CERCARBONO
Certified Carbon Standard

Methodological Module NF-IW-Org-dra

For the Design and Implementation of Actions to Reduce GHG Emissions from Change of Use and Drainage of Non-forested Inland Wetlands with Organic Soils

Version 1.1

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1 Purpose and conditions of applicability

This methodological module is designed for the implementation of climate change mitigation activities through the reduction of land use change and drainage in non-forested inland wetlands with organic soils. It should be used in conjunction with Cercarbono's modular methodologies including the **NF-IW-Org-dra** segment, which focuses on activities to **reduce GHG emissions from land use change and drainage of non-forested inland wetlands with organic soils**.

The implemented mitigation reached through this type of activity and calculated with this module will be reported both independently for this module and in conjunction with the other segments implemented in a CCMP, which facilitates the correct assignment of the attributes of each credit type as well as the potential reporting of mitigation in the context of the NDCs in the corresponding land use category.

Scope of the methodological module

Land use category	Wetlands.
Methodological category	Inland non-forested wetlands with organic soils.
Mitigation type	Reduction of GHG emissions.
Considered activities	Reducing drainage and land use change of non-forested inland wetlands with organic soils.
Considered pools	Above-ground tree biomass, above-ground non-tree biomass, below-ground biomass, and soil organic carbon.
Considered GHG emission sources	Biomass removal or burning for land use conversion; emissions and removals from drained inland organic soils on cropland, grassland, wetlands, settlements, and other lands; emissions from drainage ditches or channels; release of dissolved organic carbon from organic soils to drainage waters and peatland fires.

All CCMP areas belonging to this category form the **NF-IW-Org-dra** segment. Recommendations are included for the delimitation of the segment, the identification and selection of baseline and project scenarios, relevant GHG emission sources and carbon pools, as well as for the quantification and monitoring of the results attained in the segment.

If a CCMP includes this **NF-IW-Org-dra** segment, once validated, it cannot be excluded. The activity of this segment can be implemented in isolation or in conjunction with activities of other segments considered in the selected methodology in the same CCMP.

2 Segment delimitation

The delimitation of the segment requires the definition of the different elements that specify its scope:

- Time limits.
- Activities considered.
- Spatial limits.
- Carbon pools considered.
- Emission sources considered.

The **time limits** are defined at the CCMP level, for the total set of segments included in the CCMP. Other segment limits are defined in the following sections.

2.1 Activities considered in the segment

This module can be used for the implementation of activities focused on reducing GHG emissions from change of use and drainage of non-forested inland wetlands with organic soils.

2.2 Historical, projection and results periods

In addition to the time limits that are defined at the CCMP level, it is necessary to define for the segment the historical, projection and result periods, as detailed below.

These periods should be the same for all deforestation reduction and forest degradation reduction segments or land cover/land use change of non-forest wetlands included in the CCMP (segments NF-CW-mar, NF-CW-luc, NF-KW-wt, NF-IW-Org-dra, NF-IW-Min-luc, NF-W-Org-rew, F-NW-def, F-NW-deg, F-CW-def, F-CW-deg, F-IW-Min-def, F-IW-Min-deg and F-IW-Org-dr), see ***Annex 1 of the methodology*** for identification and description).

- **Historical period (of historical emissions analysis)**: period (in years) for which a trend in the agents and causes of drainage and land use change detectable in the activity data can be described and which is used to predict (estimate) the rate of land use change that would occur during the projection period. This period should not be less than ten years.
- **Projection period**: time range (in years) for which projections are made in the baseline scenario based on the historical period. Emissions from land use change are projected over this period. The starting year of this period should coincide with the project start date where the first CCMP interventions are carried out in the territory, spanning the entire project duration or beyond.
- **Results period**: time range (in years) during which the segment's activities and the results of those actions are monitored in terms of GHG emission reductions from land use change of carbon content in non-forested inland wetlands with organic soils. The results period includes the verification periods in which monitoring of GHG removals or GHG emission reductions is carried out. The duration of this period is equal to the duration of the CCMP.

2.3 Eligibility of areas and establishment of spatial limits

The areas that make up this segment:

- They cannot be forests or have been covered by forests for at least ten years before the start date of the activity. The definition of forest must be in line with that established in the international context and adapted in the country where the WCP is implemented.
- They should be inland, non-forest wetlands with organic soils, in accordance with the guidelines presented in the document ***Determination of the Parameters for the Definition of the Segments of the Modular Methodology for Climate Change Mitigation Activities on Forest Lands and Wetlands***.
- The implementation of mitigation activities in the segment should not cause disturbance to natural forests.
- They must be supported by the ownership or administrative capacity of the CCMP.

This segment cannot overlap spatially with any segment established in another methodological module. The segment (portions of land where avoided land use change actions will take place) must be explicitly identified, among others, to avoid double counting in the results. Once defined, the segment will be part of the CCMP area.

In grouping CCMPs, the spatial limits of the segment may change during implementation due to the inclusion of new instances. In this case, a validation of the new areas and an update of the mitigation potential calculations of the segment considering these areas will be necessary.

The segment should be explicitly delimited by considering its area and strata.

The strata are the potential non-forest wetland **types**, grouped as having common characteristics for calculation purposes.

The eligibility analysis based on historical wetland cover comprises the following steps:

2.3.1 Collection of cartographic information

Information sources from remote sensing, orthophotos, coverages or land-use planning tools developed by institutions in charge of official cartography in the country where the CCMP is implemented are allowed, which are classified in medium spatial resolution and high spatial resolution. Mapping with drones or Global Positioning System (GPS)[1] is also allowed, whose quality must be adequate and proportional to the scale of the project according to the guidelines defined by the ISO 19157:2013 Standard or by the institution in charge of the official cartography of the country where the CCMP is implemented.

[1] The use of free map viewers as a source of complementary information is allowed as long as the images or maps used are of the same date as the assessed period.

The mapping files must be compatible with a Geographic Information System in shapefile (.shp) format, in the coordinate system defined by the institution in charge of the official mapping of the country where the CCMP is implemented.

For compatibility with other segments, the minimum mappable area, understood as the minimum unit of interpretation of cartographic sources and corresponding to the working scale, must be equal to the minimum size established in the forest definition of the country where the CCMP is implemented.

The following spatial resolutions can be used:

- **Medium spatial resolution**: information with a spatial resolution of 30 m to 100 m, which allows defining working scales smaller than 1: 50,000, coming from spectral sensitivity systems or satellite images such as, for example, Landsat, SPOT, ALOS, AVNIR-2, ASTER and IRSS.
- **High spatial resolution**: information with a spatial resolution of less than 30 m, allowing working scales larger than 1: 50,000 to be defined, from spectrally sensitive systems, satellite, or aerial imagery, e.g., Sentinel, RapidEye, orthophotos and LiDar.

Consideration should be given to the final scale of the products and the relevance of the information sources to the size of the discrete areas included and the total CCMP area.

The use of cartographic information with date differences of no more than one year with respect to the dates of analysis is allowed.

The following table shows the structure of how the CCMP can present the information.

Table 1. Possible structure of the presentation of CCMP supporting information.

Department, state, or province	Geographical location or sub-scene detail	Type of data source*	Area of coverage (ha)	Date of data source

* Picture, orthophoto, official map or other applicable sources.

2.3.1.1 Information in raster format

The information in raster format should be used by specialised software for the interpretation of the images. Each process must be documented: pre-processing, corrections, enhancements, classification, assignment, and final interpretation of the images.

