VCS Module

VMD0009

Estimation of emissions from activity shifting for avoiding planned deforestation/forest degradation and avoiding planned wetland degradation (LK-ASP)

Version 1.3

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Sectoral Scope 14

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1 SOURCES

This module is one of numerous modules that constitute the VCS methodology *VM0007 REDD+ Methodology Framework* (*REDD+ MF*).

This module uses the latest version of the following tools and modules:

- CDM tool *Estimation of direct N_2O emissions from nitrogen application (E-NA)*
- V*MD0006 Estimation of baseline carbon stock changes and greenhouse gas emissions from planned deforestation/forest degradation and planned wetland degradation (BL-PL)*
- *VMD0013 Estimation of greenhouse gas emissions from biomass and peat burning (E-BPB)*
- *VMD0015 Methods for monitoring of greenhouse gas emissions and removals in REDD project activities (M-REDD)*
- *VMD0016 Methods for stratification of the project area (X-STR)*

2 SUMMARY DESCRIPTION OF THE MODULE

This module allows for estimating GHG emissions caused by the activity shifting leakage of avoiding planned deforestation and avoiding planned wetland degradation project activities, noting that throughout the document “planned deforestation” refers to both planned deforestation and planned degradation.

This module provides procedures for determining the net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation, ($\Delta C_{LK\text{-}AS,planned}$) and or planned wetland degradation ($GHG_{LK\text{-}WRC\text{-}AS,planned}$).

This module was originally developed for APD and AD project activities. It is also mandatory for use in stand-alone APWD project activities.

3 DEFINITIONS

In addition to the definitions set out in VCS document *Program Definitions* and VCS methodology VM0007 *REDD+ MF*, the following definition applies to this methodology:

Alternative Areas
The forested areas in the country currently potentially available for production of the commodity(s) produced by baseline class of agent considering soil type, elevation, precipitation and access to markets for the specified commodity(s)

4 APPLICABILITY CONDITIONS

The module is applicable for estimating the leakage emissions due to activity shifting from forest lands that are legally authorized and documented to be converted to non-forest land, including

activity shifting to forested wetland that is drained or degraded as a consequence of project implementation. The module is also applicable for estimating the leakage emissions due to activity shifting from non-forested wetlands that are legally authorized and documented to be converted and degraded. Under these situations, displacement of baseline activities can be controlled and measured directly by monitoring the baseline deforestation or wetland degradation agents or class of agents.

This tool must be used for projects in areas where planned deforestation happens on forested wetlands, regardless of the absence of wetland within the project boundaries.

The module is mandatory if Module *BL-PL* has been used to define the baseline, and the applicability conditions in Module *BL-PL* must be complied with in full.

5 PROCEDURES

5.1 PART 1: Where the Specific Deforestation Agent has been Identified

$$\Delta C_{LK-AS,planned} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} \left(LKA_{planned,i,t} \times \Delta C_{BSL,i} \right) + GHG_{LK,E,i,t} \quad (1)$$

Where:

$\Delta C_{LK-AS,planned}$	Net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation up to year t^* (t CO_2e)
$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum i in year t (ha)
$\Delta C_{BSL,i}$	Net carbon stock changes in all pre-deforestation pools in baseline stratum i (t CO_2e ha^{-1})
$GHG_{LK,E,i,t}$	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum i in year t (t CO_2e)
i	1, 2, 3, … M strata (unitless)
t	1, 2, 3, … t^* time elapsed since the start of the project activity (years)

Procedures for GHG emissions due to wetland degradation from planned deforestation displaced from the project area are provided in Section 5.3.

By estimating the total area of deforestation across all the lands managed by the baseline deforestation agent (including the projected baseline deforestation within the project boundaries) it makes it possible to monitor possible activity shifting by agents to other areas under its management. The predicted deforestation within the project boundary is then subtracted from the total deforestation across all the land managed by the baseline agent/class. This subtraction gives the expected deforestation if no leakage occurs. If deforestation is subtracted from the total area of monitored deforestation by the baseline agent of deforestation, the result is the area of leaked deforestation.

The five-year monitoring cycle levels vary in annual deforestation by an agent. Nevertheless, a difference may occur between deforestation monitored over a period of five years and the new

calculated forest clearance by the baseline agent of the planned deforestation ($NewR_{t\_1\text{-}5}$) that is not related to leakage, and may result in a different of up to 10% in the accounting of leakage.

Where the specific deforestation agent can be identified, leakage does not need to be considered where it can be demonstrated that the management plans and/or land-use designations of the deforestation agent's other lands (which must be identified by location) have not materially changed as a result of the project[1] (e.g., the deforestation agent has not designated new lands as timber concessions, increased harvest rates in lands already managed for timber, cleared intact forests for agricultural production or increased fertilizer use to enhance agricultural yields).

Further, in this module, leakage does not to be considered where only the agent class has been identified but verifiable information exists to demonstrate that the management plans and/or land-use designations of the whole class of deforestation agent's other lands have not materially changed due to the project activities.

