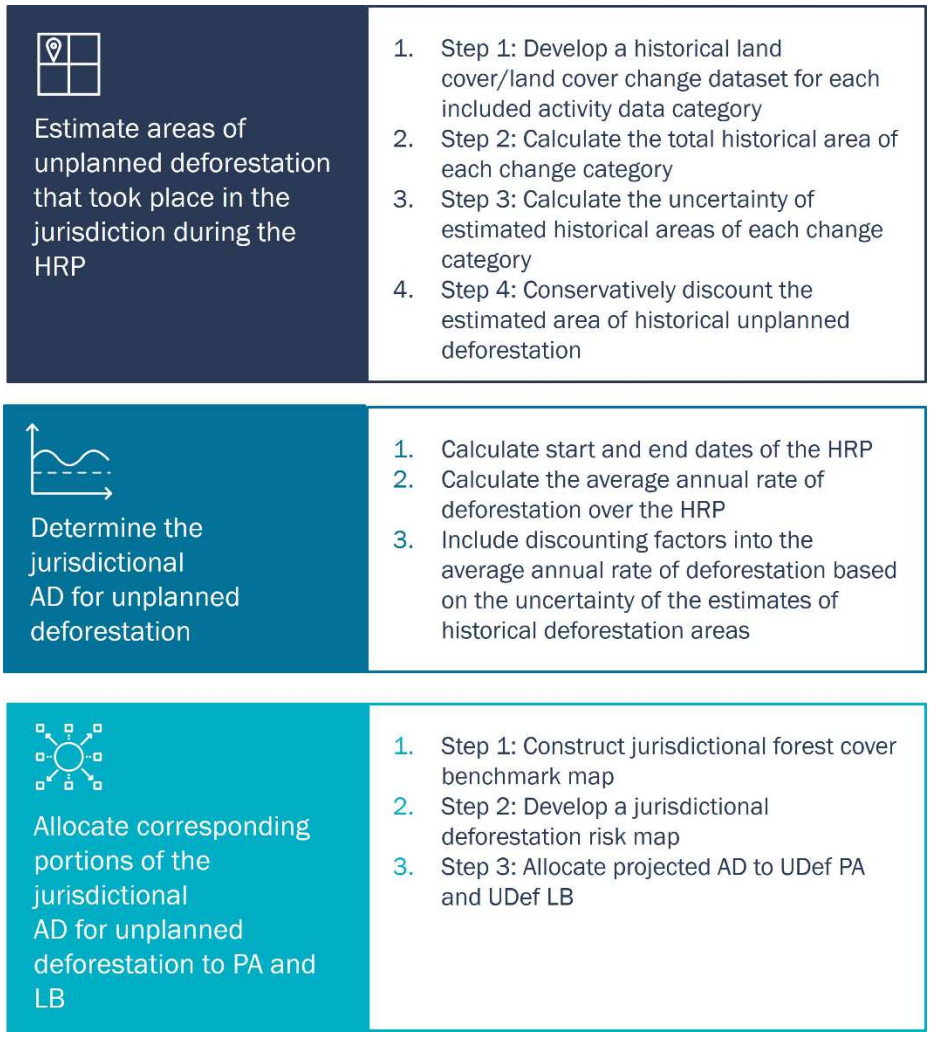
| Required change category | Required classes |
|---|---|
| Deforestation | Large-scale unplanned deforestation; Small-scale unplanned deforestation |
| Forest regrowth | Forest regrowth |
| Stable forest | Stable forest |
| Stable non-forest | Stable non-forest |

## A1.4 Compilation and Allocation of UDef AD

Verra will use the following procedures to compile jurisdictional deforestation AD and allocate this to UDef PAs and UDef LBs (Figure 5).

least 10 consecutive years for such lands to become "forest" and therefore it is not possible for them to be deforested earlier.

**Figure 5: Allocation of jurisdictional deforestation AD to UDef PAs and UDef LBs**




Historical land cover change is estimated using a sample of high-resolution imagery. Uncertainty of the estimate is assessed and used to determine whether the resulting AD must be conservatively discounted.

### A1.4.1 Estimate Areas of Unplanned Deforestation that Took Place in the Jurisdiction During the HRP

Historical AD refers to the total area of the jurisdiction that experienced deforestation over the HRP. Historical AD must be estimated using a sample-based approach that uses human interpretation of high-resolution imagery within sample plots[22] distributed in a representative manner across the jurisdiction. Where available, in situ observations may be used to supplement visual interpretation of

[22] For a fuller treatment of best practices regarding plot-based AD development, see Section 4.2 of GFOI (2020).

sample plots but are not required. Other spatial data may be used to increase sampling design efficiency or aid image interpretation.

The historical AD must be conservatively discounted based on the estimated statistical uncertainty and then annualized. The uncertainty-discounted average annual historical AD estimate will be used to project future AD over the BVP and develop the jurisdictional AD baseline for unplanned deforestation.

Development of wall-to-wall forest, land cover or land cover change maps is not a requirement for estimating AD. However, wall-to-wall maps from any source may be used to develop efficient stratified sampling strategies for estimating historical AD. Any sampling strategy that is spatially representative of the jurisdiction and supported by current best practices may be used as long as its use assists in producing estimates that meet accuracy requirements.

### Step 1: Develop a Historical Land Cover/Land Cover Change Dataset

Historical AD should be estimated using a sample-based approach. The sample-based method yields an estimate of the area of unplanned deforestation for the HRP, together with an evaluation of statistical uncertainty, as expressed by confidence intervals.

SOPs must be developed and employed by the data developer and must include, at a minimum, sample design, response design and data sources, data collection, and data analysis. The SOPs should also include detailed guidance on quality management during all these steps and should be annexed to the *AD Baseline Allocation Report*.

#### Jurisdictional Sampling Frame and Areas of Identified Exclusions

AD sampling must be carried out over the entire jurisdiction, except for areas determined to be "identified exclusions." Table 11 lists the categories of identified exclusions and the conditions under which they must be mapped. Locations of irrefutably identified and bounded exclusions must be spatially delineated and excluded from the jurisdictional sampling frame.

**Table 11: Description of maps of identified exclusions**

| Data Product | Description of Identified Exclusions | Requirement for Producing Data Product |
|---|---|---|
| Map of Identified Exclusion - Intertidal Zone | Coastal or riverine areas subject to regular inundation by tides | **Required** where 1000 ha of mangrove forests are known to exist in the jurisdiction<br>**Optional** in all other cases |

| Data Product | Description of Identified Exclusions | Requirement for Producing Data Product |
|---|---|---|
| Map of Identified Exclusion – Commercial Plantations | Forests meeting all of the following conditions:<br>1) Currently managed primarily with the objective to earn revenue through timber harvesting;<br>2) Harvesting practices involve clear cuts, patch cuts, seed trees, continuous thinning, group selection or related practices; and<br>3) Wood is harvested to supply commercial markets.[23] | **Required** where commercial plantations larger than 1000 ha are known to exist in the jurisdiction<br>**Optional** in all other cases |
| Map of Identified Exclusion – Natural Disturbances | Deforestation during the HRP caused by known infrequent, large-scale natural disturbance | **Required** where both of the following conditions are met:<br>1) An individual natural disturbance is known to have resulted in more than 1000 ha of deforestation; and<br>2) It is possible to spatially delineate deforestation attributable to a natural disturbance from other potential causes of deforestation with high confidence using available datasets.<br>**Optional** in all other cases |
| Map of Identified Exclusion– Planned Infrastructure | Deforestation during the HRP caused by large-scale infrastructure projects | **Required** where both of the following conditions are met:<br>1) An individual infrastructure project is known to have resulted in more than 1000 ha of deforestation; and<br>2) It is possible to spatially delineate deforestation attributable to an infrastructure project from other potential causes of deforestation with high confidence using available datasets.<br>**Optional** in all other cases |

[23] Commercial markets here are defined as sale of products to end users and public and private companies with sales conducted distant (more than 50 km) from the UDef PA.