2.3.1.2 Information in vector format

The sources of information in vector format used must be identified, described, and supported. If vectorisation of images is required, the procedure used should be documented.

Whether raster or vector information is used, the procedure for arriving at the land cover maps at each of the dates of analysis must be supported.

2.3.1.3 Documentary information

The documentation used for the analysis must consider the entire area to be included in the segment and must support the existing coverage at the date for which the analysis is made. The cartographic interpretation must be supplemented to support the coverages at the date of commencement of the CCMP and those at the time of legal support.

2.3.2 Map cross-referencing and coverage changes

With the maps generated in each period, a change or confusion matrix must be created to show which coverages remain in non-forest wetland and which become another land use in the two periods of analysis.

A change or confusion matrix is a square matrix of n x n, where n refers to the number of coverages. This matrix shows the relationship between two years of analysis corresponding to the area under study. The first row corresponds to the coverages determined in Year 1 (start date of the CCMP). The first column corresponds to the cover determined in Year 2 (ten years before the CCMP start date). The matrix includes the areas for each period of analysis to corroborate the accuracy of the classification and the changes in coverage to be considered within the eligibility analysis.

The following table shows how the CCMP **can** present the information for the change or confusion matrix.

Table 2. Example of change or confusion matrix structure.

Crossover Year1/Year2	Wetland 1	Land cover 1-1	Land cover 1-2	Land cover 1-n	Total Year 1
Wetland 2					
Land cover 2-1					
Land cover 2-2					
Land cover 2-n					
Total Year 2					

2.3.3 Eligible areas

Eligible areas must be determined according to cross-referenced information and presented in a traceable form, in **shapefile** (.shp) format where the information is evidenced and presented in a transparent manner.

The following table presents the structure of how the CCMP **can** present the information for eligible areas.

Table 3. Example of a structure for the presentation of eligibility information.

Item	Wetland	Land cover LB1*	Land cover LB2*	Land cover LBn*	Total
Eligible area					
Ineligible area					

Item	Wetland	Land cover LB1*	Land cover LB2*	Land cover LBn*	Total
Total (ha)					

* Land cover LB1: Land cover at the first time point; Land cover LB2: Land cover at the second time point; Land cover LBn: Land cover at the *n-th* time point.

2.3.4 Compatibility with land use categories, land-use planning, and applicable environmental legislation

The CCMP shall demonstrate the compatibility of the actions developed in the segment with the land use categories, if any, in the country where it is implemented.

If the initiative is intended to be implemented in environmentally protected areas, a permit or authorisation, as appropriate, must also be obtained from the environmental authority with jurisdiction in the area of intervention, which will verify the compatibility of the CCMP with the management instrument and the zoning established therein.

The CCMP must specify all applicable laws, statutes, and regulatory frameworks (local, regional, national, among others) in force in terms of categorisation or land management and must identify, implement, and periodically evaluate compliance with them.

Once the area eligibility analysis has been carried out, the spatial limits of the segment can be defined, selecting from the eligible areas those that will make up the segment.

3 Identification and calculation of the segment's baseline scenario

The baseline scenario in this module consists of estimating the amount of carbon in the pools and emissions by sources that would occur within the segment limits in the absence of the activities to be performed in the segment. The pools and GHG emission sources possible to consider in a CCMP are detailed in ***Table 7*** and ***Table 8***, respectively.

The calculation of GHG emissions of the baseline scenario is the result of the change in GHG emission sources and pools selected based on the change in the behaviour of the agents and drivers of land use change, for which the following steps should be followed:

- Determine the location of the segment within the CCMP, adjusted to non-forest wetland areas through the analysis of agents and drivers of land use change (***Section 3.1***).
- Establish the historical period where activity data and GHG emission factors are measured for the calculation of historical emissions from land use change (***Section 2.2***).
- Design and implement sampling for representative measurement of GHG emission factors (***Section 3.5***).
- Perform land use trend projection of the baseline scenario (***Section 3.7***).

3.1 Analysis of agents and causes of non-forest wetland decline

The analysis of agents and drivers of land use change starts from the preliminary analysis (see ***corresponding section in the methodology***) and is supported by secondary information collected on socio-economic variables of historical processes of land use change. The agents and causes included are those that are associated with unsustainable uses of the non-forest wetland, but also those that show the potential for sustainable management or leverage conservation processes including ethnic, cultural and livelihood conservation factors.

The analysis of the agents and causes of deforestation or land cover/land use change of non-forest wetlands should be carried out in aggregate for all segments considered in ***Section 2.1***.

The analysis of agents and causes should be an iterative process as better and more up-to-date information becomes available to improve the effectiveness of CCMP actions. In its first iteration the main results should provide the territorial information inputs to generate:

- A first portfolio of activities for reduction of land use change (a framework of possible activities is included in ***Annex 3 of the methodology***).
- The spatial delimitation of the segment areas.
- The temporal delimitation of the CCMP.
- The definition of the final location of the considered activity segments.

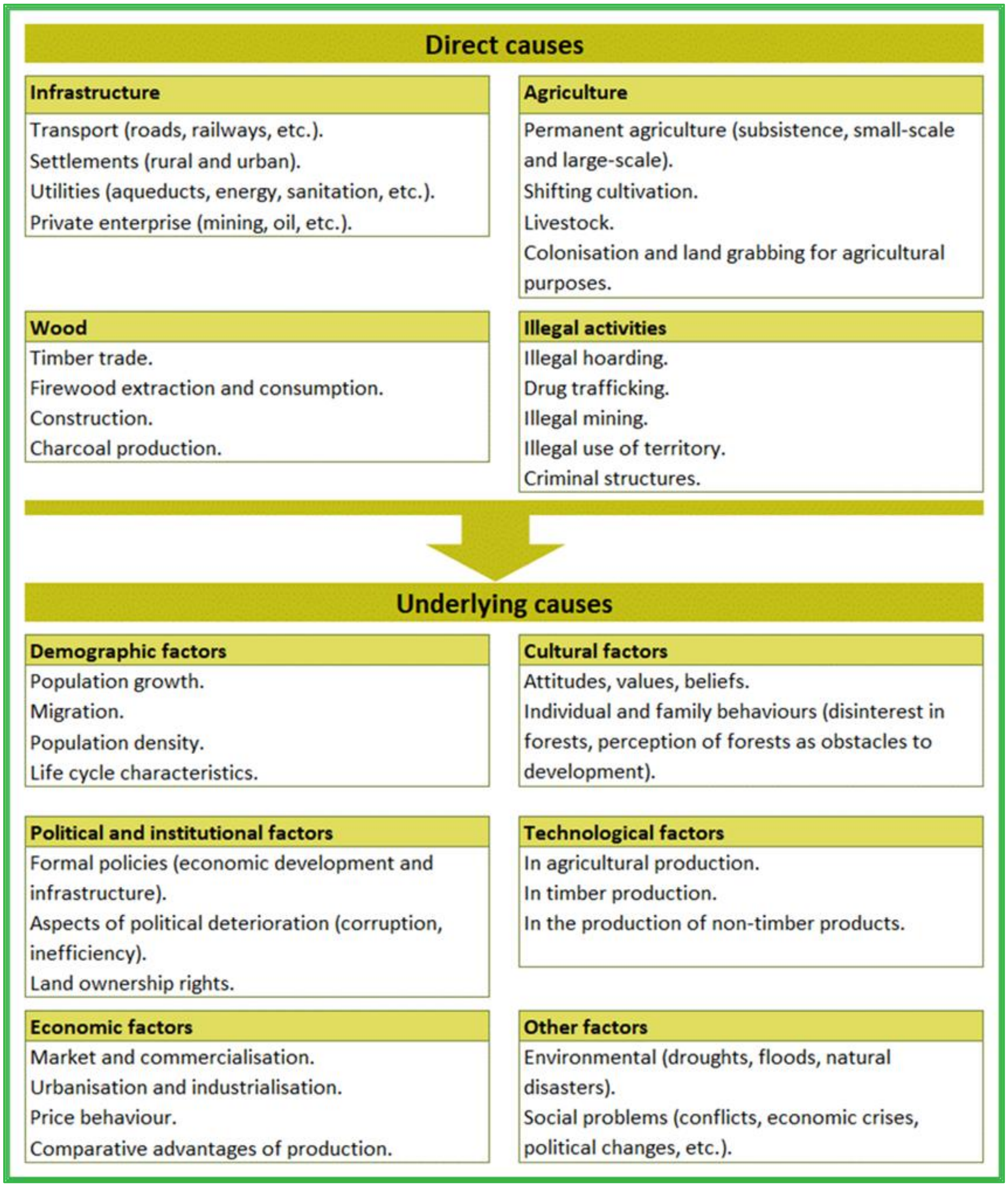
It is recommended that the remaining iterations are carried out on an annual basis according to the circumstances of the CCMP. This means that the first diagnosis of causes and actors is done in the consolidation of the PDD. Once the first verification is done, one calendar year should be counted and the dialogues at the local level and the information on socio-economic factors should be reprocessed to analyse the new behaviours of the agents and causes.