Likewise, leakage does not need to be accounted for where it can be demonstrated that it is unrelated to the project and responds to factors outside the control of project proponents (eg, markets, policies, etc.). Project proponents must present verifiable information demonstrating this situation, such as official documents, market analysis, peer-reviewed literature and other relevant sources, as well as an assessment showing how and to what extent it affected their leakage accounting.

5.1.1 STEP 1: Determination of the Baseline Rate of Forest Clearance by the Deforestation Agent

Three options are provided for estimating the baseline rate of forest clearance by the deforestation agent. Option 1.2 may only be used if a historic trend analysis (Option 1.1) or a documented deforestation projection (Option 1.3) is not feasible.

5.1.1.1 Option 1.1: Historical Deforestation Trend

With this approach, the baseline annual deforestation by the baseline deforestation agent may be estimated by extrapolating the historical annual trend using a linear regression. To determine this trend, survey the deforestation agent and examine official records[2] to determine the total area deforested by the deforestation agent each year over the previous five years within the country. Annual data for a minimum of five years and a maximum of ten years must be used to create a linear regression. The results of the analysis must produce a statistically significant regression with a $p \leq 0.05$ and an adjusted r2 of ≥ 0.75, otherwise Option 1.2 must be used.

$$WoPR_{i,t} = a + b \times t \quad (2)$$

[1] See Section 3.7.16 of the *VCS Methodology Requirements,* v4.0, or latest version.

[2] Official records may include permits for concessions or permits to deforest for agricultural/commercial purposes.

Where:

$WoPR_{i,t}$	Deforestation by the baseline agent of the planned deforestation in the absence of the project in stratum *i* in year *t*[3] (ha)
a	Estimated intercept of the regression line (ha)
b	Slope of the linear regression (ha yr^{-1})
t	1, 2, 3, … t^* time elapsed since the projected start of the project activity (years)

5.1.1.2 Option 1.2: Historic Deforestation Average

Under this approach, the baseline annual deforestation by the baseline deforestation agent is assumed to be equal to the average deforested area, during the five years prior to the project start date.

Survey the deforestation agent and, if available, examine official records[4] to determine the total area deforested by the deforestation agent each year over the previous five years within the country.

$$WoPR_{i,t} = \sum_{ag=1}^{ag} \frac{HistHa_{i,ag}}{5} \quad (3)$$

Where:

$WoPR_{i,t}$	Deforestation by the baseline agent of the planned deforestation in the absence in stratum *i* in year *t* (ha) Note that the same area of deforestation will be applied for each year of the baseline period
$HistHa_{i,ag}$	Number of hectares of forest cleared by the baseline agent of the planned deforestation in the five years prior to project implementation in stratum *i* by agent *ag* within the country (ha)
i	1, 2, 3, … *M* strata (unitless)
ag	1, 2, 3, ... agents of deforestation (unitless)
t	1, 2, 3, … t^* time elapsed since the projected start of the project activity (years)

Where there is no history of deforestation and no verifiable plans for controlled lands and future-controlled lands then *WoPR* must be set to planned baseline rate for the project ($D\%_{planned}$ × $A_{planned}$ from Module *BL-PL*).

[3] Note that the rate will differ by year in the baseline period.

[4] Official records may include permits for concessions or permits to deforest for agricultural/commercial purposes

5.1.1.3 Option 1.3: Deforestation Projections

Option 1.3a

In cases where the identified deforestation agent has made public a business plan or similar documentation containing data suited for estimating a conversion rate over the baseline period, such rate may be used if all the following conditions are met:

1. The business plan or similar documentation is the most recent one published by the agent at the time of the validation;
2. The growth rates resulting from the business plan are consistent[5] with those from previous plans published by the identified agent and with recent and foreseen (i.e., during the baseline period) conversion rates for the agent class and/or the growth rates of the agent´s industry in the country;
3. The agent's historic performance *vis à vis* previous published plans and current financial situation and market demand for the agent´s main products allow for the assumption that the published plans will be met (with a deviation of at most ± 10%).

Option 1.3b

Use the guidance provided in Module *BL-PL*, Part 1.2 (Area of deforestation $A_{planned,i}$) to identify all the areas that may be expected to be converted to non-forest land by the agent/class outside the project boundaries during the baseline period ($A_{planned,I,OP}$). Apply Section 1.3 (Rate of deforestation $D\%_{planned,i,t}$) of Module *BL-PL* to estimate the rate of deforestation (area deforested per year, ha yr^{-1}) in such areas ($D\%_{planned,i,t,OP}$).