| Data Product | Description of Identified Exclusions | Requirement for Producing Data Product |
|---|---|---|
| Map of Identified Exclusion– Planned Deforestation | Deforestation during the HRP caused by large-scale planned deforestation cleared by a single agent | **Required** where both of the following conditions are met:<br>1) An individual planned deforestation activity is known to have resulted in more than 1000 ha of deforestation cleared by a single agent; and<br>2) All other VCS definitions for planned deforestation are met.<br>**Optional** in all other cases |
| Map of Identified Exclusion– Water | Permanent bodies of water incapable of sustaining forests | **Optional** in all cases |

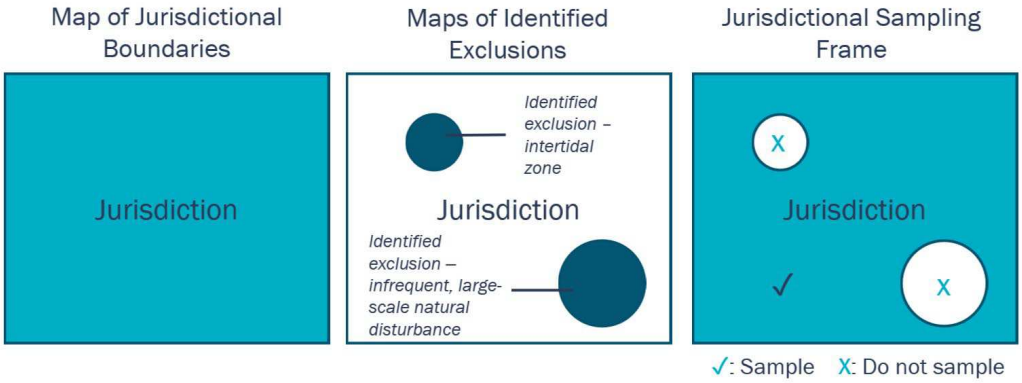
The spatially delineated areas excluded from sampling within the jurisdiction must be provided as a series of identified exclusion maps. The entire area of the jurisdiction in hectares, including "identified exclusions," is termed *AJ*.

AD sampling must only be undertaken in areas that are within the jurisdictional boundaries and are not identified as excluded. Where a 10 km buffer is required, sampling must not occur within this buffer. The remaining area of the jurisdiction once identified exclusions have been removed is termed the jurisdictional sampling frame. Figure 6 illustrates the process of developing the jurisdictional sampling frame.

The purpose of this step is not to exhaustively identify all cases of allowable categories for exclusion but rather to limit sample effort and improve the accuracy of the sample-based AD estimates.

The maps of identified exclusions are also used to reclassify apparent deforestation, as is further described in Section A1.4.3 Step 1. The excluded areas are assigned a deforestation risk category of zero in certain circumstances, as described in Section A1.4.3 Step 2.

**Figure 6: Conceptual illustration of the development of identified exclusion area maps and jurisdictional sampling frame**




## Sample Design

The sampling design must ensure that sample plots are distributed across the entire jurisdictional sampling frame, yielding a representative sample of the landscape considering spatial patterns of deforestation. Sampling designs may be systematic, random, stratified random sampling or any other design supported by current best practices. The sampling strategy method should ensure that the uncertainty (defined as a half-width of the 90 percent confidence interval) of the final estimate of deforestation is within ±10 percent of the estimate of the mean, otherwise the estimate is subject to a conservative discounting.

Any relevant spatial criterion may be employed to stratify the jurisdictional sampling frame, including observed land cover change in an ancillary wall-to-wall map, areas of hypothesized high versus low risk of deforestation or any other criterion that assists in limiting interpretation effort to meet the uncertainty targets of the estimated AD.

Where a stratified sampling design is not employed, the entire jurisdictional sampling frame must be considered to constitute a single sampling stratum.

Areas excluded from the jurisdictional sampling frame (areas mapped as identified exclusions) must not be included in any sampling stratum nor be incorporated in the calculations of area (in hectares) of any sampling stratum.

## Response Design

Collected sample data are used to identify land cover conditions at the start date and end date of the HRP within the jurisdiction spatial boundary and to assign a change (deforestation or forest regrowth) or no change (stable forest or stable non-forest) result to each observation. Where evidence exists of intermediary land cover[24] changes occurring between the start and end dates of the HRP, such

[24] The term "land cover" here encompasses both land cover and land use.

evidence should be used to inform the classification of a sample unit. Only one result may be identified per location per HRP.

Rules for determining the evidence and interpretation guidance that should be employed must be described in the SOP for image interpretation and may rely on a combination of imagery, secondary remote sensing data, and ancillary spatial or non-spatial data.

For each sample unit where change is observed, the date on which change is observed must be identified and recorded using the satellite imagery time series.

### Data Sources

Sample data are developed through the interpretation of a time series of high-resolution imagery spanning a period within ±365 days of the start and end dates of the HRP. For the primary imagery dataset, a spatial resolution of 10 m or finer must be used for all time periods. Where suitable/usable images are not available, the time series may be supplemented with imagery from a wider time range or of a coarser spatial resolution to help interpret observations. Maps may be employed in the design of efficient sampling strategies. Other data sources, such as airborne and spaceborne active and passive remote sensing, and ground observation, may also be used to supplement the interpreters' observation of high-resolution imagery. Imagery should be orthorectified to minimize the effect of spatial error between images from different acquisition dates or terrain distortions.

### Data Collection

Visual interpretation is used to assign each sample unit to a change or non-change classification. Where a stratified sampling design is employed, each sample plot observation is recorded with reference to the sampling stratum in which the sample plot is located.

Detailed procedures for quality management during the interpretation process must be formulated and described in the Standard Operating Procedures for Sample Plot Interpretation. Typically, these procedures will include cross-validation among interpreters, at least for a subset of sample units assessed by all interpreters, and rules for dealing with disagreements on class identification between analysts. Such SOPs will vary by jurisdiction and AD collection instance but must include:

1) Sample plot design and spatial plot allocation to the sampling frame;
2) Data sourcing and pre-processing;
3) Visual interpretation of forest and non-forest land covers;
4) Recording dates of imagery collection;
5) Description of the jurisdiction-specific characteristics of large-scale planned deforestation, and associated interpretation guidance;

6) Guidance for assessing whether observed deforestation is likely to have occurred on land already in an established management system involving clearing and replanting of trees on a short (less than 10 years) cycle;

7) Minimum qualifications of analysts, including familiarity with jurisdiction-specific land cover interpretation; and

8) Cross-checks among analysts, recording of analyst certainty around each plot interpretation and rules for resolving disagreements.

Where deforestation is observed in plots, assess whether the deforestation meets either of the following two conditions:

a) Likely occurred on land already in an established management system involving clearing and replanting of trees on a short (less than 10 years) cycle.

   i) Where the deforestation event likely meets the criteria for identified exclusion – commercial plantation, it should be delineated and added to the map of identified exclusions. Such plots are eliminated from the sampling design.

   ii) Where the deforestation event does not meet the criteria for identified exclusion – commercial plantation, the plot should be considered non-forest at the start of the HRP and the associated change category for that plot recorded accordingly. Examples of land use categories that may meet this condition, depending on the context of a jurisdiction, include but are not limited to smallholder wood lots, agroforestry, tree crops, and agricultural fallows.

b) Occurred as part of a large-scale deforestation event. Where the deforestation observation is located within a larger deforestation event of 100 contiguous hectares or more, and where that deforestation event appears likely to be by a single agent (as opposed to an aggregation of many small-scale agents), the analyst must make the following determination:

   i) Where the deforestation event is unambiguously large-scale planned deforestation (unambiguously meeting the VCS definition of planned deforestation and exceeding 100 contiguous hectares[25]), it should be spatially delineated and added to the map of identified exclusions (identified exclusion – planned deforestation or identified exclusion – planned infrastructure). Such plots are eliminated from the sampling design.

   ii) Where the deforestation event does not unambiguously meet the definition of planned deforestation, the plot observation should be recorded as change category deforestation. An additional record must be made for such plots identifying them as "large-scale deforestation."

[25] To guide this step, a description of the jurisdiction-specific characteristics of planned deforestation must be developed and documented in the SOP for Sample Plot Interpretation. The analyst should consider the local context and apply a jurisdiction-specific decision tree for identifying planned and unplanned deforestation.

## Data Analysis

The sample-based approach produces counts of observations of sample units within each sampling stratum.

Such sample unit counts are denominated as $CountJ_{CHC,ss}$ for the change categories (*CHC*) of deforestation, regrowth, stable forest, and stable non-forest in the SS sampling strata. The counts of classified sample units must be summarized following the format in Table 12.