The CCMP should describe the agents and drivers of direct land use change, as well as the associated underlying causes that will determine the dynamics of activities to be implemented (***Figure 1***). It is recommended to use a variety of information (e.g., expert consultation, participatory social assessments, literature review, etc.).

To this is added the knowledge of future conditions that directly or indirectly influence the decision of the different agents (e.g., new policies that encourage the production of a certain crop, policies around land use, among others).

Underlying causes are classified as those related to social, economic, demographic, technological, political, and institutional and cultural factors. The behaviour of the underlying and direct causes should be described at the project level.

Figure 1. Direct and underlying causes of land use change.



Source: Adapted from Geist & Lambin (2002).

For the description of the agents and drivers of land use change present in the segment, the combination of remotely sensed information with field-corroborated social dynamics data is recommended. For spatial analysis, mappable indicators associated with economic activities can be used. *Table 4* provides a framework of variables that can be considered and measured in an analysis of agents and drivers of deforestation that may be applicable to non-forest wetlands.

The delimitation of the agents and drivers of land use change analysis is based on the identification of micro-watersheds overlapping or adjacent to the project area or a smaller area, in case a restricted distribution of such agents and drivers operating in the project area is demonstrated, which constitutes the reference area (see ***spatial limits section of the methodology***). The delimitation of micro-watersheds should follow the guidelines available at the national level (this methodology uses the micro-watershed as the unit of analysis, however, other similar elements that apply in each country can be integrated). In cases where micro-watersheds do not represent a logical unit of analysis of agents and drivers of deforestation or land cover/land use change of non-forest wetlands (e.g., because there are external factors that influence these agents and drivers, such as administrative divisions or infrastructure elements that generate specific conditions in each sector), the CCMP may use, with due justification, a different spatial delimitation for the analysis of agents and drivers of land use change.

Table 4. Mapping indicators and data sources of the main activities associated with land use change (drivers).

Activity/driver of land use change	Mapping indicator	Common data sources (national level)	Common data sources for GHG emissions estimation (national level)	Examples of other indirect data
Commercial agriculture	Large areas logged, post-harvest land use.	Historical satellite imagery (e.g., Landsat).	Traditional forest inventories / field measurements.	Commodity prices, agricultural censuses, share of gross domestic product, exports, among others.
Subsistence farming, smaller crops, and rotational crops	Small, logged areas, usually associated with rotation cycles.	Historical satellite images with high temporal density or high resolution to determine rotation pattern.	Traditional forest inventories / field measurements and targeted surveys.	Population growth in rural and urban areas, agricultural imports and exports, land use practices, among others.
Expansion of infrastructure	Road network, new mines, and built-up areas.	Historical satellite images.	Traditional forest inventories / field measurements.	Growth in urban and rural population, infrastructure development programmes, import and export prices of raw materials (mining).
Industrial or commercial harvesting of wood and non-wood products	Small-scale canopy damage, logging roads and associated infrastructure.	Historical satellite imagery analysed in conjunction with concession areas. Direct analysis for recent years.	Traditional forest inventories / field measurements and harvest estimates from commercial forestry activities. GHG emission factors can be measured consistently over each historical period.	Rural and urban population growth, percentage of energy users and sources of energy, consumption patterns and their changes.

Activity/driver of land use change	Mapping indicator	Common data sources (national level)	Common data sources for GHG emissions estimation (national level)	Examples of other indirect data
Extraction of products from the ecosystem for subsistence, local and regional markets	Very small-scale canopy damage, understorey impacts, footpaths.	- Limited historical data. - Information from local studies or national *proxies*. - Only long-term cumulative changes can be observed by satellite imagery.	- Limited historical data. - Information from local scale studies. - Community-based monitoring has a key role. - Other indirect methods of measuring carbon stock changes can be employed.	Land use practices (e.g., agricultural burning), links to other activity data attributable to burning, fire prevention and natural fires.
Other disturbances (e.g., uncontrolled fires)	Burn scars and associated impacts.	Historical fire-related satellite data, analysed in conjunction with Landsat-type data.	Regular estimation of emissions can be measured consistently for different periods depending on data availability.	

Source: Adapted from Kissinger *et al*., 2012.

3.1.1 Additional segment analysis factors

In addition to the behaviour of the economic activities described above and summarised in *Table 4*, the following factors should be analysed in the segment:

Biophysical factors

Climate, soils, lithology, topography, relief, hydrology, and vegetation, which show spatial-temporal variation.

Economic and technological factors

Consider, for example, the commercialisation and growth of international timber markets or economic variables with low domestic costs (land, labour, fuel, etc.), increased product prices and the demands of remote urban and industrial centres.

Production factors

Analyse production systems and their influence on land use change, whether they are in forest areas, legally or illegally established in the project reference area. For example: extractive industries, legal timber extraction, illegal timber extraction, cattle ranching, illicit crops, among others.

Demographic factors

The composition and distribution of the population, as well as the context in which the population interacts with other factors, are the most important demographic aspects for understanding the pressure on land use and land cover changes, as well as the analysis of migration processes, which in turn are linked to other non-demographic factors, such as government policies, changes in consumption patterns and globalisation, which is clearly facilitated by the construction of infrastructure (e.g. access roads).

Institutional factors

Government policies play a major role in forest cover transformations, either directly or indirectly, mediating and interacting with demographic, economic, biophysical, and other factors. For example, access to land, capital, technology, and information are structured and often limited by national policies and institutions.

For the identification of the likely segments for the CSE, the available information on areas susceptible to restoration considered in national plans will be included in the analysis of agents and causes.

Territorial analysis

A product of the spatial information associated with the agents and causes is a map indicating how the different sources of pressure on the ecosystems operate. This map should be easy to read and illustrative, as with this input it is recommended that participatory social mapping processes are carried out by means of a broad convocation of actors in the CCMP area. This process is achieved through the establishment of working groups in which it is confirmed whether what is detected in the mappable inputs is happening. This last step is what determines the diagnosis of the agents and causes of deforestation or land cover/land use change of non-forest wetlands. It is also recommended to have as input the construction of timelines that include motivations, memories, histories, attitudes, values, perceptions, as well as personal and collective beliefs that affect decision-making.

