



T-VER-P-TOOL-01-10
Methods for Stratification of the Project Area
in Mangrove and Seagrass

Version 01

1. Introduction

This document is a tool for stratification of the project area in mangrove and seagrass, in case the project area is in heterogeneous form, to accurately assess carbon stock by sink. This method is used for stratification based on soil characteristics, including land use and greenhouse gas emissions from the soil organic carbon, unless GHG emissions from soil organic carbon are omitted. In the equation, i is used for sub-areas, M is the total number of sub-areas, M_{WPS} is the total number of sub-areas in the project implementation and M_{BSL} is the total number of sub-areas in the baseline.

2. Relevant definitions

Details are shown in Annex 1

3. Characteristics of relevant activities and conditions

This document is a tool for project activities with the restoration of mangrove forests and seagrasses where the boundaries of the project area must be defined to prevent drainage outside the project area.

4. Methodology

It may be stratified for estimation (ex-ante) and may be re-examined when monitoring the estimation results (ex-post). In any case, the project proponent must prepare a map in the project document.

4.1 Requirements for areas that can be used in mangrove and seagrass restoration project activities

Areas that can be used for CO₂ emission reduction project activities must have the total soil organic carbon content 100 years after the project implementation and the baseline is significantly different. This can be considered using the following equation

In the case of no leakage from project activities

$$\sum_{i=0}^{M_{WPS}} (C_{PROJ,i,t100} \times A_{PROJ,i,t100}) \geq 1.05 \times \sum_{i=0}^{M_{BSL}} (C_{BSL,i,t100} \times A_{BSL,i,t100})$$

Equation 1

In case of leakage from project activities

$$\left(\sum_{i=0}^{M_{WPS}} (C_{PROJ,i,t100} \times A_{PROJ,i,t100}) - \left(\sum_{i=0}^{M_{BSL}} (C_{BSL,i,t100} \times A_{BSL,i,t100}) \right) \right) \times LKF \geq 1.05 \times \sum_{i=0}^{M_{BSL}} (C_{BSL,i,t100} \times A_{BSL,i,t100}) \quad \text{Equation 2}$$

$$LKF = GHG_{LK-WRC} / GHG_{BSL-WRC} \quad \text{Equation 3}$$

When:

$C_{PROJ,i,t100}$ = Soil organic carbon from project implementation in area i at t=100; tonnes of carbon per rai

$C_{BSL,i,t100}$ = Soil organic carbon in the baseline in area i at t=100; tonnes of carbon per rai

$A_{PROJ,i,t100}$ = Area size of the project in area i at t=100; rai

$A_{BSL,i,t100}$ = Area size of baseline in area i at t=100; rai

LKF = Leakage factor

$GHG_{BSL-WRC}$ = GHG emissions in the baseline of project activities, net until year t; tonnes of carbon dioxide equivalent

GHG_{LK-WRC} = Greenhouse gas emissions from the leakage of project activities, net until year t; tonnes of carbon dioxide equivalent

t_{100} = 100 years after the project start date

The total soil organic carbon from the project implementation and the baseline after 100 years can be calculated from the following equation.

$$C_{BSL,i,t100} = C_{BSL,i,t0} - \left(\sum_{t=1}^{t=100} CO_{2_BSL_SOIL,t} \times 12/44 \right) \quad \text{Equation 4}$$

$$C_{PROJ,i,t100} = C_{BSL,i,t0} - \left(\sum_{t=1}^{t=100} CO_{2_PROJ_SOIL,t} \times 12/44 \right) \quad \text{Equation 5}$$

When

$C_{BSL,i,t100}$ = Soil organic carbon in the baseline in area i at t=100; tonnes of carbon per rai

$C_{PROJ,i,t100}$ = Soil organic carbon from project implementation in area i at t=100; tonnes of carbon per rai

$CO_{2_BSL_SOIL,t}$ CO_2 emissions from soil organic carbon of the baseline in area i in year t; tonnes of carbon dioxide equivalent per rai per year

$CO_{2_PROJ_SOIL,t}$ CO_2 emissions from soil organic carbon of the project in area i in year t; tonnes of carbon dioxide equivalent per rai per year.

If it is negative, it must be adjusted to zero according to the law of conservation.