**Table 12: Format for recording plot observations, with reference to associated parameter names**

| | | Change Categories (*CHC*) | | | | |
|---|---|---|---|---|---|---|
| | | Deforestation | Stable Forest | Stable Non-Forest | Regrowth | *ss* Total |
| Sampling Stratum (*SS*) | ss = 1 | $CountJ_{deforestation,ss=1}$ | $CountJ_{stable\text{-}forest,ss=1}$ | … | … | $CountJ_{ss=1}$ |
| | ss = 2 | $CountJ_{deforestation,ss=2}$ | $CountJ_{stable\text{-}forest,ss=2}$ | … | … | $CountJ_{ss=2}$ |
| | ss = 3 | $CountJ_{deforestation,ss=3}$ | $CountJ_{stable\text{-}forest,ss=3}$ | … | … | $CountJ_{ss=SS}$ |
| | **Totals** | $CountJ_{deforestation}$ | $CountJ_{stable\text{-}forest}$ | | | [table total] |
| | **CHC totals** | $CountJ_{deforestation}$ | $CountJ_{stable\ forest}$ | … | … | $CountJ$ |

Parameters for stable non-forest and forest regrowth follow the pattern of deforestation in Table 12 but are omitted for space.

The count of sample unit observations made in each sampling stratum ss is denoted as $CountJ_{ss}$.

Sampling stratum weights $ws_{ss}$ must be calculated for the 1, 2, 3, …, SS strata by dividing the mapped area of each sampling stratum ($AJ_{ss}$) by the total area of the jurisdiction ($AJ$). Because sampling strata are only defined for the sampling frame, $AJ_{ss}$ should not include any areas from the jurisdiction with an identified exclusion (Table 13).

**Table 13: Calculation of sample stratum weights**

| Sampling stratum (*ss*) | Sampling stratum area (hectares) | Stratum weight (ratio) |
|---|---|---|
| Stratum 1 | $AJ_{ss=1}$ | $ws_{ss=1} = AJ_{ss=1} / AJ$ |
| Stratum 2 | $AJ_{ss=2}$ | $ws_{ss=2} = AJ_{ss=2} / AJ$ |
| Stratum SS | $AJ_{ss=SS}$ | $ws_{ss=SS} = AJ_{ss=SS} / AJ$ |

Sample strata weights ($ws_{ss}$) sum to one minus the fraction of the jurisdiction covered by identified exclusions.

The counts of sample units observed within each sampling stratum ($CountJ_{ss}$), counts of sample units classified as deforestation, stable forest, stable non-forest, and regrowth ($CountJ_{UDef,ss}$, $CountJ_{SF,ss}$, $CountJ_{SNF,ss}$, $CountJ_{Reg,ss}$) and the strata weights ($ws_{ss}$) are used to estimate the proportion of the jurisdiction classified as deforestation, stable forest, stable non-forest, and regrowth ($PropJ_{UDef,ss}$, $PropJ_{SF,ss}$, $PropJ_{SNF,ss}$, $PropJ_{Reg,ss}$). For each stratum weight, area proportions must be calculated by multiplying by the stratum weight and dividing by the total count for the respective stratum, as follows:

$$PropJ_{CHC,ss} = ws_{ss} \times \frac{CountJ_{CHC,ss}}{CountJ_{ss}} \quad (65)$$

Where:

$PropJ_{CHC,ss}$ = Weighted proportion of *AJ* that falls into sampling stratum ss and is classified as change category *CHC* (dimensionless)

$ws_{ss}$ = Weight of sampling stratum ss (dimensionless)

$CountJ_{CHC,ss}$ = Total count of sample units that fall into sampling stratum ss and change category *CHC* (sample units)

$CountJ_{ss}$ = Total count of sample units in stratum ss (sample units)

*CHC* = Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg)

ss = 1, 2, 3, …, SS sampling stratum

The resulting proportions must be summarized as illustrated in Table 14.

**Table 14: Format for recording estimated jurisdictional proportions, with reference to associated parameter names**

| Strata (*ss*) | Change Categories (*CHC*) | | | Stratum total |
|---|---|---|---|---|
| | Change Category 1 (e.g., deforestation) | Change Category 2 (e.g., stable forest) | Change Category | |
| Stratum 1 | $PropJ_{CHC=1,ss=1}$ | $PropJ_{CHC=2,ss=1}$ | … | $WS_{ss=1}$ |
| Stratum 2 | $PropJ_{CHC=1,ss=2}$ | $PropJ_{CHC=2,ss=2}$ | … | $WS_{ss=2}$ |
| Stratum SS | $PropJ_{CHC=1,ss=SS}$ | $PropJ_{CHC=2,ss=SS}$ | … | $WS_{ss=SS}$ |
| **CHC total** | $PropJ_{CHC=1}$ | $PropJ_{CHC=2}$ | … | |

Parameters for stable non-forest and forest regrowth follow the pattern of deforestation and stable forest in Table 14, but are omitted for space.

### Step 2: Calculate the Total Historical Area of Each Change Category

Estimate the area within the jurisdiction classified in each change category using the column totals for the proportions estimated in Table 14, summing across sampling strata and change categories as follows:

$$AJ_{CHC} = \sum_{ss=1}^{SS} PropJ_{CHC,ss} \times AJ \quad (66)$$

Where:

$AJ_{CHC}$ = Area of the jurisdiction classified as change category *CHC*[26] over the HRP (ha)

$PropJ_{CHC,ss}$ = Weighted proportion of *AJ* that falls into sampling stratum ss and is classified as change category *CHC* (dimensionless)

*AJ* = Area of the jurisdiction (ha)

*CHC* = Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg)

ss = 1, 2, 3, …, SS sampling stratum

A conservative discount should be applied to the estimated areas of historical deforestation based on their assessed uncertainty (see Steps 3–4 below).

### Step 3: Calculate the Uncertainty of Estimated Historical Areas of Each Change Category

Calculate the standard error of the proportions and areas:

$$S(PropJ_{CHC}) = \sqrt{\sum_{ss=1}^{SS} \frac{ws_{ss}^{2} \times \frac{CountJ_{CHC,ss}}{CountJ_{ss}} \times \left(1 - \frac{CountJ_{CHC,ss}}{CountJ_{ss}}\right)}{CountJ_{ss} - 1}} \quad (67)$$

$$S(AJ_{CHC}) = S(PropJ_{CHC}) \times AJ \quad (68)$$

Where:

$S(PropJ_{CHC})$ = Standard error of the proportion of *AJ* in change category *CHC* (dimensionless)

$PropJ_{CHC}$ = Proportion of *AJ* in change category *CHC* (dimensionless)

$ws_{ss}$ = Weight of sampling stratum ss (dimensionless)

[26] Represents the parameter associated with each change category i.e., $AJ_{UDef}$, $AJ_{SF}$, $AJ_{SNF}$, and $AJ_{Reg}$.

| | | |
|---|---|---|
| $CountJ_{CHC,ss}$ | = | Total count of sample units that fall into sampling stratum ss and change category *CHC* (sample units) |
| $CountJ_{ss}$ | = | Total count of sample units in stratum ss (sample units) |
| $AJ_{CHC}$ | = | Area of jurisdiction classified as change category *CHC* over the HRP (ha) |
| $S(AJ_{CHC})$ | = | Standard error of the area with change category *CHC* (ha) |
| *AJ* | = | Area of the jurisdiction (ha) |
| *CHC* | = | Change category: unplanned deforestation (UDef), stable forest (SF), stable non-forest (SNF), regrowth (Reg) |
| ss | = | 1, 2, 3, …, SS sampling stratum |

The remaining steps in this section (A1.4.1) are shown for the change category (*CHC*) of unplanned deforestation (UDef). All remaining equations express a UDef subscript in place of *CHC*, and may be understood as *CHC* = UDef.