With the socio-economic information compiled, a summary timeline of the factors that have generated the processes of land use change must be constructed. In addition, correlations of events and trend analysis of these variables will be carried out for the most effective design of CCMP actions, a reference framework of actions is included in ***Annex 3 of the methodology***.

If, for example, the relationship between the analysis of agents and causes shows that the main agent of land use change is the illegal occupants of extensions of land for the establishment of livestock in an indigenous reservation, and this is confirmed by the information on land use change, community testimonies and secondary information that describes historical processes of occupation of the reservation, after corroborating this process, actions should be generated from the CCMP such as those included in the table below.

Table 5. Examples of actions to reduce deforestation and forest degradation in an indigenous reservation by improving local governance.

Possible actions to reduce land use change	
	Formulate and implement an ethnic-territorial planning instrument.

Administration measures	Strengthen the governance of indigenous people in their reservation through funding for their organisational structures and administrative capacity building for the design and implementation of projects.
Control measures	Implement a local early warning system for land use change.
	Co-finance an agreement with the environmental authority to strengthen control processes in the reservation.
	Support the development of command-and-control measures, so that complaints about logging processes can be enforced without putting the community at risk.
Planning measures	Design and implement a roadmap for accessing financial mechanisms such as PES for forest cultural services.

One tool that can be included for the analysis of the current and future behaviour of the agents and drivers of land use change is the construction of risk maps of non-forest wetland loss, based on the variables analysed. If this alternative is implemented, the cartographic inputs and sources used must be traceable, for which it is recommended that ***Table 6*** be considered.

Table 6. List of cartographic inputs and sources used.

Mapping factor	Source	Variable that represents	Variable analysis	Data evaluation range	Criterium	Algorithm or equation used	Comments
ID	Filename	Units	Description				

In the framework of this methodology, risk maps are complementary tools for the analysis of drivers and causes and, therefore, for the design of land-use actions to avoid deforestation, forest degradation or land cover/land use change of non-forest wetlands. However, they do not replace projection systems and the inclusion in the baseline scenario of activities other than deforestation.

3.2 Considered carbon pools

The carbon pools included in the segment are those that can be measured to assess the carbon content in the baseline scenario and whose changes are assessed in the project scenario associated with the activities considered.

The pools that can be included in the segment are presented in ***Table 7***.

Table 7. Pools that can be included in the segment.

Pool	Inclusion	Comments
Above-ground tree biomass	**Opt.**	May be included, although tree biomass does not reach the definition of forest in these ecosystems. Includes woody tree biomass. Includes stems, stumps, branches, bark, seeds, and foliage. This pool is expected to be maintained due to avoided land cover changes and avoidance of wetland drainage.
Above-ground non-tree biomass	**Opt.**	Pool subject to segment activities. includes non-tree and woody biomass (shrubs and herbaceous). Includes stems, branches, bark, seeds, and foliage. This pool is expected to be maintained due to avoided land cover changes and avoidance of wetland drainage.

Pool	Inclusion	Comments
Below-ground biomass	**Opt.**	May be included, although tree biomass does not reach the definition of forest in these ecosystems. Includes living root biomass greater than 2 mm in diameter. This pool is expected to be maintained due to avoided land cover changes and avoidance of wetland drainage.
Dead wood and coarse and fine detritus	**No**	Pool not subject to segment activities. Includes aboveground non-living wood, either standing or fallen such as dead roots and stumps greater than 10 cm in diameter.
Wood products	**No**	Pool not subject to segment activities.
Soil organic carbon (SOC)	**Yes**	Pool subject to segment activities. Includes organic carbon from mineral and organic soils at a minimum depth of 30 cm and roots less than 2 mm in diameter. Soil organic carbon content is expected to be maintained, due to avoided land cover changes and avoidance of wetland drainage.

3.3 Specific considerations for the soil organic carbon pool

The CCMP should estimate the impacts of drainage and land use change on CO_2 emissions and removals from organic soils due to increased microbial decomposition caused by drainage or land use change. This methodological module does not consider the loss of dissolved organic carbon (DOC) in drainage waters that would occur in the baseline scenario, as the available science and data are insufficient to provide guidance on CO_2 emissions or removals associated with these carbon fluxes.

The most important factors considered for estimating in situ CO_2 emissions and removals from drained organic soils are land use and climate. Other factors, such as soil fertility and drainage level, affect emissions and can be considered where appropriate and with suitable methods. It is recommended to stratify the use categories generated by land use change according to climate classification, fertility, and drainage.

For the estimation of changes in SOC, the CCMP should use annual emission factors that estimate C losses following drainage, which stimulates oxidation of previously accumulated organic matter in a largely anoxic environment. The area of drained organic soils for land use change in each climate type present in the segment is multiplied by the associated emission factor to obtain an estimate of annual CO_2 emissions in that stratum. The emission factor used should be at the local level, developed based on direct measurements and supported by official publications or studies published in peer reviewed articles.

3.4 GHG emission sources considered

The potential sources of GHG emissions included in the baseline scenario of this segment are due to the land cover/land use change of non-forest wetlands and correspond accordingly to the GHG emissions avoided by these actions in the project scenario due to the implementation of the segment activities.

The GHG emission sources identified in the baseline scenario are to be monitored in the project scenario.

Table 8. GHG emission sources that can be included in the segment.

Process - source	GHG	Inclusion	Details
Biomass removal or burning for land use conversion.	CO_2	Yes	Activity considered in the segment, in the baseline scenario. CH_4 and N_2O conservatively excluded.
	CH_4	No	
	N_2O	No	
Emissions and removals from drained inland organic soils on cropland, grassland, wetlands, settlements, and other lands.	CO_2	Yes	Activity considered in the segment's baseline scenario.
Emissions from drainage ditches or channels.	CH_4	Yes	Activity considered in the segment baseline scenario.
	CO_2	Yes	
Release of dissolved organic carbon (DOC) from organic soils to drainage water.	CO_2	Yes	Activity considered in the segment baseline scenario.
Peatland fires.	CO_2	Yes	Activity considered in the segment if peatlands are shown to be present and can be spatialised.
	CH_4	Yes	
	CO	Yes	

In the case of burns and fires, following the IPCC (2006) guidelines, it is essential to understand the nature of these, to classify them as anthropogenic or different, and their calculation corresponds to the carbon fraction of the available fuel mass (biomass).

To make an estimate in a consistent manner, it is necessary:

- Obtain estimates of the area burnt.
- Estimate the mass of fuel available for combustion, which includes live biomass, litter, and dead wood.
- Select combustion factor.
- Select GHG emission factors.

3.5 GHG emission factors

GHG emission factors should be representative of the non-forest wetland strata in the segment and should demonstrate internal consistency with the area where activity data is monitored and the project area.

Quantification should be performed on the pools affected by the significant sources (accumulating 90 % of carbon) and with measurement feasibility. For these pools, GHG emission factors are calculated based on local inventories or data from official local studies or published in indexed journals.

For field measurement it is recommended to follow national forest inventory manuals or similar, adjusted to non-forested wetland conditions. These inventories, and other processes of compiling information on GHG emission sources and carbon pools should have a representative number of samples to determine in each area, for each segment and for each stratum, the variables needed in the calculation of carbon content in all affected pools and for all selected sources.