The new calculated forest clearance in stratum *i* in year *t* by the baseline agent of the planned deforestation where no leakage is occurring ($NewR_{i,t}$) is thus the average number of hectares deforested per year in all of the agent´s concessions, as follows:

$$NewR_{i,t} = \left(D\%_{planned,i,t,OP} \times A_{planned,i,OP}\right) \quad (4)$$

Where:

$NewR_{i,t}$	New calculated forest clearance in stratum *i* in year *t* by the baseline agent of the planned deforestation where no leakage is occurring (ha)
$D\%_{planned,i,t,OP}$	Projected annual proportion of land that will be deforested outside the project boundary in stratum *i* in year *t* (percent)
$A_{planned,i,OP}$	Total area of planned deforestation outside the project boundary over the baseline period for stratum *i* (ha)
i	1, 2, 3, … *M* strata (unitless)

[5] Any significant deviations from historic conversion rates in similar market demand conditions for the agent´s main commodities need to be substantiated (e.g., in cases where a larger area is needed to produce the same amount of goods as in previous periods due to lower land productivity in the concessions that will be managed by the agent during the baseline period).

t	1, 2, 3, … t^* time elapsed since the projected start of the project activity (years)

Following completion of this option, proceed to Step 3 (i.e., Step 2 below does not need to be applied).

5.1.2 STEP 2: Estimate New Projection of Forest Clearance by the Baseline Agent Of Deforestation with Project Implementation if No Leakage is Occurring

Subtract the total project area of planned baseline deforestation from the historic area of deforestation to calculate the new area.

$$NewR_{i,t} = WoPR_{i,t} - \left(D\%_{planned,i,t} \times A_{planned,i}\right) \quad (5)$$

Where:

$NewR_{i,t}$	New calculated forest clearance in stratum i in year t by the baseline agent of the planned deforestation where no leakage is occurring (ha)
$WoPR_{i,t}$	Deforestation by the baseline agent of the planned deforestation in stratum i in year t in the absence of the project (ha)
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in project stratum i in year t (percent)
$A_{planned,i,}$	Total area of planned deforestation over the baseline period for project stratum i (ha)
i	1, 2, 3, … M strata (unitless)
t	1, 2, 3, … t^* time elapsed since the projected start of the project activity (years)

5.1.3 STEP 3: Monitor All Areas Deforested by Baseline Agent of Deforestation Through the Years in Which Planned Deforestation was Forecast To Occur

All areas deforested by the baseline agent of deforestation must be monitored. Areas of deforestation may be anywhere in the host country. There is no requirement to track international leakage.

$$LKA_{planned,i,t} = A_{defLK,i,t} - NewR_{i,t} \quad (6)$$

Where:

$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum i in year t (ha)
$NewR_{i,t}$	New calculated forest clearance by the baseline agent of the planned deforestation in stratum i in year t where no leakage is occurring (ha)
$A_{defLK,i,t}$	The total area of monitored deforestation by the baseline agent of the planned deforestation in stratum i in year t (ha)
i	1, 2, 3, … M strata (unitless)
t	1, 2, 3, … t^* time elapsed since the start of the project activity (years)

If $NewR_{i,t}$ exceeds $A_{defLK,i,t}$ then $LKA_{planned,i,t}$ must be set as zero as positive leakage is not considered under the VCS.

5.1.4 STEP 4: Monitor GHG Emissions Outside the Project Boundary by Baseline Agent of Deforestation

Where a specific agent of deforestation has been identified, fertilizer use and biomass burning must be monitored. Conservatively any emissions must be counted as leakage regardless of whether the source was or was not included in baseline calculations:

$$GHG_{LK,E,i,t} = E_{biomassburn,i,t} + N_2O_{direct-N,i,t} \quad (7)$$

Where:

$GHG_{LK,E,i,t}$	Greenhouse gas emissions as a result of leakage of avoiding deforestation activities in stratum *i* in year *t* (t CO_2e)
$E_{biomassburn,i,t}$	Non-CO_2 emissions due to biomass burning in stratum *i* in year *t* (t CO_2e)
$N_2O_{direct-N,i,t}$	Direct N_2O emission as a result of nitrogen application on the alternative land use in stratum *i* in year *t* (t CO_2e)
i	1, 2, 3, … *M* strata (unitless)
t	*1, 2, 3 … t** time elapsed since the start of the project activity (years)

Where the baseline agent of deforestation is unwilling to share information on areas burned and quantity of fertilizer used the values must be estimated based on common practice as defined by participatory rural appraisal (PRA).

5.2 PART 2: Where Only a Class of Deforestation Agents can be Identified

Where the specific deforestation agent cannot be identified, or where it is not possible to access the necessary information from the identified deforestation agent, leakage must be quantified based upon the difference between historic and with-project rates of deforestation by the identified most-likely-class of deforestation agent within the country using Approach 1 below. Alternatively, where Approach 1 cannot be applied, and where such agents are driven by the demand for market commodities, the project may directly account for market leakage associated with the specific project activity. Where directly accounting for leakage, market leakage must be accounted for at the country scale using Approach 2.

In both cases, the most-likely agent class must be identified taking into account, for example, the suitability of the project area (soil, altitude, geographical location, etc.) for the most common commodities produced in the country, the usual practices and preferences of the agents of planned deforestation in the country and the market demand at the start of the project activities.

5.2.1 APPROACH 1: Leakage Estimation Based On the Historical Deforestation Trends of the Most-Likely Agent Class

This approach follows the same rationale as the one applied in cases where the deforestation agent can be identified and therefore relies on the methods explained in Part 1 above. Consequently, the estimation of the net greenhouse gas emissions due to activity shifting leakage for projects preventing planned deforestation ($\Delta C_{LK\text{-}AS,planned}$) must be carried out by applying Equations 1 to 7 above using data on the identified class of deforestation agents.