Calculate the percentage uncertainty of the estimated area. The percentage uncertainty is defined as the half-width of the two-sided 90 percent confidence interval, expressed as a percentage of the estimated area.

$$U\%\left(AJ_{UDef}\right) = t_{alpha=10\%} \times \frac{S\left(AJ_{UDef}\right)}{AJ_{UDef}} \times 100\% \quad (69)$$

Where:

| | | |
|---|---|---|
| $U\%(AJ_{UDef})$ | = | Percentage uncertainty of the estimated area of unplanned deforestation (where *CHC* = UDef) within the jurisdiction over the HRP (%) |
| $S(AJ_{UDef})$ | = | Standard error of the estimated area of unplanned deforestation (where *CHC* = UDef) within the jurisdiction over the HRP (ha) |
| $AJ_{UDef}$ | = | Undiscounted area of change category (*CHC*) unplanned deforestation within the jurisdiction over the HRP (ha) |
| $t_{alpha=10\%}$ | = | Value of the t distribution for a two-sided 90 percent confidence interval (a value of 1.6449 may be used for AD analyses) |

### Step 4: Conservatively Discount the Estimated Area of Historical Unplanned Deforestation

The estimated historical area of unplanned deforestation is discounted based on its uncertainty level. Where the percentage uncertainty of the estimated transition area is less than or equal to 10 percent, the estimate is used without modification and the discount factor is zero. Estimates with uncertainty levels above 20 percent are not admissible. Where the percentage uncertainty is between 10 percent and 20 percent, the area estimate must be scaled down by discount factor *DF*.

The discount factor *DF* is calculated as follows:

$$DF_{UDef} = \frac{U\%(AJ_{UDef})}{100 \times t_{alpha=10\%}} \times t_{alpha=66.67\%} \quad (70)$$

Where:

| | | |
|---|---|---|
| $DF_{UDef}$ | = | Discount factor for unplanned deforestation (%) |
| $U\%(AJ_{UDef})$ | = | Percentage uncertainty of the estimated area of unplanned deforestation (where *CHC* = UDef) within the jurisdiction over the HRP (%) |
| $t_{alpha=10\%}$ | = | Value of the t distribution for a two-sided 90 percent confidence interval (a value 1.6449 may be used for AD analyses) |
| $t_{alpha=66.67\%}$ | = | Value of the t distribution for a one-sided 66.67% confidence interval (a value of 0.4307 may be used for AD analyses) |

Using the estimated area and the discount factors, calculate the final AD values:

$$AJc_{UDef} = AJ_{UDef} \times (1 - DF_{UDef}) \quad (71)$$

Where:

| | | |
|---|---|---|
| $AJc_{UDef}$ | = | Area of unplanned deforestation within the jurisdiction over the HRP, conservatively discounted for uncertainty (ha) |
| $AJ_{UDef}$ | = | Undiscounted area of change category (*CHC*) unplanned deforestation (UDef) within the jurisdiction over the HRP (ha) |
| $DF_{UDef}$ | = | Discount factor for unplanned deforestation (%) |

### A1.4.2 Determine the Jurisdictional AD for Unplanned Deforestation

Areas of change are annualized by dividing the area experiencing change by the number of years elapsed from the start to the end date of the HRP.

The timespan between the start and end of the HRP must be based on the average acquisition dates of the images used to generate observations (or dates of field observations) and must be consistent with the start and end date reported in the *AD Baseline Allocation Report*.

Alignment between the BVP and the HRP is ensured as follows:

1) The HRP end date ($HRP_{end}$) must differ by no more than one year from the start date of the BVP; or

2) The historical period calculated as the difference between $HRP_{start}$ and $HRP_{end}$ must not be shorter or longer than half a year (i.e., ±6 months) from the nominal length of the HRP.

Where it is not possible to meet either of these conditions due to data availability, Verra must determine which criterion will be modified.

$$HRP_{start} = \sum_{ss=1}^{SS} \left( \frac{\sum_{s=1}^{S} t_{start,ss,s}}{CountJ_{ss}} \times ws_{ss} \right) \quad (72)$$

$$HRP_{end} = \sum_{ss=1}^{SS} \left( \frac{\sum_{s=1}^{S} t_{end,ss,s}}{CountJ_{ss}} \times ws_{ss} \right) \quad (73)$$

Where:

$HRP_{start}$ = Area-weighted average date of imagery used for interpretation of sample plots at the start of the HRP (decimal year)

$HRP_{end}$ = Area-weighted average date of imagery used for interpretation of sample plots at the end of the HRP (decimal year)

$t_{start,ss,s}$ = Acquisition date of image for sample s in sampling stratum ss at start of the HRP (decimal year)

$t_{end,ss,s}$ = Acquisition date of image for sample s in sampling stratum ss at end of the HRP (decimal year)

$CountJ_{ss}$ = Total count of sample units in stratum ss (sample units)

$ws_{ss}$ = Weight of sampling stratum ss (dimensionless)

ss = 1, 2, 3, …, SS sampling stratum

s = 1, 2, 3, …, S sample unit

The estimated area of unplanned deforestation in the jurisdiction, conservatively discounted for uncertainty, is annualized by dividing by the number of years elapsed from the start to the end date of the HRP:

$$Annualized\ AJc_{UDef} = \frac{AJc_{UDef}}{HRP_{end} - HRP_{start}} \quad (74)$$

Where:

*Annualized* $AJc_{UDef}$ = Average annual area of unplanned deforestation within the jurisdiction over the HRP, conservatively discounted for uncertainty (ha)

$AJc_{UDef}$ = Area of unplanned deforestation within the jurisdiction over the HRP, conservatively discounted for uncertainty (ha)

$HRP_{end}$ = Area-weighted average date of imagery used for interpretation of sample plots at the end of the HRP (decimal year)

$HRP_{start}$ = Area-weighted average date of imagery used for interpretation of sample plots at the start of the HRP (decimal year)

### A1.4.3 Allocate Jurisdictional Baseline AD for Unplanned Deforestation to PA and LB

The annualized jurisdictional AD is spatially distributed across the jurisdiction according to the risk of deforestation so that areas of high risk receive a higher allocation than areas of low risk. Therefore, a deforestation risk map must be constructed by applying *VT0007*. This procedure requires an FCBM as input. Once the deforestation risk map is constructed and the AD is determined, *VT0007* is used to allocate portions of the jurisdictional AD to the UDef PA and UDef LB based on the projected deforestation within these areas. The projected deforestation is then summed for each forest stratum and the per forest stratum AD multiplied with the corresponding average emission factors to calculate the emission baseline for unplanned deforestation in the UDef PA and UDef LB.

This entire process comprises the following steps, summarized below. Step 1 is fully described here. Steps 2–3 are described but require application of *VT0007*. Steps 4–7 are listed here for reference but are fully described in Section 5.3.3; they are completed by the project proponent.

Undertaken by Verra:

Step 1. Create a jurisdictional FCBM for the HRP.

Step 2. Using *VT0007*, for areas of stable forest that exist at the end date of the HRP, predict deforestation risk.

Step 3. Using *VT0007*, quantify deforestation risk as projected deforestation per pixel; adjust projected deforestation to match total derived from jurisdictional AD baseline for unplanned deforestation, yielding the allocated risk map.

Undertaken by project proponent:

Step 4. Stratify the area of stable forest at the end of the HRP in the UDef PA and UDef LB per project-developed forest stratum (see Section 5.3.2.1).

Step 5. Sum the AD for the BVP for each forest stratum within the UDef PA and UDef LB (see Section 5.3.2.2)

Step 6. Estimate average emission factors per forest stratum within the UDef PA and UDef LB (see Section 5.3.2.3, Steps 1–5).

Step 7. Determine the baseline for unplanned deforestation in the UDef PA and UDef LB by multiplying the allocated portions of the AD within the BVP per forest stratum by their corresponding emission factors (see Section 5.3.2.3, Step 6 and Section 5.3.2.5).

## Step 1: Construct Jurisdictional Forest Cover Benchmark Map

### Conduct Jurisdictional Mapping

Verra will construct a jurisdictional raster FCBM covering the jurisdictional area, plus a buffer of at least 10 km outside the boundary of the jurisdiction (excluding areas outside of the national borders and areas mapped as identified exclusions), which is needed for using *VT0007*.

The FCBM is a single map that is constructed by first mapping the presence or absence of forests at the start, mid-point, and end of the HRP, resulting in the eight unique combinations or forest transitions listed in Table 15.