To classify a source as significant, information on potentially significant GHG emission sources and their estimation is recorded, arranged in a table in ascending order of the total amount of carbon emitted in the historical period in the CCMP area, and all activities less than or equal to the 90th percentile are classified as significant. As definitive emission factors are often not available at the time of this calculation, they can be used from secondary information.

GHG emission factors are calculated on the pools that may be affected by the changes highlighted in green, as indicated in ***Table 9*** and net emissions are assumed (the values of the new land use land covers are considered).

Above-ground and below-ground biomass pools should be included. In case any GHG emission source or carbon pool is not estimated, the reasons should be duly explained. Similarly, it is possible that information gaps may occur in the activity data. For these cases it is proposed to use the notation NA (not applicable) or NE (not estimated).

Field sampling (inventory) allows the compilation of data on the structure and composition of the non-forested wetland to feed statistical methods for estimating the carbon content of the selected pools.

The rationale for the selection of statistical methods should be clearly documented. The selection of its parameters should be consistent with ***Figure 1 of the methodology***. In case the CCMP does not have adequate developments for the segment, data from official local studies or data published in indexed journals can be applied, considering the process described in the reliability principle.

In ***Table 9***, the matrix includes possible changes in land use according to IPCC (2006); it is common for the CCMP to report changes in forest/non-forest categories. Both options are valid, if they are justified.

Table 9. Matrix of land use changes that may occur in the CCMP intervention area and in the NF-IW-Org-dra segment.

<table>
<tr><th colspan="2" rowspan="2">Land use</th><th colspan="6">x_1 (ha)</th><th rowspan="2">Total (ha)</th></tr>
<tr><th>Forest land</th><th>Agricultural land</th><th>Pasture</th><th>Settlements</th><th>Secondary vegetation</th><th>Other land</th></tr>
<tr><td rowspan="6">x_2 (ha)</td><td>Forest land</td><td>Degradation</td><td></td><td colspan="4">Removals</td><td></td></tr>
<tr><td>Agricultural land</td><td rowspan="5">Emissions</td><td></td><td></td><td></td><td></td><td rowspan="3">Emissions</td><td></td></tr>
<tr><td>Pasture</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Settlements</td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Secondary vegetation</td><td></td><td colspan="4">Removals</td><td></td></tr>
<tr><td>Other land</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="2">Total (ha)</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

x: Represents the time variable.

x_1: Historical period.

x_2: Projection period.

(grey)	Transitions included in the methodology but not included in the segment.
(green)	Transitions potentially included in the segment.

Selected official local studies or studies published in indexed journals should be used in the data range in which they were constructed and follow the quantification recommendations of their authors (e.g., corrections for heteroscedasticity).

The data in the field forms are evidence of monitoring and should be documented and available for verification and use in subsequent calculations.

In calculating the net loss of carbon stocks, the estimate of the statistically representative carbon content of the land covers that have replaced the non-forested wetland should be included.

The **below-ground biomass** is assumed to degrade linearly, over a period of 20 years from the time of the land use change; therefore, the annual factor corresponds to 5 % of the total below-ground tree biomass concerned. These values are accounted for annually for 20 years, starting from the year after the land use change. In the case of estimating emissions from land use change in the **soil organic carbon** pool, the carbon content is emitted in equal proportions over a period of oxidation (recommended twenty years) after the land use change event occurs, so each annual estimate should include the expected portion of soil emissions for the year in which the estimate is made.

The emission factors calculated for this segment are the same for the baseline scenario and the project scenario.

3.6 Baseline scenario activity data

The selection of activities and the procedures for the calculation of activity data should be internally consistent with the baseline scenario. If new emission sources are identified, they should be included in the project scenario and the baseline scenario reassessed.

3.7 System and projection period

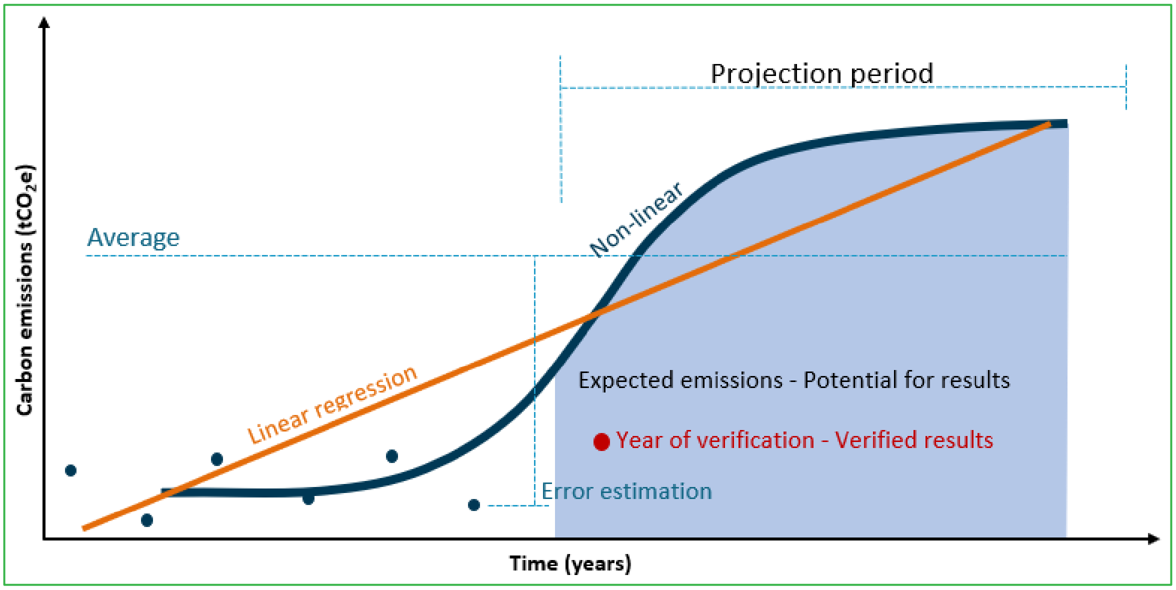
The choice of the land use change projection system should be a function of accuracy and relevance. To assess accuracy, the one that demonstrates the least error between model and actual data should be selected. Projections can be linear (trends or imputations of constant rates of land use change), non-linear (e.g., logistic models) or models based on the probability of wetland loss as a function of socio-economic or biophysical variables.

The appropriateness of the projection method is assessed in terms of choosing a reliable method (demonstrating its appropriateness through scientific references).

Figure 2 exemplifies the theoretical choice of method, where the total amount of emissions and potential GHG emission mitigation outcomes is the area under the curve (highlighted in blue).

The projection should include information for the historical period (annual emissions) that allows estimating the most realistic possible trend. In cases of linear trends, all annual data of the historical series should be included. For models that partially require information from the historical series (e.g., land use change rate from a logistic model, calculated from two years), you should be conservative in the choice of method and years of the projection.

Figure 2. Example of a projection period.



A cut-off of the activity data monitored and during the historical period should be made. This will be the base information for the projection.

Possible equations for estimating the annual land use change projection are averages, linear projections, or non-linear projections, such as logistic or models that correlate socio-economic and biophysical variables with the probability of such change. Two examples follow:

Logistic model:

$$AdefBL_x = \frac{Adef}{1 + e^{a+bx}} \quad \text{(Eq. 1)}$$

Variable	Name	Units
$AdefBL_x$	Area with land use change in the segment's baseline scenario in year x (over the historical period).	ha
Adef	Area of non-forested wetland susceptible to land use change.	ha
e	Euler constant.	
a	Model constant.	
bx	Annual land use change rate for the last couple of years of the historical period.	