$C_{BSL,i,t0}$ = Soil organic carbon in the baseline at the project start date in area i; tonnes of carbon per rai. At a depth of 1 m, the standard values in Table 1 are applied unless different values are proven.

t_{100} = 100 years after the project start date

$12/44$ = Unit conversion from tonnes CO_2e per year to tonnes carbon per year

Table 1. Standard value for soil carbon content.

Characteristics of project area	$C_{BSL,i,t0}$ (tonnes of carbon per rai)
mangrove forest	
organic soil	75.36
inorganic soil	45.76
organic soil combined with inorganic soil	61.76
seagrass	17.28
Source: IPCC, 2013	

4.2 The effect of sea level rise on the geographic extent of the project area

Proponents must take into account sea level rise and the potential for wetland migration, drowning and erosion that will affect the scope of the project area. This is because the project area cannot be changed during the crediting period. Project proponents can predict sea level rise for both the base case and project implementation from forecasts provided by the IPCC or from research appropriate to the project site. Including the use of information from expert opinion. If predicted by the IPCC, which is forecasting the impact on a global scale,

the project proponents need to take into account such conditions for impacts calculation at the project area level such as the collapse of the area. Topography slope, land use, and land management must be reported, together with exogenous sediment loads and tidal extents from published research and/or from the use of expert opinion data, such as consideration of waterway obstructions. in nearby areas that may result in coastal squeeze.

The trend of tidal extent changes depends on the amount of suspended sediment entering the area. If the suspended sediment content is > 300 mg/l, it will balance with seawater rise as predicted by the IPCC at a difference of at least 1 meter in elevation and elevation. The project proponent may use a lower amount of suspended sediment in the water as appropriate. Alternatively, project proponents may suggest that some areas in the baseline are submerged causing no GHG emissions into the atmosphere and/or some areas under the project. Calculation of GHG emissions from eroded and/or sub-merged soils must follow conservation rules, or the project proponent may suggest that it is insignificant both in the base case and from the project implementation.

Project site extent projections shall be reported by map from the project commencement date until the end of the credit application period and, where applicable, an additional 100 years of sea level change rates.

4.3 Source of sea grass

The project proponent must stratify the seagrass source according to clearly distinguishable depth levels and the characteristics of the soil sediment.. The erosion or increase of the project area must be taken into account in the base case. Project proponents are only credited for maintaining and conserving for the seagrass at its original depth. Credits cannot be earned for seagrass expansion. That differs from the depth in the baseline .

4.4 Estimation of land erosion

Erosion in wetlands in low tide is divided into two categories: 1) area subject to changes in sea level, sediment content, and human activities such as navigation; and 2) area that is blinded by wind waves or far from the open sea that may be eroded by the amount of sediment that exceeds the amount of sea water. It is therefore necessary to forecast future erosion, both with sea level rise, sediment loads and human activities. Project proponents

must take into account factors that may cause erosion, which will vary from area to area. Therefore, specialist advice may be required if the area is very complex.

An indication of erosion is the density of waterways. (The area of the waterway to the total project area) by more than 20% or there may be a change of the original vegetation to vegetation that grows in more flooded areas. There is an increase in the height of the water level when compared to the average water level during the high tide period. The area with the amount of sediment suspended in sea water > 300 milligrams per liter. will balance the situation of increasing the amount of sea water.

4.5 Landscape stratification based on vegetation cover for the use of standard values for SOC accumulation rate

Standard values for the accumulation rate of soil organic carbon may be applicable in areas with different coverage. As for the baseline coverage, it depends on the time period. The coverage part under the project implementation period is calculated based on existing research papers.

4.6 Salinity stratification for CH₄ emission calculation

The project area may be stratified according to the salinity value used in the CH₄ emission calculation. which has a salinity value close to that of open sea water while areas with limited exchange of water have a different salinity than open sea water. Therefore, the frequency of sea water exchange was used to classify the landscape instead of the salinity value. If the number of samples is less than once per month for a year The minimum salinity value must be used instead of the average salinity value.

4.7 Stratification for a non-tidal water source

Water sources where water is not exchanged with tidal water, such as wells, ditches, must be calculated separately from other areas. There will be no CH₄ emissions from these water sources unless there is an expansion of the water area during the course of the project.