5.2.2 APPROACH 2: Market Leakage Assessment

5.2.2.1 STEP 1: Identify commodity produced by baseline class of agent

For many classes of agents, it is likely that a single commodity will be associated (e.g., oil palm producers or cattle ranchers) and thus this commodity must be used for the leakage analysis.

For other classes of agents, the most likely commodity must be assessed. This assessment must include justification including information on commodity suitability and the commodities currently being produced by others in the same class of agent. Where justifiable, different commodities may be assigned to different strata.

5.2.2.2 STEP 2: Assess Proportion of Available Areas that are Forested

Determine the areas in the country currently potentially available for production of the commodity(s) specified in Step 1 (henceforth referred to as “alternative areas”). The determination must reference to soil type, elevation, precipitation and access to markets for the specified commodity(s). Determine the proportion of this available area that is currently forested (PF_c).

5.2.2.3 STEP 3: Evaluate Project Area Relative to Other Forested Areas for Commodity Production in the Country

STEP 3.1 Assess productivity of project area for commodity production

STEP 3.2 Assess productivity of alternative areas in the country for commodity production

Assessment of productivity must include soil type, elevation and precipitation. Experts in the production of the specific commodity must be consulted (e.g., Government Ministry of Agriculture). For both the project area and the alternative areas, this productivity assessment must result in an area weighted average productivity value representing the weighted average productivity of all parcels included in the assessment and expressed as tonnes of the commodity per ha per year.

5.2.2.4 STEP 4: Assess Proportional Leakage Factor

Where average productivity of alternative areas is the same ±15% as the average productivity of the relevant strata in the project area:

$LK_{CP\text{-}ME,c,i} = 0.4$

Where average productivity of alternative areas is >15% less than the relevant strata in the project area:

$LK_{CP\text{-}ME,c,i} = 0.7$

Where average productivity of alternative areas is >15% more than the relevant strata in the project area:

$LK_{CP\text{-}ME,c,i}$ = 0.2

Where project proponents are able to clearly demonstrate that market leakage will only happen out of the country (e.g., based on official data from the government or peer-reviewed literature), market leakage must be set as zero.

Moreover, if leakage management activities are established within areas under the control of the project proponent in order to minimize the displacement of land use activities to areas outside the project area by maintaining the production of commodities (e.g., by establishing agricultural intensification practices on non-wetlands), a leakage management adjustment factor (LK_{MAF}) may be applied. The leakage management adjustment factor discounts the value of $LK_{CP\text{-}ME,c,i}$ in a proportion equal to the annual volume of commodities provided by the leakage management areas with respect to the total annual volume of commodities that would have been produced in the project area in the absence of the project, as follows:

$$LK_{MAF} = 1 - (PROD_{LMA,c,t} / PROD_{BL,c,t}) \quad (8)$$

Where:

LK_{MAF}	Leakage management adjustment factor (unitless)
$PROD_{LMA,c,t}$	Production of commodity *c* in year *t* in leakage management areas (tonnes per year)
$PROD_{BL,c,t}$	Production of commodity *c* in year *t* in the baseline case (tonnes per year)
c	1, 2, 3, ... *C* commodities (unitless)
t	1, 2, 3, … *t** time elapsed since the start of the project activity (years)

Where the leakage management areas produce an amount equal or higher than the expected baseline production of a given commodity, leakage must be assumed to be zero. In order to apply this factor, project proponents need to demonstrate the production of the volume of the relevant commodities used to estimate this deduction, as well as evidence that such goods have reached the national markets. Any increase in GHG emissions associated with the leakage management activities must be accounted for, unless deemed *de minimis* or conservatively excluded.

5.2.2.5 STEP 5: Estimate Leakage

$$\Delta C_{LK-AS,planned} = \sum_{t=1}^{t*} \sum_{i=1}^{M} \sum_{c=1}^{C} \left(\Delta C_{BSL,planned} \times PF_c \times LK_{CP-ME,c,i} \times LK_{MAF} \right) \quad (9)$$

Where:

$\Delta C_{LK\text{-}AS,planned}$	Net CO_2 emissions due to activity shifting leakage for projects preventing planned deforestation up to year *t** (t CO_2e)
$\Delta C_{BSL,planned}$	Net CO_2 emissions in the baseline from planned deforestation in the project area (t CO_2e)
PFc	Proportion of available area for production of commodity *c* that is currently forested (unitless)
$LK_{CP\text{-}ME,c,i}$	Leakage factor for displacement of class of planned deforestation agents in stratum *i* (unitless)
LK_{MAF}	Leakage management adjustment factor (unitless)
c	1, 2, 3, ... *C* commodities

i	1, 2, 3, … M strata
t	1, 2, 3, … t^* years elapsed since the start of the project activity

5.3 PART 3: Peatlands and Tidal Wetlands

In countries with wetlands and where the planned deforestation baseline land use is for a commodity that can be produced on drained or degraded wetland, the project proponent must account for GHG emissions arising from the drainage or degradation of wetland resulting from the increased deforestation. The steps below must be applied.