The eight transitions are summarized into four simplified categories (stable non-forest, stable forest, deforestation in the first half of the HRP, and deforestation in the second half of the HRP) for use with *VT0007* as follows:

- Areas mapped as non-forest at the start of the HRP are considered stable non-forest, regardless of subsequent land cover.
- Areas mapped as forest for all three periods are considered as stable forest.
- Areas mapped as forest at the start of the HRP and non-forest at the midpoint of the HRP are considered deforested in the first half of the HRP, regardless of subsequent land cover.
- Areas mapped as forest at the start and midpoint of the HRP and non-forest at the end of the HRP are considered deforested in the second half of the HRP.

The minimum mapping unit of the FCBM must match the minimum area threshold of the forest definition. For the primary imagery dataset, a spatial resolution of 30 m or finer must be used for all time periods. The spatial resolution of the FCBM raster file must match the spatial resolution of the primary imagery dataset and must not exceed 30 m.

**Table 15: Interpretation of FCBM into simplified classes for use in *VT0007***

| HRP Start Year Forest | HRP Midpoint Forest | HRP End Year Forest | Forest Transition Values | Interpreted Classes for Use in *VT0007* | Class Key for Use in *VT0007* |
|---|---|---|---|---|---|
| No | No | No | 1 | 1 | Stable non-forest |
| No | No | Yes | 2 | 1 | Stable non-forest |
| No | Yes | No | 3 | 1 | Stable non-forest |
| No | Yes | Yes | 4 | 1 | Stable non-forest |
| Yes | Yes | Yes | 5 | 2 | Stable forest |
| Yes | No | No | 6 | 3 | Deforested in first half of HRP |

| | | | | | |
|---|---|---|---|---|---|
| Yes | No | Yes | 7 | 3 | Deforested in first half of HRP |
| Yes | Yes | No | 8 | 4 | Deforested in second half of HRP |

### Accuracy Assessment of the Jurisdictional FCBM

The accuracy of areas of the jurisdictional FCBM ($FCBM_j$) must be assessed by comparison against sample-based observations. The assessment includes user's and producer's accuracies, understood as follows:

- **User's accuracy**: For a mapped class, the estimated proportion of the mapped class's area that correctly depicts actual land cover or land use.
- **Producer's accuracy**: For an actual land cover or land use class, the estimated proportion of that land cover or land use class's area that is assigned the correct mapped class.

Two components of accuracy must be assessed:

1) **Deforestation between the start and end of the HRP**: the user's and producer's accuracies must each be 70 percent or greater for areas mapped as deforestation over the HRP.
2) **Forest at the end of the HRP:** user's and producer's accuracies must each be greater than 90 percent for areas mapped as forest at the end of the HRP.

Where it is demonstrated that 50 percent or more of the forest area of the jurisdiction has a canopy cover of less than 50 percent, the following accuracy standards may be applied:

a) **Deforestation between the start and end of the HRP:** the user's and producer's accuracies must each be 60 percent or greater for areas mapped as deforestation over the HRP.
b) **Forest at the end of the HRP:** user's and producer's accuracies must each be greater than 80 percent for areas mapped as forest at the end of the HRP.

The eight forest transition values are summarized as three simplified categories for FCBM accuracy assessments: (1) non-forest at the end of the HRP, (2) forest at the end of the HRP, and (3) deforested within the HRP (Table 16).

**Table 16: Interpretation of FCBM into simplified classes for accuracy assessment**

| HRP Start Year Forest | HRP Midpoint Forest | HRP End Year Forest | Forest Transition Values | Interpreted Classes for Accuracy Assessment | Class Key for FCBM Accuracy Assessment |
|---|---|---|---|---|---|
| No | No | No | 1 | 1 | Non-forest at end of HRP |
| No | No | Yes | 2 | 2 | Forest at end of HRP |
| No | Yes | No | 3 | 1 | Non-forest remaining non-forest |

| HRP Start Year Forest | HRP Midpoint Forest | HRP End Year Forest | Forest Transition Values | Interpreted Classes for Accuracy Assessment | Class Key for FCBM Accuracy Assessment |
|---|---|---|---|---|---|
| No | Yes | Yes | 4 | 2 | Forest at end of HRP |
| Yes | Yes | Yes | 5 | 2 | Forest at end of HRP |
| Yes | No | No | 6 | 3 | Deforested within HRP |
| Yes | No | Yes | 7 | 3 | Deforested within HRP |
| Yes | Yes | No | 8 | 3 | Deforested within HRP |

Accuracy assessment observations must follow the same protocol for imagery interpretation used in AD development.

To assess the accuracy of the two main classes (area of deforestation over the HRP and area of forest at end of the HRP), a minimum of 100 sample observations should be made of the target and non-target classes (totaling a minimum of 200 observations per estimate). Observations should be spatially representative of the entire FCBM. A single observation may be used to inform both estimates.

The sample-based observations used for this accuracy assessment incorporate some of the sample observations collected for AD development. Additional sample observations may be taken to ensure that mapped classes reach the minimum required number or to achieve spatial representativeness of the $FCBM_j$.

### Where Relevant, Integrate Project FCBMs into Jurisdictional FCBMs

During the development of the $FCBM_j$, all proponents of projects either currently active or in the VCS pipeline and anticipating validation within the BVP are allowed to submit project-specific FCBM ($FCBM_p$) encompassing the UDef PAs and UDef LBs associated with the same periods for which the jurisdictional FCBM is being developed.

For each $FCBM_p$ submission, the following assessment is undertaken:

1) The accuracy of each submitted $FCBM_p$ must be assessed using the same accuracy criteria and minimum sampling size as those applied to the $FCBM_j$, and using the same SOP for image interpretation used to develop jurisdictional AD. Where the mapped area of deforestation in an $FCBM_p$ is not sufficiently large to accommodate 100 sample points, the sample size may be reduced such that all sample points are delineated without overlapping one another.

2) Simultaneously, accuracy of the jurisdictional FCBM within the spatial boundaries of the $FCBM_p$ must be assessed using the same sample.

3) Where the $FCBM_p$ is shown to provide substantially more accurate estimates of the two main classes (area of deforestation over the HRP and area of forest at the end of the HRP) than the jurisdictional FCBM, the $FCBM_p$ must replace the portions of the jurisdictional FCBM with which it intersects. "Substantially more accurate" is defined in this assessment as meeting both of the following conditions:

    a) The average of the user's and producer's accuracies of the forest area at the end of the HRP, as calculated from the $FCBM_p$, is greater by at least five percent than the same average calculated from the same spatial extent of the jurisdictional FCBM; and

    b) The average of the user's and producer's accuracies of the area of deforestation over the HRP, as calculated from the $FCBM_p$, is greater by at least five percent than the same average calculated from the same spatial extent of the jurisdictional FCBM.

    For example, where the jurisdictional FCBM, when assessed strictly within the boundaries of the $FCBM_p$, is found to have average user's and producer's accuracies of 65 percent, the $FCBM_p$ must achieve average accuracies of 70 percent or greater to be incorporated. Note that the $FCBM_p$ accuracies are not compared to accuracies for the entire jurisdictional FCBM, but only to those areas of the jurisdictional FCBM that overlap spatially with the $FCBM_p$.

6) An $FCBM_p$ meeting conditions a) and b) must be incorporated directly into the $FCBM_j$ by replacing any mapped values with those depicted on the $FCBM_p$. An $FCBM_p$ failing either condition a) or b) must not be incorporated directly into the jurisdictional FCBM. After all $FCBM_p$ have been assessed and any potential modifications to the jurisdictional FCBM have been made, the resulting modified map retains the name "jurisdictional FCBM." Projects wishing to submit $FCBM_p$ after a jurisdictional FCBM has been validated must wait until the commencement of data development for the subsequent BVP.

### Reassign AD for Areas within Identified Exclusions

The final jurisdictional FCBM is subjected to a final adjustment to reassign specific AD that fall within areas mapped as identified exclusions. Any deforestation in identified exclusion areas (mapped as a forest to non-forest transition – interpreted classes 3 and 4 in Table 15) in the final jurisdictional FCBM are reassigned to stable non-forest. This reassignment ensures that these forest clearings are not used to inform the risk modeling of unplanned deforestation. The reassignment of classes of the FCBM is depicted in Table 17.