The imputation of a fixed annual land cover/land use rate, e.g., as proposed by Puyravaud (2003):

$$FCR = \left(\frac{1}{(x_2 - x_1)} \times Ln\frac{A_2}{A_1}\right) \cdot 100 \qquad \text{(Eq. 2)}$$

Variable	Name	Units
FCR	Fixed annual land cover/land use change rate.	
X_1	Starting year of the analysis period.	
X_2	Final year of the analysis period.	
A_1	Non-forested wetland areas in the first year of the land use change period analysed.	ha
A_2	Non-forested wetland areas in the last year of the period of land use change analysed.	ha

In this case, the annual land use change area of the baseline scenario of the segment ($AdefBL_t$) would be calculated as:

$$AdefBL_t = FCR \times Adef \qquad \text{(Eq. 3)}$$

Variable	Name	Unit
$AdefBL_t$	Annual deforested area of the baseline scenario of the deforestation segment.	ha
FCR	Fixed annual land cover/land use change rate.	
Adef	Area of forest susceptible to deforestation.	ha

3.8 Estimated GHG emissions from the baseline scenario

The total GHG emissions of the baseline scenario is the sum of the annual emissions of the projection period from land use change in the segment.

3.8.1 Sequence and segment calculations

Process	Variable and calculation	Data source
Baseline scenario (estimated future GHG emissions in the absence of the project)		
Analysis of agents and drivers of land use change.		Done by the developer.
Temporal delimitation.	t = CCMP year index. T = Total CCMP duration, in years.	Defined by developer.
Area delimitation.		
— Reference area.		GIS layers defined by the developer based on the possibilities and analysis of actors and causes.
— Potential leakage area.		
— Leakage management area.		
— Define the potential non-forest wetland land use change segment.		
— — The stratum index of the segment's baseline scenario is defined.	f	Defined in the methodology.

Process	Variable and calculation	Data source
Define the total number of strata of the segment baseline scenario.	TSSLB	Defined by the developer according to the characteristics of the non-forest wetland.
Define the area of each stratum ***f*** of the segment baseline scenario.	$ASBL_f$	
Determine the above-ground biomass per unit area of each stratum ***f*** of the segment's baseline scenario.	AbS_f	Inventories or acceptable references.
Determine the below-ground biomass per unit area of each stratum ***f*** of the segment baseline scenario.	BbS_f	Field measurement or allometric model supported.
Determine soil organic carbon per unit area of each stratum ***f*** of the segment's baseline scenario.	$SocS_f$	Field measurement or acceptable references.
Define emission sources.		CO_2, CH_4 and N_2O, as selected.
Calculate annual below-ground biomass (inf included) emission factors for each stratum f of the segment baseline scenario.	$EFBbS_f = \frac{BbS_f}{20}$ until t = 20. (Eq. 4)	Calculation.
Estimate annual land cover/land use change activity data for each stratum ***f*** of the segment's baseline scenario.	$ADSBL_{t,f}$	Projection based on analysis of agents and drivers of deforestation and land cover/land use change of non-forest wetlands.
Estimate land use change emissions in each year ***t*** and each stratum ***f*** of the segment baseline scenario.	$CO2ESBL_{t,f} = ADSBL_{t,f} * (AbS_f + EFBbS_f + SocS_f)$ (Eq. 5)	Calculation.
Estimate cumulative emissions from land use change in all strata of the segment baseline scenario.	$CO2ESBL = \sum_{t=1}^{T} \sum_{f=1}^{TSSBL} CO2ESBL_{t,f}$ (Eq. 6)	Calculation.

4 Identification and calculation of the project scenario of the segment

The project scenario depends mainly on the activities carried out on the territory and their effect on land use change. The calculation of GHG emissions should correspond to the result of the change in GHG emission sources and the selected carbon pools for which the following general steps should be followed:

- Calculation of total and annual emissions of the baseline scenario expected for the projection period.
- Implementation of project actions in the territory.
- Quantification of results.

In addition, leakage and compliance with safeguards and Sustainable Development Goals (SDGs) should be analysed and described jointly for all segments considered in the CCMP.

4.1 Mitigation actions

Once the segment activity data has been estimated and the agents and drivers of land use change in the segment have been identified, the actions to be implemented are determined, initiated, and documented.

Considered actions must not impair the natural functions, hydrological conditions, sedimentation, and native vegetation of wetlands.

In the implementation of the actions considered in this methodology, actions should be territorial, i.e., not exclusively focused on policy changes, although if they exist, they should be reported.

Territorial actions must be supported by the commitment of landowners and landholders to contribute to the project's actions.

Actions can be developed exclusively with the communities, in alliances with government institutions or with private actors. In each case, the starting date of the activity and the period in which land cover/land use change of non-forest wetlands reduction is generated due to its implementation should be specified.

Note 1: The longest range of time that any project activity is generating change in any project activity (in any segment) determines the duration of the CCMP.

Note 2: The time at which the generation of changes in REDD+ activities by CCMP activities begins determines the end point of the historical period and the beginning of the projection period (without and with project scenarios).

Actions to reduce land use change should be aligned with the current environmental policy in the country implementing the CCMP. Possible actions to reduce land use change at project level are included in ***Annex 3 of the methodology***.

Actions to reduce land use change can be synergistic, complementary, or identical to those undertaken in the other segments of the CCMP.

The avoided land use change of the project scenario arises from the comparison of the expected land use change of the corresponding segment and the annual data during the result period.

4.2 Stratification of the project scenario

When the segment has different stratification criteria or classes in the stratification criteria compared to the baseline scenario, it will be necessary to stratify differently from the baseline scenario.

As in the baseline scenario, in any of the cases where stratification is necessary, it will be necessary to define the land cover of each stratum in each segment. If, in any of the segments, scenarios or in the implementation of activities, no subdivision of areas is required, a single stratum will be considered to exist (and therefore the corresponding sub-index will have a single value equal to one).

4.3 Carbon pools

All pools included in the baseline scenario of the segment must be considered in the project scenario (following the principle of internal consistency). Furthermore, no pools may be added or removed during the duration of the CCMP.

In this methodology, the inclusion of at least the soil organic carbon pool in the segment is mandatory.

All selected pools are considered to remain constant in areas that remain as non-forest wetland and therefore the values defined for each pool remain static for the duration of the CCMP.

4.4 GHG emission sources

The GHG emission sources that can be included or excluded from the project activity are shown in ***Table 8***. Their selection should demonstrate internal consistency with the emission sources included in the baseline scenario.

4.4.1 Potential leakage area

Based on the characterisation of agents and drivers of land use change, a potential leakage area, outside the CCMP monitoring area, is defined based on four criteria:

1. Areas where the same productive activities associated with the agents and drivers of land use change are present.
2. Ecosystem equivalence with the project area.
3. Micro-watersheds adjacent to the project monitoring area (if in the reference area).
4. Stable non-forest wetland areas.

Where demonstrable evidence can be collected that the land use change in the potential leakage area is attributable to agents not linked to the CCMP area, the detected land use change is not attributed to the project activity and shall not be considered as leakage.

Over this potential leakage area, a leakage management area (defined in the ***spatial limits section of the methodology***) is delimited.

The possible sources of GHG emissions due to leakage that can be included or excluded from the project activity are shown in ***Table 10***.

Table 10. Leakage considered in a CCMP.