In Section 5.3.4 procedures for stand-alone CIW project activities are provided.

$$GHG_{LK\text{-}WRC\text{-}AS,planned} = \Delta C_{LK\text{-}ASP\text{-}PEAT} + \Delta C_{LK\text{-}ASP\text{-}TW} \quad (10)$$

Where:

$GHG_{LK\text{-}WRC\text{-}AS,planned}$	Net GHG emissions due to wetland degradation from planned deforestation displaced from the project area up to year t^* (t CO_2e)
$\Delta C_{LK\text{-}ASP\text{-}PEAT}$	Net GHG emissions due to peatland drainage from planned deforestation displaced from the project area up to year t^* (t CO_2e)
$\Delta C_{LK\text{-}ASP\text{-}TW}$	Net GHG emissions due to tidal wetland degradation from planned deforestation displaced from the project area up to year t^* (t CO_2e)

5.3.1 STEP 1: Estimate the Soil Organic Carbon Loss in All of the Agent's Concessions

Where the deforestation agent has been identified or where Approach 1 when only the agent class has been identified is used, the cumulative carbon lost at t_{PDT} ($C_{loss\text{-}PDT}$) or the cumulative soil organic carbon loss at t_{SDT} ($C_{loss\text{-}SDT}$) in all of the agent´s concessions must be estimated. Note that this option may only be applied if the identified agent is not expected to obtain any new concessions during the baseline period, or if information on all such new concessions is available at project start. If this information is not available, the procedure applied in cases where only the agent class is identified (described below) must be used, in which case it must be assumed that the areas under management of the identified agent at project start are part of the alternative areas in Part 2, Step 2, above.

Where the agent has not been identified and Approach 2 (market leakage) has been applied, the estimation of $C_{loss\text{-}PDT}$ or $C_{loss\text{-}SDT}$ must be carried out for the alternative areas in the country where the production of the identified commodity is feasible according to Step 1 of Part 2 above.

$$C_{loss\text{-}PDT} = (C_{t0\text{-}} - C_{PDT}) \times 44/12 \quad (11)$$

$$C_{loss\text{-}SDT} = (C_{t0} - C_{SDT}) \times 44/12 \quad (12)$$

Where:

$C_{loss\text{-}PDT}$	Cumulative peat loss at t_{PDT} (t CO_2e ha^{-1})
$C_{loss\text{-}SDT}$	Cumulative soil organic carbon loss at t_{SDT} (t CO_2e ha^{-1})
C_{t0}	Soil organic carbon stock at t_0 (t C ha^{-1})

C_{PDT}	Soil organic carbon stock at t_{PDT} (t C ha^{-1})
C_{SDT}	Soil organic carbon stock at t_{SDT} (t C ha^{-1})
t_{PDT}	Peat Depletion Time (years)
t_{SDT}	Soil organic carbon Depletion Time (years)

t_{PDT} can be taken from $t_{PDT\text{-}BSL,i}$ or t_{SDT} can be taken from $t_{SDT\text{-}BSL,i}$ in Section 5.5 and 5.6, respectively, of Module *X-STR*[6] or by using default values derived from the peer-reviewed literature, including default factors, where available.

C_{t0} must be quantified using Module *X-STR* (See $C_{BSL,i,t0}$ in Section 5.4.1). C_{PDT} and C_{SDT} (whichever is relevant) must be quantified using Module *X-STR* (See $C_{BSL,i,t100}$ in Section 5.4.1, substituting t_{PDT} or t_{SDT} for t_{100}).

Official or peer-reviewed data on the wetlands in the country or, if applicable, in the region where the deforestation/degradation agent operates, may be applied instead of direct measurements to estimate $C_{loss\text{-}PDT}$ or $C_{loss\text{-}SDT}$. Project participants must demonstrate that the selected data will lead to conservative estimates of leakage emissions from wetlands.

5.3.2 STEP 2: Estimate the CO_2 Emission Factor from Leakage to Peatland or Tidal Wetland per ha

$$LK_{EF\text{-}PEAT} = C_{loss\text{-}PDT} \quad (13)$$

$$LK_{EF\text{-}TW} = C_{loss\text{-}SDT} \quad (14)$$

Where:

$LK_{EF\text{-}PEAT}$	CO_2 emission factor from leakage to undrained peatlands (t CO_2e ha^{-1})
$C_{loss\text{-}PDT}$	Cumulative peat loss at t_{PDT} (t CO_2e ha^{-1})
$LK_{EF\text{-}TW}$	CO_2 emission factor from leakage to intact tidal wetlands (t CO_2e ha^{-1})
$C_{loss\text{-}SDT}$	Cumulative soil organic carbon loss at t_{SDT} (t CO_2e ha^{-1})

Alternatively, peer-reviewed default emission factors for land conversion to drained peatland or degraded tidal wetland in all the undrained peatland areas where leakage could take place may be used as $LK_{EF\text{-}PEAT}$ or $LK_{EF\text{-}TW}$, if available. The project proponent must demonstrate that the selected default factors will lead to conservative estimates of leakage emissions from peatlands.