**Table 17: Reassignment of FCBM class prior to application within *VT0007***

| Area Mapped as Identified Exclusion | Identified Exclusion Category | Included in Jurisdictional Sampling Frame | Include in FCBM | Interpreted Classes for Use in Risk Mapping (from Table 15) | Reassignment of Class for Use in Risk Mapping | Assigned Risk Value |
|---|---|---|---|---|---|---|
| Yes | Active commercial plantations<br>Intertidal zone | No | Yes | 1 – Stable non-forest | 1 – Stable non-forest | N/A |
| | | | | 2 – Stable forest | 2 – Stable forest | N/A |
| | | | | 3 – Deforested in first half of HRP | 1 – Stable non-forest | N/A |
| | | | | 4 – Deforested in second half of HRP | | |
| | Deforestation by infrequent, large-scale natural disturbances<br>Deforestation by large-scale infrastructure | No | Yes | 3 – Deforested in first half of HRP | 1 – Stable non-forest | N/A |
| | | | | 4 – Deforested in second half of HRP | | |
| | Permanent bodies of water | No | Yes | 1 – Stable non-forest | 1 – Stable non-forest | N/A |
| No | N/A | Yes | Yes | Per Table 15 | No reassignment | As modeled by *VT0007* |

## Step 2: Develop a Jurisdictional Deforestation Risk Map

A jurisdictional deforestation risk map – a digital map covering the extent of the jurisdiction that indicates, for every location mapped as forest, the quantified risk of undergoing deforestation during the BVP – must be developed by employing the most recent approved version of *VT0007* and the $FCBM_j$ resulting from Step 1. The resulting risk map assigns a projected deforestation density in hectares to each location mapped as stable forest in the final jurisdictional $FCBM_j$. The quantity of projected deforestation in the risk map is adjusted to match the projected jurisdictional baseline AD for unplanned deforestation during the BVP. Because the risk values are expressed as projected deforestation densities and adjusted to match the baseline AD, they are referred to as allocated risk values. This is because each risk value represents a proportion of the total observed deforestation as determined by the AD.

Before adjusting the quantity, the risk map is modified by changing the risk values assigned to stable forest areas within identified exclusion zones. These forests are masked to ensure that no AD is allocated to forests that are not eligible for avoiding unplanned deforestation projects and were not sampled to generate UDef AD.

## Step 3: Allocate Projected AD to the UDef PA and UDef LB

The most recent approved version of *VT0007* must be used to allocate portions of the AD over the BVP to the PAs and LBs of all existing VCS registered projects, projects in the VCS pipeline and any other planned projects for which the proponent has applied for a baseline AD allocation for unplanned deforestation.

The application of *VT0007* will require the following:

1) Digital map of jurisdictional boundaries;
2) FCBMs ($FCBM_j$);
3) Digital maps of PAs and LBs; and
4) Jurisdictional deforestation risk map.

### AD Baseline Allocation to UDef PAs and UDef LBs

Application of *VT0007* generates a map of allocated risk expressed in per annum densities of projected deforestation (ha/pixel/year). To calculate the portion of the jurisdictional AD baseline for the UDef PA and the UDef LB, sum the allocated risk pixels within each respective area.

Baseline AD allocations to UDef PA and UDef LB are termed $AD_{PA,UDef}$ and $AD_{LB,UDef}$.

Where:

$AD_{PA,UDef}$ = Portion of the jurisdictional UDef AD baseline allocated to the UDef PA (ha)
$AD_{LB,UDef}$ = Portion of the jurisdictional UDef AD baseline allocated to the UDef LB (ha)

UDef LBs must not extend beyond national boundaries.

Where a portion of a UDef LB extends beyond the boundary of the jurisdiction into another part of the country, AD are allocated to that portion of the UDef LB as follows:

- Where the portion of the UDef LB outside of the jurisdiction falls into a separate VCS avoiding unplanned deforestation jurisdiction from that to which the associated project belongs, that portion receives its AD allocation from the adjoining jurisdiction's most recent jurisdictional deforestation risk map and AD. Where the adjoining VCS avoiding unplanned deforestation jurisdiction's BVP ends prior to the end of the project jurisdiction's BVP, AD is allocated until the end of the project jurisdiction's associated BVP by assuming that the annualized AD allocation for the remaining years of the adjoining jurisdiction's BVP continues until the end of the project jurisdiction's BVP.
- Where the portion of the UDef LB outside of the jurisdiction does not fall into a separate VCS avoiding unplanned deforestation jurisdiction, then a separate risk value - "extra-jurisdictional" *exJ* - is defined to encompass this portion.

AD allocation is calculated as follows:

$$AD_{LB,UDef,exJ} = \frac{A_{LB,UDef,exJ}}{A_{LB,UDef} - A_{LB,UDef,exJ}} \times AD_{LB,UDef} \quad (75)$$

Where:

$AD_{LB,UDef,exJ}$ = UDef AD baseline allocated to UDef LB with risk value *exJ* (ha)

$A_{LB,UDef}$ = Area of the UDef LB (ha)

$A_{LB,UDef,exJ}$ = Area of the UDef LB with risk value *exJ* (ha)

$AD_{LB,UDef}$ = Portion of the jurisdictional UDef AD baseline allocated to the UDef LB (ha)

## Delivery of Data to Project Proponents in *AD Baseline Allocation Report*

AD will be provided to project proponents by Verra as a part of the *AD Baseline Allocation Report*, including:

1) UDef AD allocated to the UDef PA ($AD_{PA\text{-}UDef}$)
2) UDef AD allocated to the UDef LB ($AD_{LB\text{-}UDef}$)
3) The portions of the jurisdictional FCBM intersecting the UDef PA and UDef LB; and
4) The portions of the jurisdictional deforestation risk map intersecting the UDef PA and UDef LB.

## A1.5 Updating the AD Baseline Allocation Report

The *AD Baseline Allocation Report* must be updated and revalidated prior to the start date of each subsequent BVP. Each updated *AD Baseline Allocation Report* will represent a new BVP.

Where compatible with the most recent version of this module, the updated *AD Baseline Allocation Report* must employ the same methods as those used in the initial *AD Baseline Allocation Report*, updated where needed (e.g., to enable the use of new satellite data sources).

# APPENDIX 2: DEVELOPMENT OF JURISDICTIONAL DATA ON ACTIVITY SHIFTING BY GEOGRAPHICALLY MOBILE AGENTS FOR PROJECT LEAKAGE ESTIMATES

*Note – these activities are undertaken by Verra at the start of each BVP.*

Verra will estimate emissions from deforestation outside the UDef LB using a single emission factor encompassing all lands available for conversion to agricultural land use within the national extent. This emission factor is approximated using area-weighted carbon stocks of all lands in the national extent, forested and non-forested, that are assessed to be all of the following:

a) Physically accessible to geographically mobile deforestation agents;

b) Suitable for agriculture; and

c) Unprotected.

The following general steps are described in this section.

1. Spatially delineate all lands in the national extent that are physically accessible to agents, suitable for agriculture, and unprotected.
2. Develop an area-weighted emission factor for activity shifting to outside the UDef LB.

## A2.1 Step 1: Spatially Delineate Land Available for Activity Shifting Outside the UDef PA and UDef LB

The area of forest and non-forest land within the jurisdictional boundaries that is available for leakage due to geographically mobile actors is determined by the spatial distribution of the following factors:

1) Suitability of land for agriculture;

2) Physical accessibility; and

3) Relative protection status.

Jurisdictional maps portraying each of these three factors must be constructed.

### Suitability of Land for Agriculture

Using peer-reviewed and accuracy-assessed map-based sources, delineate the area of potentially arable land as follows. Lands currently managed under agricultural crop production must be excluded. All temperate and tropical natural forests are considered potentially arable excluding all areas with a slope in excess of 10 percent as well as forests on serpentine and flooded soils.

Other natural vegetation types such as grassland, shrubland, savanna, bushland, and wetlands should also be considered potentially arable. Areas of natural vegetation that are unsupportive of agriculture due to reasons such as insufficient precipitation should be excluded from the estimation of potentially arable non-forest land. A minimum threshold of mean annual precipitation for rain-fed agriculture in the jurisdiction should be established and a map of mean annual precipitation should be used to conduct this analysis.

The output of this analysis is a digital map of potentially arable land with all lands indicated to be either "potentially arable" or "not potentially arable."