5. Relevant information and parameters

5.1 Information and parameters required monitoring

Parameter	$A_{WPS,i,t} ; A_{i,t}$
Unit	Rai
Definition	The area size for the project i in year t
Source of information	Monitoring report
Monitoring method	- Area exploration - Use satellite/air photographs.
Frequency of monitoring	According to the monitoring cycle for certification
Remark	-

6. Reference

1. VCS Module: VMD0016 - Methods for Stratification of the Project Area (X-STR; Version 1.2)
2. 2013 Supplement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Wetlands

Annex

Annex 1 Relevant definitions

Baseline	The occurrence of normal greenhouse gas emissions where a greenhouse gas emission reduction project has not yet been implemented.
Tidal wetland restoration	Creation or improvement of hydrology, salinity, water quality, sediment supply or vegetation in degraded or converted intertidal wetlands including activities that create wetlands on areas higher than sea level rise. Activities that convert one wetland type to another and those that convert open sea areas to wetlands.
CO ₂ emission reduction project	Projects that have implemented project activities to reduce carbon dioxide emissions compared to the baseline.
Salinity Average	The average salinity of the wetlands used shows variation in salinity during periods of high CH ₄ emission such as the growing season in temperate ecosystems.
Salinity Low Point	The average salinity of the wetlands used shows variation in salinity during periods of high CH ₄ emission, such as the growing season in temperate ecosystems.
Organic Soils	<p>Organic soil is soil that has various characteristics as specified by the FAO, which must have the characteristics in items 1 and 2 or items 1 and 3 as follows:</p> <p>(1) having a thickness of 10 centimeters or more Soil thickness < 20 cm. must contain organic carbon of 12% or more when soil mixing reaches a depth of 20 cm.</p> <p>(2) In case the soil has never been saturated with water for more than 2-3 days and has >20% by weight of organic carbon in the soil (approximately 35% of organic matter in the soil).</p> <p>(3) In case the soil is saturated with water and</p> <p>(i) have at least 12% by weight of soil organic carbon (approximately 20% organic matter) where the soil does not contain clay minerals, or</p>

	<p>(ii) have at least 18% by weight of soil organic carbon (approximately 30% organic matter) where the soil contains 60% or more of clay minerals, or</p> <p>(iii) moderate soil organic carbon for clay minerals with moderate levels.</p> <p>Area data should be classified according to climatic zones, i.e. temperate and humid tropics. and classified by soil fertility for temperate forest areas organic soil area information may be compiled from the country's official statistical data or the organic soil area of each country reported by the FAO. (http://faostat.fao.org/)</p> <p>Source: 2006 IPCC Guidelines (Vol. 4 Chapter 3)</p>
Mineral soil	Soils that do not fall within the definition of organic soils.
Open Water	Areas where the water level is at the ground level, not above the water during low tide.
Mangrove	Wetland with predominantly mangrove vegetation, both shrubs and perennials. It grows in salt water along the coast or in brackish water areas.
Wetland	<p>Areas of water resources in the land that both occur naturally (1) and man-made (2) having a permanent and temporary flooding nature, both still and flowing water sources freshwater, brackish and saltwater, as well as marine and coastal areas (3), as well as coastal ecosystems and islands surrounded by interconnected ecosystems. with more detailed descriptions as follows:</p> <p>(1) Naturally occurring wetlands in the land (Inland wetlands): creeks, marshes, canals, lagoons, ponds, reservoir, rivers, streams, tributaries, streamlet, canal banks, banks, streams, ponds, lakes, basins, basins, lake, fields, lake, marshland, freshwater swamp forest, bog, waterfall, rapids (2) human-made wetlands, such as dams, reservoirs, rice fields, salt fields, permanent and temporary flooding, agricultural farming, aquaculture farming, or various water canals (3) marine and coastal wetlands (Marine/coastal wetlands) means coastal areas in the area</p>

	include islands, rocky beaches, sandy beaches, mudflats, mudflats, seashores, rock formations, coral reefs, seagrass, bays, delta, estuaries, swamp forests, mangroves, and forests.
Tidal wetland	Wetlands under the influence of tidal currents (e.g., wet marshes, forests in floodplain areas seagrass and mangrove forests) including submerged seagrass beds.
Degraded tidal wetland	Wetlands affected by humans or nature cause physical, chemical or biological changes that affect the diversity of life. Decreased soil carbon content or the complexity of the ecosystem's role.
Seagrass meadow	The area where seagrass is present, as defined, includes the living community and geographic areas where the community is present. It is typically found in subtidal areas that are always underwater, but can also be found in areas that are exposed during low tide.



Document information

Version	Amendment	Entry into force	Description
01	--	1 March 2023	-