5.3.3 STEP 3: Estimate the Net GHG Emissions Due to Leakage to Undrained Peatlands or Intact or Partially Degraded Tidal Wetlands as a Result of Implementation of a Planned Deforestation Project ($\Delta C_{LK\text{-}ASP\text{-}PEAT}$ or $\Delta C_{LK\text{-}ASP\text{-}TW}$)

If the agent has been identified or Approach 1 is used, in order to obtain $\Delta C_{LK\text{-}ASP\text{-}PEAT}$ or $\Delta C_{LK\text{-}ASP\text{-}TW}$, multiply the total area of monitored activity shifting (in ha) (given by $LKA_{planned,i,t}$ (from Equation

[6] Noting that similarity in peat depth (for PDT) or soil organic carbon content (for SDT) and land use with stratum *i* referred to must be demonstrated; t_{PDT} and t_{SDT} may be assumed to exceed the project crediting period and are limited to t=100.

6)) by the proportion of undrained peatland areas in the agent´s concessions with respect to the total area of such concessions, and then by $LK_{EF\text{-}PEAT}$ or $LK_{EF\text{-}TW}$, as follows:

$$\Delta C_{LK\text{-}ASP\text{-}PEAT} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} LKA_{planned,i,t} \times PROP_{PEAT\text{-}AGENT} \times LK_{EF\text{-}PEAT} \quad (15)$$

$$\Delta C_{LK\text{-}ASP\text{-}TW} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} LKA_{planned,i,t} \times PROP_{TW\text{-}AGENT} \times LK_{EF\text{-}TW} \quad (16)$$

Where:

$\Delta C_{LK\text{-}ASP\text{-}PEAT}$	Net GHG emissions due to peatland drainage from planned deforestation displaced from the project area up to year t^* (t CO_2e)
$\Delta C_{LK\text{-}ASP\text{-}TW}$	Net GHG emissions due to tidal wetland degradation from planned deforestation displaced from the project area up to year t^* (t CO_2e)
$LKA_{planned,i,t}$	The area of activity shifting leakage in stratum i in year t (ha)
$PROP_{PEAT\text{-}AGENT}$	Proportion of undrained peatland areas in the agent´s concessions with respect to the total area of such concessions (unitless)
$PROP_{TW\text{-}AGENT}$	Proportion of intact or partially degraded tidal wetland areas in the agent´s concessions with respect to the total area of such concessions (unitless)
$LK_{EF\text{-}PEAT}$	CO_2 emission factor from leakage to undrained peatlands (t CO_2e ha^{-1})
$LK_{EF\text{-}TW}$	CO_2 emission factor from leakage to intact tidal wetlands (t CO_2e ha^{-1})
i	1, 2, 3, … M strata
t	1, 2, 3, … t^* years elapsed since the start of the project activity

If only the agent class has been identified and Approach 2 (market leakage approach) is used, leakage is obtained by applying the following equations:

$$\Delta C_{LK-ASP-PEAT} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} \left(D\%_{planned,i,t} \times A_{planned,i} \times LK_{CP-ME,c,i} \times LK_{MAF} \times PROP_{PEAT-ALT} \times LK_{EF-PEAT} \right) \quad (17)$$

$$\Delta C_{LK-ASP-TW} = \sum_{t=1}^{t^*} \sum_{i=1}^{M} \left(D\%_{planned,i,t} \times A_{planned,i} \times LK_{CP-ME,c,i} \times LK_{MAF} \times PROP_{TW-ALT} \times LK_{EF-TW} \right) \quad (18)$$

Where:

$\Delta C_{LK\text{-}ASP\text{-}PEAT}$	Net GHG emissions due to peatland drainage from planned deforestation displaced from the project area up to year t^* (t CO_2e)
$\Delta C_{LK\text{-}ASP\text{-}TW}$	Net GHG emissions due to tidal wetland degradation from planned deforestation displaced from the project area up to year t^* (t CO_2e)
$D\%_{planned,i,t}$	Projected annual proportion of land that will be deforested in stratum i in year t (percent)
$A_{planned,i,}$	Total area of planned deforestation over the baseline period for stratum i (ha)
$LK_{CP\text{-}ME,c,i}$	Leakage factor for displacement of class of planned deforestation agents (unitless)
LK_{MAF}	Leakage management adjustment factor (unitless)
$PROP_{PEAT\text{-}ALT}$	Proportion of undrained peatland areas in the alternative areas with respect to the total alternative areas (unitless)

$PROP_{TW-ALT}$	Proportion of intact or partially degraded tidal wetland areas in the alternative areas with respect to the total alternative areas (unitless)
$LK_{EF-PEAT}$	CO_2 emission factor from leakage to undrained peatlands (t CO_2e ha^{-1})
LK_{EF-TW}	CO_2 emission factor from leakage to intact or partially degraded tidal wetlands (t CO_2e ha^{-1})
i	1, 2, 3, … *M* strata
t	1, 2, 3, … *t** years elapsed since the start of the project activity