### Physical Accessibility

Potentially arable land must be physically accessible to transportation networks to be eligible for leakage due to geographically mobile actors. Physically accessible land is defined here as all potentially arable land within 10 km of an existing road.

The output of this analysis is a digital map of physically accessible land with all lands indicated to be either "accessible" or "inaccessible."

### Relative Protection Status

The protection status of land limits its availability for migration. This module recognizes that the effective level of protection is often lower than the intended management objective due to lack of enforcement, allowance of certain economic activities or land tenure conflict. "Protection" in this context does not pertain only to state-protected conservation lands, but also to areas such as timber concessions and large privately held forests and non-forested land in which activities to exclude migrant settlement would typically be undertaken.

Protected lands should be considered to include all protected forests falling in IUCN categories I, II, and III, all currently managed timber concessions and all existing UDef PAs and UDef LBs associated with projects that have been validated or verified in the past five years.

The output of this analysis is a digital map of protection status with all lands assigned to be either "protected" or "unprotected."

The digital maps of potentially arable land, physically accessible land, and protection status are combined into a single map. Lands indicated as "not potentially arable," "inaccessible," or "protected" are considered "unavailable." All remaining lands are classified as "available."

The output of this analysis is a digital map of land available for activity shifting.

$A_{available}$ is then the calculated area of "available" land.

## A2.2 Step 2: Develop Area-Weighted Emission Factor for Activity Shifting to Outside the UDef LB

Emissions factors for lands subjected to activity shifting are estimated by conservatively assuming that activity shifting results in long-term agricultural land use.

For simplicity, the emission factor will represent the area-weighted carbon stock of available forests in the aboveground (AB) and belowground (BB) pools.

A carbon stratification map must be sourced to conduct a spatial overlay to identify the area of each jurisdictional carbon stratum that falls within the "available" category.

The carbon stratification map must be sourced from peer-reviewed forest carbon stock maps with consistent coverage of the jurisdiction. Overlaying the maps of "available" arable lands on the carbon stock maps will allow derivation of the average stock across all relevant pixels. Where this stock is aboveground biomass only, belowground biomass should be added with a root-to-shoot ratio sourced from *IPCC Guidelines for National Greenhouse Gas Inventories*.

The output is a jurisdictional emission factor due to land cover transition in areas available for activity shifting outside the UDef LB expressed as:

$\Delta C_{OLB}$ = Emissions from carbon stock change due to land cover transition in areas available for activity shifting outside the UDef LB (t $CO_2e$/ha)

The jurisdictional emission factor due to land cover transition in areas available for activity shifting outside the UDef LB will be estimated for each BVP and will be specified in the *AD Baseline Allocation Report*.

# APPENDIX 3: THE PROJECT BASELINE DEVELOPMENT PROCESS

Development of an avoiding unplanned deforestation project using this methodology requires the development of an emissions baseline using Verra-allocated AD.

As described in Appendixes 1 and 2, the jurisdictional average annual unplanned deforestation rate and the jurisdictional emission factor for land cover transition in areas available for activity shifting outside the UDef LB are produced by Verra. Project proponents use the procedure described in this appendix to get AD for their project from Verra, then convert it into emission baselines using project-specific emission factors (as set out in Section 5.3.2.3).

Figure 7 illustrates the high-level process for avoiding unplanned deforestation projects applying this module. Projects must be listed or registered on the Verra Registry to request AD allocation.

**Figure 7: High-level baseline generation process**


## A3.1 AD Availability

Information about AD availability by jurisdiction is available on the Verra website. Where AD is not available for a jurisdiction where a project is planned using *VMD0055,* please contact Verra.

## A3.2 Submission of UDef AD Baseline Allocation Request

Project proponents must submit an *AD Baseline Allocation Request Form* via the Verra Project Hub to receive the data required to apply this module. The request must contain the following for each UDef PA or each project activity instance (in the case of grouped projects):

1) Project identification number;

2) Name of the UDef PA (e.g., compartment number, allotment number, local name, where relevant);

3) A KML file with geodetic polygons that precisely delineate the area where the project proponent has the legal right to control and operate project activities, as defined by the *VCS Standard*;

4) Whether this is a formal request (aimed at moving directly to validation/verification) or a due diligence request; and

5) The (anticipated) start date of the project or project activity instance.

Project proponents may request pipeline listing for a project as "under development" before or concurrently with submitting an *AD Baseline Allocation Request Form.* Where project proponents want to request data before pipeline listing, they must request to create a new project on the Verra Registry. Project proponents are encouraged to request AD allocation early in their development process. They may request pipeline listing as "under development" using estimated data in a draft project description, but must update the project description using Verra-allocated AD before requesting pipeline listing as "under validation."

For grouped projects, an *AD Baseline Allocation Request Form* must be submitted each time a project activity instance is added to the project.

## A3.3 Review of AD Baseline Allocation Requests

In reviewing the allocation request, Verra will consider the following:

1. Whether the project nests under a JNR Program:

    a) Where a project overlaps[27] fully with a program area of a registered JNR program, the project must nest according to the jurisdictional program's nesting scenario and follow the provisions of the program to establish its baseline. Unless the nesting provisions explicitly rely on Verra to allocate AD baseline, the AD baseline will be directly allocated by the jurisdictional program.[28]

    b) Where a project partially overlaps with the boundaries of a registered JNR program, point a) above must apply to the overlapping areas. Unless the nesting provisions of the JNR program rely on Verra to allocate the AD baseline, AD will be allocated by the JNR program for the overlapping areas, and by Verra for the non-overlapping areas.

[27] In this section, overlap refers to a geographical and temporal overlap. Temporal overlap means the project starts during the jurisdictional BVP.

[28] The project may still apply other portions of this methodology provided this is explicitly allowed by the JNR program.

Overlapping areas must nest under the JNR program according to the jurisdictional program's rules. Projects that partially overlap with a JNR program must be designed as "multiple project activities" and must refer to the related requirements in the most recent version of the *VCS Standard*.

c) Where a project overlaps with a JNR program in development (i.e., not yet registered), Verra will produce and allocate baseline AD for the overlapping area until the JNR program is registered, at which point projects will nest under the JNR program. The project's transition to the JNR nesting requirements is effective for the verification that follows the JNR program's registration, regardless of the number of years that are still valid under the Verra-allocated AD baseline.

2. Whether an existing jurisdictional baseline applies:

a) Where a project overlaps fully with a jurisdiction for which jurisdictional AD were previously developed by Verra, the project will receive its allocation in accordance with the previously developed data.

b) Where a project partially overlaps with a jurisdiction for which jurisdictional AD were previously developed by Verra, the project will be allocated baseline AD based on the previously developed data for the overlapping areas only. Verra will produce jurisdictional AD for the non-overlapping jurisdictions and allocate them to the relevant portion of the project.

c) Where no jurisdictional AD are available for a project, Verra will allocate jurisdictional AD to the project.

## A3.4 Process and Responsibilities for AD Baseline Allocation

### A3.4.1 Stakeholders' Contribution to Jurisdictional Products

AD baseline allocation requires Verra to produce a jurisdictional AD baseline, jurisdictional FCBM, and jurisdictional deforestation risk map. Verra will take submissions of data products for a given jurisdiction related to AD collection and risk mapping. Stakeholders may submit materials, including datasets, maps, technical guidance, recommended definitions, and SOPs. A complete description of the types of technical materials permitted for submission and the duties of the data developer in responding to them are catalogued in Appendix 4.

Forest cover benchmark map data submissions may be jurisdictional in scope or restricted to the project areas and leakage belts of existing or proposed avoiding unplanned deforestation projects.

Verra gives higher priority to the use of datasets from official government sources, such as those derived from national forest monitoring systems or REDD monitoring, reporting, and verification platforms, provided those datasets and sources meet the standards and specifications described in Appendix 4.

### A3.4.2 Production of Jurisdictional AD Baseline

Jurisdictional AD baselines are produced by Verra following the procedures and requirements set out in Appendix 1.

A request for proposals from potential DSPs in specific jurisdictions will be issued publicly. Verra will select and contract a DSP considering their technical expertise, experience in the chosen jurisdiction(s), financial offer, and ability to deliver within the pre-determined timeframe.

DSPs act as agents of Verra; therefore, the work of the DSP is referred to as Verra's throughout this module.