Source	GHG	Inclusion	Explanation
Displacement by grazing and live-stock production	CO_2	Optional	To be considered if significant in the potential leakage area.
	CH_4	Optional	To be considered if significant in the potential leakage area.
	N_2O	No	Excluded (manure management is not included in the scope of this methodology).
Displacement by agricultural activi-ties	CO_2	Optional	To be considered if significant in the potential leakage area.
	CH_4	Optional	To be considered if significant in the potential leakage area.
	N_2O	No	Excluded.
Increased fertiliser use	CO_2	No	Excluded.
	CH_4	No	Excluded.
	N_2O	Optional	To be considered if significant in the potential leakage area.
Timber harvesting	CO_2	Optional	To be considered if significant in the potential leakage area.
	CH_4	Optional	To be considered if significant in the potential leakage area.
	N_2O	No	Excluded.
Deforestation	CO_2	Yes	To be considered if significant in the potential leakage area.
	CH_4	Optional	To be considered if significant in the potential leakage area.
	N_2O	No	Excluded.

The relevance of the inclusion of leakage in the CCMP is defined by entering the monitoring area in the CCMP. If the project is in overlap with a reference level, leakage is not accounted for.

4.5 GHG emission factors of the project scenario

All GHG emission factors included by the CCMP in the baseline scenario must be considered in the project scenario.

4.6 Project scenario activity data

The selection of activities and the procedures for the calculation of activity data should be internally consistent with the baseline scenario. If new emission sources are identified, they should be included in the project scenario and the baseline scenario reassessed.

Monitoring of the segment activity data must be performed annually and over the years of the results period, both in the segment area, the monitoring area, and the leakage area.

4.7 Estimated avoided emissions from the implementation of segment activities

The sequence and calculations of the segment **Reducing GHG emissions from land-use change and drainage of non-forested inland wetlands with organic soils (NF-IW-Org-dra)**, are summarised below.

Annex 4 of the methodology lists different sources of complementary information useful for the estimation and calculation of some variables mentioned below.

Process	Variable and calculation	Data source
Project scenario (estimated future GHG emissions if the project were to be implemented)		
Define actions to reduce land use change in the segment.		Defined by the developer.
The stratum index of the project scenario of the segment is defined.	g	Defined by the methodology.
Define the total number of strata of the segment project scenario.	TSSP	Defined by the developer, depending on the characteristics of the forest.
Define the area of each stratum ***g*** of the segment project scenario.	ASP_g	Determined by the developer.
Estimate the annual land use change activity data for each stratum ***g*** of the segment project scenario.	$ADSP_{t,g}$	Projection based agents and causes analysis and effectiveness of planned activities.
Determine the aboveground biomass per unit area of each stratum ***g*** of the segment project scenario.	AbS_g	Acceptable inventories or references.
Determine the belowground biomass per unit area of each stratum ***g*** of the segment project scenario.	BbS_g	Field measurement or allometric model supported.
Determine soil organic carbon per unit area of each	$SocS_g$	Field measurement or acceptable references.

Process	Variable and calculation	Data source
stratum ***g*** of the segment project scenario.		
Calculate annual below-ground biomass (if included) emission factors for each stratum ***g*** of the segment project scenario.	$EFBbS_g = \frac{BbS_g}{20}\ until\ \mathrm{t} = 20.$ (Eq. 7)	Calculation.
Calculate the land use change emissions in each year ***t*** and each stratum ***g*** of the segment project scenario.	$CO2ESP_{t,g} = ADSP_{t,g} * \left(AbS_g + EFBbS_g + SocS_g\right)$ (Eq. 8)	Calculation.
Calculate land use change emissions for all strata of the segment project scenario.	$CO2ESP = \sum_{t=1}^{T} \sum_{g=1}^{TSSP} CO2ESP_{t,g}$ (Eq. 9)	Calculation.

4.8 Leakage estimation

For the potential leakage area, estimates of potential leakage emissions resulting from the implementation of the activities of all segments considered in the CCMP should be made as indicated in the methodology.

5 Estimated net GHG emission reductions from the segment

Using the same method as for estimating activity data and emission factors, mitigation results are calculated annually, comparing the expected baseline scenario data with that obtained because of the implementation of the segment's actions.

Based on ***Table 9*** and ***Figure 2***, the point at which the historical period ends, and the results period (projection period) begins is identified, which corresponds to the point at which the segment's actions influence the land cover/land use change of non-forest wetlands.

Using the same methods and procedures used to estimate activity data and emission factors in the historical period, during the accreditation period, the volume of results is calculated for each year by comparing the expected (projected) data with that obtained because of the implementation of the segment's actions.

The results are expressed annually in tonnes of carbon dioxide (tCO_2) over the entire accreditation period.

Process	Variable and calculation	Data source
Estimation of the total mitigation potential of the segment		
Calculate the total mitigation in each year ***t*** of the segment.	$$TMS_t = \sum_{f=1}^{TSSBL} CO2ESBL_{t,f} - \sum_{g=1}^{TSSP} CO2ESP_{t,g}$$ (Eq. 10)	Calculation.
Calculate total segment mitigation.	$$TMS = \sum_{t=1}^{T} TMS_t$$ (Eq. 11)	Calculation.

6 Monitoring and quantifying results

6.1 Frequency of monitoring

In this segment, monitoring of GHG emission reductions should be annual, while monitoring of GHG emissions should be done on a continuous basis, as outlined in ***Section 6.3***.

Activity data should be monitored during the years of the results period, in the CCMP area and in the potential leakage and leakage management areas.

6.2 Monitoring the implementation of the activities proposed for the segment

The CCMP activities implemented within the segment area must be consistent with the project area management plans and the PDD. The CCMP shall include, in the monitoring report, a summary of the activities carried out in the segment during each verification period and their effectiveness in terms of climate change mitigation, in the context of the activities proposed in the PDD, comparing what was planned with what was implemented.

In the segment of GHG emission reductions from change of use and drainage of non-forest inland wetlands with organic soils, activity data must be monitored annually over the years of the results period, in the segment area and in the potential leakage and leakage management areas (which is defined at the project level and not at the segment level).

If the data used for the emission factors applicable to the segment come from local inventories, official local studies or published in indexed journals and it is evident that there are no significant changes in the emission factors in the monitored categories of the baseline scenario, the emission factors used in the project scenario should be the same and the inventory does not need to be repeated.

6.3 Emissions monitoring

This module only covers non-CO_2 gas emissions from forest fires. Increases in these emissions should only be estimated and accounted for if they were included in the baseline scenario.

To estimate the increase in GHG emissions due to forest fires in the potential leakage area, it should be assumed that forest clearing is done by burning the forest. The parameter values used to estimate emissions shall be the same as those used to estimate forest fires in the baseline scenario, except for the initial carbon buffers, which shall be those of the initial forest classes burned in the potential leakage area.

The CCMP shall keep a logbook of burn and fire occurrence, where the information shown in ***Table 11*** shall be reported. Based on this table, and according to the procedures established in the CDM tool[2], GHG emissions will be estimated for each occurrence and then the annual sum and for the corresponding verification periods.

Table 11. Possible structure of the fire and burn occurrence reporting table.

Date	Stratum	Affected area (ha)	Burnt biomass (%)	Comments

The result of the estimates should be reported using the same table formats used in the *ex-ante* assessment of baseline GHG emissions from forest fires in the CCMP area.