5.3.4 Stand-Alone CIW Project Activities

For stand-alone CIW project activities, the procedures provided in Section 5.3.3 can be applied here, *mutatis mutandis*, noting that:

$D\%_{planned}$ represents Projected annual proportion of wetland that will be drained or degraded

- $A_{planned}$ represents Area of planned wetland degradation.

$$GHG_{LK-WRC-AS,planned} = \Delta C_{LK-ASP-PEAT} + \Delta C_{LK-ASP-TW} \quad (19)$$

Where:

$GHG_{LK-WRC-AS,planned}$	Net GHG emissions due to wetland degradation from planned deforestation displaced from the project area up to year *t** (t CO_2e)
$\Delta C_{LK-ASP-PEAT}$	Net GHG emissions due to peatland drainage from planned deforestation displaced from the project area up to year *t** (t CO_2e)
$\Delta C_{LK-ASP-TW}$	Net GHG emissions due to tidal wetland degradation from planned deforestation displaced from the project area up to year *t** (t CO_2e)

6 DATA AND PARAMETERS

6.1 Data and Parameters Available at Validation

Data / Parameter	$\Delta C_{BSL,i}$
Data unit	t CO_2-e ha^{-1}
Description	Net carbon stock changes in all pools in the baseline stratum *i*
Equations	1
Source of data	Module *BL-PL*
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module *BL-PL*
Purpose of Data	Calculation of leakage emissions

Comments	N/A

Data / Parameter	$HistHa_i$
Data unit	ha
Description	Average annual area of deforestation by the baseline agent of deforestation in stratum *i* for the 5 years prior to project implementation
Equations	2
Source of data	Data sources or own measurements
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation.
Purpose of Data	Calculation of leakage emissions
Comments	Must be re-evaluated whenever the baseline is revised

Data / Parameter	$A_{planned,l,OP}$
Data unit	Ha
Description	Total area of planned deforestation outside the project boundaries over the entire project lifetime for stratum *i*
Equations	4
Source of data	Own assessment
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	GPS coordinates and/or remote sensing data and/or legal parcel records
Purpose of Data	Calculation of leakage emissions
Comments	Must be re-evaluated whenever the baseline is revised

Data / Parameter	$D\%_{planned,i,t,OP}$
Data unit	%
Description	Projected annual proportion of land that will be deforested outside the project boundaries in stratum *i* in year *t*
Equations	4
Source of data	Own assessment

Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	Use a verifiable plan or proxy areas
Purpose of Data	Calculation of leakage emissions
Comments	Must be re-evaluated whenever the baseline is revised

Data / Parameter	$D\%_{planned,i,t}$
Data unit	%
Description	Projected annual proportion of land that will be deforested in stratum *i* in year *t*
Equations	5
Source of data	Module *BL-PL*
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See Module *BL-PL*
Purpose of Data	Calculation of leakage emissions
Comments	N/A

Data / Parameter	$PROD_{BL,c,t}$
Data unit	Tonnes of commodity *c* per year
Description	Production of commodity *c* in year *t* in the baseline case
Equations	8
Source of data	Own assessment
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	Estimated taking into account the proportion of the project area that would be used for the production of the identified commodity(ies) each year of the baseline period and the average productivity of the project area for such commodity(ies) (assessed in Step 3.1 of Approach 2).
Purpose of Data	Calculation of leakage emissions
Comments	Must be re-evaluated whenever the baseline is revised

Data / Parameter	t_{PDT}
Data unit	yr
Description	Peat Depletion Time
Equations	12, 14
Source of data	Taken from $t_{PDT-BSL,i}$ Section 5.5 in module *X-STR*
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See module *X-STR*
Purpose of Data	Calculation of leakage emissions
Comments	N/A

Data / Parameter	t_{SDT}
Data unit	yr
Description	Soil organic carbon Depletion Time
Equations	13, 15
Source of data	Taken from $t_{SDT-BSL,i}$ Section 5.6 in module *X-STR*
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	See module *X-STR*
Purpose of Data	Calculation of leakage emissions
Comments	N/A

6.2 Data and Parameters Monitored

Data / Parameter:	$A_{planned,i}$
Data unit:	ha
Description:	Total area of planned deforestation over the entire project lifetime for stratum *i*
Equations	5
Source of data:	Data sources or own measurements
Description of measurement methods	GPS coordinates and/or remote sensing data and/or legal parcel records.

and procedures to be applied:	*Ex ante*, $A_{planned,i}$ must be determined as described in Module *BL-PL*
Frequency of monitoring/recording:	Must be examined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC procedures to be applied:	See section 9.3 of *REDD+ MF* or other VCS methodology that uses this module.
Purpose of data:	Calculation of leakage emissions
Calculation method:	N/A
Comments:	N/A