### A3.4.3 Development of the Jurisdictional Deforestation Risk Map

*VT0007* sets out*:*

1. The benchmark risk mapping approach; and
2. The statistical methods for comparing the performance of alternative risk maps against the benchmark risk map.

Verra will apply procedures provided in *VT0007* to develop a benchmark risk map and at least two alternative risk maps that incorporate jurisdiction-specific risk factors. The best-performing risk map will be adopted for use in the jurisdiction during the entirety of the respective BVP. Jurisdictional deforestation risk maps will be updated at the beginning of each subsequent BVP.

### A3.4.4 Expert Assessment of Jurisdictional Data

An independent expert will be contracted by Verra to assess the data and procedures used to construct the jurisdictional AD and deforestation risk map. The assessment process may require Verra to adjust the AD or risk map to ensure compliance with this methodology and associated modules and tools.

### A3.4.5 Allocation of Baseline AD to Project

Verra is responsible for allocating baseline AD to the UDef PA and UDef LB[29] using the most recent version of *VT0007*. Verra will invoice a project-specific project activity data allocation fee upon receipt of an allocation request. Data will be allocated when the fee is paid.

As described in A1.4.3 Step 3 of Appendix 1, Verra produces an *AD Baseline Allocation Report* and shares it with the stakeholder who requested baseline AD allocation. to the project's page on the Verra Registry. The *AD Baseline Allocation Report* contains the information set out in Appendix 1 Section A1.1. Using this information, projects are responsible for allocating baseline AD to each forest stratum

[29] See Sections A1.2.1 and A1.2.2 for how the UDef PA and UDef LB are delineated by Verra based on the project area KML that is provided by the project proponent when submitting the *AD Baseline Allocation Request Form*.

of the UDef PA and UDef LB as described in Section 5.3.2.2 of this module. The results must be used to assess baseline GHG emissions and must be described in the project description.

Where the boundaries of the project area are altered during the validation or the registration process (e.g., as a result of a VVB corrective action request, or as a result of Verra's accuracy review), the project proponent must request a new AD baseline allocation using the corrected project area. Verra issues a revised *AD Baseline Allocation Report* that must be used to correct the baseline GHG emissions.

The final AD Baseline Allocation Report is uploaded to the project's page on the Verra Registry once the project is registered.

# APPENDIX 4: DATA CONTRIBUTION BY STAKEHOLDERS

Verra is responsible for AD collection, risk map development, and AD allocation. Verra will contract with data service providers (DSPs) to accomplish this.

Any stakeholder may provide data products related to AD collection and risk mapping for a given jurisdiction, provided these products meet the requirements set out in Table 18 below.

As a first step in the process of AD collection, risk mapping, and allocation, Verra will make a public announcement of a request for proposals for DSPs and submissions of supplementary materials. The roles and responsibilities of stakeholders and DSPs are set out in Table 18.

**Table 18: AD data collection, risk mapping and allocation roles**

| Primary Data Product | Submissions from Project Proponents, Governments, and Other Engaged Stakeholders | Data Service Provider Responsibilities |
|---|---|---|
| Jurisdictional Boundary Definition (Appendix 1 Section A1.2.1) | Proposed definition of jurisdiction and justification | None; final decision is made by Verra |
| Unplanned Deforestation Activity Data<br>(Appendix 1 Section A1.4) | Sample plot observations representative of the jurisdiction, including those developed for national FREL and by other groups that meet the standards described in Appendix 1 for sample plot observations, covering time period and resolution of source imagery.<br>The imagery on which observations were made must be made available to the DSP to the highest degree feasible. | The DSP must evaluate these materials and incorporate them to the highest degree feasible. Any observations that meet requirements must be retained.<br>The DSP may collect additional plots to supplement national data for such purposes as reducing overall uncertainty to meet requirements and improving spatial representation of any areas not covered by national data. |
| | Supplementary materials, which may include any combination of:<br>• Working definition of forest (where adjustments from official definition are needed for practical reasons);<br>• Sample plot observations;<br>• Spatial stratification of jurisdiction; | The DSP will review all submissions and provide a response to each submission on whether and how the submission will be incorporated into the analysis plan.<br>Where submissions represent official government data, the DSP should use these data where the |

| | | |
|---|---|---|
| | • SOP for imagery interpretation;<br>• Description of the jurisdiction-specific characteristics of planned deforestation;<br>• SOP for identification of planned deforestation; and<br>• Imagery data.<br>Submissions must include a description of each item and the proposed application of the item within AD generation. | data are shown to be of at least comparable fitness for purpose as other available data sources.<br>Except in the case of official government data, DSP is not obligated to use any or all submissions in dataset generation. |
| **Maps of Identified Exclusion Areas**<br>**(Appendix 1 Section A1.4.1 Step 1)** | Maps depicting any of the identified exclusion areas (active commercial plantations; intertidal zones; infrequent, large natural disturbances; large-scale infrastructure; permanent bodies of water) | The DSP will review all submissions and provide a response to each submission on whether and how the submission will be incorporated into the analysis plan.<br>Where submissions represent official government data, the DSP should use these data where the data are shown to be of at least comparable fitness for purpose as other available data sources.<br>Except in the case of official government data, the DSP is not obligated to use any or all submissions in dataset generation. |
| **Map of Available Land for Activity Shifting**<br>**(Appendix 1 Section A2.1)** | May include any combination of:<br>• Ancillary spatial data;<br>• National carbon stock map;<br>• Map of potentially arable land;<br>• Map of protection status; and<br>• Map of accessibility.<br>Submissions must include a description of each item and the proposed application of the item to generation of the Map of Available Land for Activity Shifting. | The DSP will review all submissions and provide a response to each submission on whether and how the submission will be incorporated into the analysis plan.<br>Where submissions represent official government data, the DSP should use these data where the data are shown to be of at least comparable fitness for purpose as other available data sources.<br>Except in the case of official government data, the DSP is not obligated to use any or all submissions in dataset generation. |

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| **Forest Cover Benchmark Map**<br>**(Appendix 1 Section A1.4.3)** | May include any combination of:<br>• Description of imagery classification approach;<br>• Ancillary spatial data;<br>• Calibration and validation points;<br>• Delineation of planned deforestation areas;<br>• Remote sensing data (e.g., imagery);<br>• Land cover maps; and<br>• Project-specific FCBM ($FCBM_p$).<br>Submissions must include a description of each item, the proposed application of the item within FCBM generation and citations. | The DSP will review all submissions, including conducting an accuracy assessment on any $FCBM_p$, and provide a response to each submission on whether and how the submission will be incorporated into the analysis plan.<br>Where submissions represent official government data, the DSP should use these data where the data are shown to be of at least comparable fitness for purpose as other available data sources.<br>Except in the case of official government data, the DSP is not obligated to use any or all submissions in dataset generation. |
| **Risk Map**<br>**(*VT0007*)** | Supplementary materials, including any combination of:<br>• Description of drivers;<br>• Spatial risk factor maps; and<br>• Modeling algorithms.<br>Submissions must include a description of each item and the proposed application of the item in risk map generation. | The DSP will review all submissions and provide a response to each submission on whether and how the submission will be incorporated into the analysis plan.<br>Where submissions represent official government data, the DSP should use these data where the data are shown to be of at least comparable fitness for purpose as other available data sources.<br>Except in the case of official government data, the DSP is not obligated to use any or all submissions in dataset generation. |
| **AD Allocation (*VT0007*)**<br>**(Appendix 1 Section A1.4.3 Step 3)** | None permitted | Conducted by the DSP unless a project proponent in the jurisdiction is the DSP. In that case, allocation will be conducted by Verra. |

# DOCUMENT HISTORY

| Version | | Comment |
|---|---|---|
| v1.0 | 27 Nov 2023<br>Updated 20 Feb 2024 | Initial version<br>Revised references to *VT0007* to align with the tool's published title. Corrected reference errors. |
| V 1.1 | August 2024 | Add forest management activities (e.g., tree harvesting for timber, fiber, or fuel production) in the project scenario.<br>Fully align procedures with most recent version of *VT0007*.<br>Clarify spatial resolution and mapping requirements, mapping terminology, and the scope of the jurisdictional sampling frame.<br>Clarify the duration for which a project may use allocated activity data.<br>Correct minor editorial and typographical errors in text and some equations. |