6.4 Carbon stocks monitoring

To quantify the actual GHG removals and GHG emission reductions achieved in the segment, it is necessary to monitor the changes in carbon stocks and GHG emissions within the segment by monitoring the following components:

- **Land use and land cover change within the segment**. It is necessary to monitor all forest areas that are converted to non-forest areas. Monitoring results must be presented in *ex-post* tables of activity data by stratum. It is mandatory that this monitoring is carried out throughout the duration of the CCMP.
- **Changes in carbon stocks**. In most cases, emission factors per land use or land cover category will not change during a fixed reference period and will not need to be monitored. However, monitoring of carbon buffers is mandatory within the segment for areas subject to a significant decrease in project scenario carbon buffers according to the initial assessment. In these areas, changes in carbon buffers should be estimated at least once after each harvesting event.
- **Impacts of natural disturbances and other catastrophic events**. Decreases in carbon stocks and increases in GHG emissions are subject to monitoring and must be accounted for under the project scenario, where significant, even if such decreases are due to natural causes, e.g. in case of forest fires or natural disturbances such as hurricanes, earthquakes, volcanic eruptions, tsunamis, floods, droughts and the like, or human-induced events, including those over which the project proponent has no control (such as fires, acts of terrorism and war). In the case of forest fires, non-CO_2 emissions from forest fires should also be accounted for.
- **Estimated total changes in actual net carbon buffers and emissions (including leakage) of GHGs in the segment area**. Considering the above elements, the estimated total changes of actual net carbon buffers and GHG emissions in the segment should be calculated and summarised in a table.

6.5 Segment stratification

As in the case of the project scenario, when different stratification criteria or classes in the stratification criteria are present during the implementation of the activities compared to

[2] *A/R Methodological Tool: Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity (Version 04.0.0).*

the baseline scenario, a stratification different from the baseline scenario (and possibly also different from the project scenario) will be necessary.

As in the baseline and project scenarios, in any case where stratification is necessary, the land cover of each stratum in each segment must be defined. In case no subdivision of areas is required in any of the segments, scenarios or in the implementation of activities, a single stratum will be considered to exist (and therefore the corresponding sub-index will have a single value equal to one).

6.6 Monitoring of leakage management areas

Monitoring of the leakage management areas is performed for the total CCMP, not for each segment separately. Please refer to the methodology for further details.

6.7 Monitoring of increases in GHG emissions

Increases in GHG emissions from fires and burning should only be estimated and accounted for if they are included in the baseline scenario.

To estimate the increase in GHG emissions due to fires in the potential leakage area, it should be assumed that vegetation clearing is done by burning. The parameter values used to estimate emissions will be the same as those used to estimate fires in the baseline scenario, except for the initial carbon buffers, which will be those of the initial classes burned in the potential leakage area.

The result of the estimates shall be reported using the same table formats used in the *ex-ante* assessment of baseline GHG emissions from forest fires in the segment.

6.8 Anthropogenic GHG emission reductions *ex-post* from the segment

Ex-post estimated net anthropogenic GHG emissions should be reported using the same table format used for the *ex-ante* assessment. ***Annex 4 of the methodology*** lists different sources of supplementary information useful for the estimation and calculation of some variables which are mentioned below, together with relevant considerations, in ***Table 12***.

Table 12. Process for calculating the segment's anthropogenic GHG *ex-post* emission reductions.

Process	Variable and calculation	Data source
Monitoring and quantification of results (calculation of the reductions reached in the segment)		
Index of the effectively implemented stratum of the segment.	h	Defined by the methodology.
Define the total number of strata effectively existing in the segment.	TSSE	Defined by the developer based on the characteristics

Process	Variable and calculation	Data source
		of the non-forest wetland.
Define the area of each stratum ***h*** effectively existing in the segment.	ASE_h	Determined by the developer.
Monitor and determine the areas with land use converted in each year ***t*** and each stratum ***h*** of the segment.	$ADSE_{t,h}$	Monitoring.
Monitor and determine the emissions from leakage that effectively occurred in each year ***t*** in the potential leakage area.	ELE_t	Monitoring and calculation.
Define the number of years from the start of the project until the time of monitoring corresponding to reporting period ***x*** (where ***x*** is the ordinal of the reporting period).	Tx	Defined by developer.
Estimate emissions from deforestation in all strata during monitoring period x of the segment's baseline scenario.	$CO2ESBL_x = \sum_{t=1}^{Tx} \sum_{f=1}^{TSSBL} CO2ESBL_{t,f}$ (Eq. 12)	Calculation.
Quantify emissions occurring in all strata of the segment during monitoring period x.	$CO2ESE_x = \sum_{t=1}^{Tx} \sum_{h=1}^{TSSE} \sum_{f=1}^{TSSBL} \left(ADSE_{t,h} * \left(AbS_f + EFBbS_f + SocS_f\right)\right)$ (Eq. 13)	Calculation.
Calculation of mitigation reached during the reporting period		
Quantify segment mitigation during reporting period x.	$SM_x = CO2ESBL_x - CO2ESE_x - SM_{(x-1)}$ * (Eq. 14)	Calculation.

*Where $SM_{(x-1)}$ is the mitigation of the segment during the previous reporting period.

Variable	Name	Units
SM_x	Mitigation reached in the segment during reporting period x.	tCO_2

6.9 Summary of results during the monitoring period

The annual mitigation achieved in the segment during reporting period x (**SM_x**) should be disaggregated together with the carbon buffer and presented according to ***Table 13***. The results for each monitoring year should be presented in separate rows.

Table 13. Disaggregation of mitigation results obtained during the monitoring period.

Segment:											
Year	Baseline scenario (t-CO_2e)					Monitoring period results (t-CO_2e)					Total gross reductions (t-CO_2e)
	Carbon stocks			Emissions		Carbon stocks			Emissions		
	Above ground biomass	Below ground biomass	Soil organic carbon	N_2O	CH_4	Above ground biomass	Below ground biomass	Soil organic carbon	N_2O	CH_4	
Total											

6.10 Monitoring and revalidation of the baseline scenario

Baseline scenarios, regardless of the approach chosen to establish them, need to be revised over time because the agents, drivers, and underlying causes of change of land use change dynamically. They also need to be updated when new instances are added to grouping CCMPs.

Frequent and unplanned updating of the baseline scenario can create serious market uncertainties. Therefore, the baseline scenario should be reviewed every five years, choosing historical and projection periods that do not generate inconsistencies and inconsistencies with the periods already verified and, therefore, with the results obtained and accredited. The tasks involved in the revision of the baseline scenario are:

- Update information on agents, drivers, and underlying causes of land use change.
- Periodically collect information on the agents, drivers, and underlying causes of deforestation in the reference area as these are essential to improve future land use change projections and segment activity design. Information should be collected that is relevant to understanding the agents of land use change, drivers, and underlying causes. When a spatial model is used to locate future land use change, new data on the spatial driving variables used to model land use change risk should be collected as they become available. They should be used to create updated spatial datasets and new "Driver Maps" for the subsequent fixed reference period.
- Adjust the land use and land cover change component of the baseline scenario.
- Adjust the annual reference deforestation areas.
- Adjust the location of projected reference deforestation.
- Adjust the carbon component of the baseline scenario.

6.11 Verifiable requirements in the implementation of the CCMP

The calculations of emission factors, activity data, historical period and projection method are performed by means of a verifiable methodological reconstruction, based on the execution of the baseline and project scenario building steps of the methodology in the segment. In case this reference is not available in the country, other academically based procedures can be followed.

In line with the principle of transparency, all information necessary for the reconstruction of the segment results should be documented.

6.12 Monitoring data and parameters

The data and parameters to be monitored are presented in ***Table 11*** and ***Table 12***.

7 Document history

Version	Date	Comments or changes
1.0	03.11.2022	Initial version of the document is open for public consultation from 03.11.2022 to 02.12.2022.
1.1	23.02.2023	Final version with integrated comments from the public consultation.