Data / Parameter:	$A_{defLK,i,t}$
Data unit:	ha
Description:	The total area of deforestation by the baseline agent or class of agent of the planned deforestation in stratum *i* in year *t*
Equations	6
Source of data:	Data sources or own measurements
Description of measurement methods and procedures to be applied:	Analysis of remote sensing data and/or legal records and/or survey information for lands owned or controlled or previously owned or controlled by the baseline agent of deforestation. Legal records will include government permits to deforest including concession licenses. *Ex ante*, project proponents must determine and justify the likelihood of leakage based on characteristics of the baseline agent or class of agent.
Frequency of monitoring/recording:	Must be reexamined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC procedures to be applied:	See Section 9.3 of *REDD+ MF* or other VCS methodology that uses this module.
Purpose of data:	Calculation of leakage emissions
Calculation method:	N/A
Comments:	N/A

Data / Parameter:	$E_{biomassburn,i,t}$
Data unit:	t CO_2-e
Description:	Non-CO_2 emissions due to biomass burning in stratum *i* in year *t*
Equations	7

Source of data:	Module *E-BPB*
Description of measurement methods and procedures to be applied:	See Module *E-BPB*
Frequency of monitoring/recording:	See Module *E-BPB*
QA/QC procedures to be applied:	See Section 9.3 of *REDD+ MF* or other VCS methodology that uses this module.
Purpose of data:	Calculation of leakage emissions
Calculation method:	N/A
Comments:	N/A

Data / Parameter:	$N_2O_{direct\text{-}N,i,t}$
Data unit:	t CO_2-e
Description:	Direct N_2O emission as a result of nitrogen application in stratum *i* in year *t*
Equations	7
Source of data:	Module *E-NA*
Description of measurement methods and procedures to be applied:	See Module *E-NA*
Frequency of monitoring/recording:	See Module *E-NA*
QA/QC procedures to be applied:	See Section 9.3 of *REDD+ MF* or other VCS methodology that uses this module.
Purpose of data:	Calculation of leakage emissions
Calculation method:	N/A
Comments:	N/A

Data / Parameter:	$PROD_{LMA,c,t}$
Data unit:	tonnes per year
Description:	Production of commodity *c* in year *t* in leakage management areas
Equations	8
Source of data:	Own assessment

Description of measurement methods and procedures to be applied:	Direct measurement of the volumes of the identified commodity(ies) produced in leakage management areas under control of the project participants that are sold in the national markets.
Frequency of monitoring/recording:	Must be examined at least every 5 years or if verification occurs on a frequency of less than every 5 years examination must occur prior to any verification event
QA/QC procedures to be applied:	See Section 9.3 of *REDD+ MF* or other VCS methodology that uses this module.
Purpose of data:	Calculation of leakage emissions
Calculation method:	N/A
Comments:	Project proponents must demonstrate that all the volume of the commodities sold in the national markets have been produced in their leakage management areas (i.e., that therefore they have not been bought from other producers and resold in such markets).

Data / Parameter:	C_{PDT}
Data unit:	t C ha^{-1}
Description:	Soil organic carbon stock at t_{PDT}
Equations	12
Source of data:	Module *X-STR*
Description of measurement methods and procedures to be applied:	Refer to $C_{BSL,i,t100}$ in Section 5.4.1 in Module *X-STR*, and substitute t_{PDT} for t_{100}
Frequency of monitoring/recording:	See Module *M-REDD*
QA/QC procedures to be applied:	See Section 9.3 of *REDD+ MF* or other VCS methodology that uses this module.
Purpose of data:	Calculation of leakage emissions
Calculation method:	N/A
Comments:	N/A

Data / Parameter:	C_{SDT}
Data unit:	t C ha^{-1}
Description:	Soil organic carbon stock at t_{SDT}
Equations	13
Source of data:	Module *X-STR*

Description of measurement methods and procedures to be applied:	Refer to $C_{BSL,i,t100}$ in Section 5.4.1 in Module *X-STR*, and substitute t_{SDT} for t_{100}
Frequency of monitoring/recording:	See Module *M-REDD*
QA/QC procedures to be applied:	See Section 9.3 of *REDD+ MF* or other VCS methodology that uses this module.
Purpose of data:	Calculation of leakage emissions
Calculation method:	N/A
Comments:	N/A

Data / Parameter:	C_{t0}
Data unit:	t C ha^{-1}
Description:	Soil organic carbon stock at t_0
Equations	12, 13
Source of data:	Module *X-STR*
Description of measurement methods and procedures to be applied:	Refer to $C_{BSL,i,t0}$ in Section 4.5.1 in Module *X-STR*
Frequency of monitoring/recording:	See Module *M-REDD*
QA/QC procedures to be applied:	See Section 9.3 of *REDD+ MF* or other VCS methodology that uses this module.
Purpose of data:	Calculation of leakage emissions
Calculation method:	N/A
Comments:	N/A

7 REFERENCES

None.

DOCUMENT HISTORY

Version	Date	Comment
v1.0	3 Dec 2010	Initial version
v1.1	20 Nov 2012	The module was revised to include avoided planned degradation as an allowable activity: • Added the text “hereafter in this module, “deforestation” refers to both deforestation and planned degradation” • Added a parameter for net CO2 emissions in the baseline from planned deforestation in the project area in equation 7.
v1.2	9 March 2015	The module was updated to include activities on peatlands.
v1.3	8 Sep 2020	The module was updated to include activities on tidal wetlands.