WR Methodological Module

Estimation of project scenario carbon stock changes from Wetland Restoration (PS-WR)

I. SCOPE, APPLICABILITY AND PARAMETERS

Scope

This module provides methods for estimating *ex-post* carbon stock enhancement related to Wetland Restoration (WR) for the project case.

This module shall also be used for developing an *ex-ante* estimate of carbon stock enhancement for the project scenario.

Applicability

This module is always mandatory when the project activity does not include hydrologic management or when emissions have been determined to be insignificant in BL-WR-HM or BL-WR-HM-WL.

Parameters

This module produces the following parameters:

Parameter	SI Unit	Description
ΔC_{ACTUAL}	t CO_2-e	Cumulative total carbon stock changes and greenhouse gas emissions for the project scenario.
ΔC_p	t CO_2-e	Cumulative total carbon stock changes for the project scenario

II. PROCEDURE

This module proceeds in five steps:

Step 1. With-project stratification

Step 2. Monitoring project implementation

Step 3. Monitoring of carbon stocks in selected pools

Step 4. Monitoring of emission sources

Step 5. Estimation of project emission reductions or enhanced removals

Step 1. With-project stratification

If the project activity area is not homogeneous, stratification should be carried out to improve the accuracy and precision of carbon stock estimates. Different stratifications may be required

for the baseline and project scenarios. For estimation of *ex-ante* carbon stocks, strata should be defined based on parameters that affect GHG removal and/or that are key variables for the methods used to measure changes in biomass stocks, for example:

a. Management regime
b. Vegetation type and species
c. Age class
d. Trend in land loss conversion
e. Water quality (e.g. salinity, nutrient inputs, distance from source, etc.)
f. Hydrology
g. Elevation and subsidence rates
h. Site index and anticipated growth rates

Project Proponents must present in the GHG Project Plan an *ex-ante* stratification of the project area or justify the lack of it. The stratification for *ex-ante* estimations shall be based on the actual implementation of the project planting/management plan. If aerial or satellite imagery is used by the Project Proponent to delineate strata, for example by vegetation type, the imagery needs to be ground-truthed. The number and boundaries of the strata defined *ex-ante* may change during the crediting period (*ex-post*).

The *ex-post* stratification shall be updated if natural or anthropogenic impacts or other factors add variability to the growth pattern or emissions of the project area. For example:

- Unexpected disturbances occur during the crediting period (e.g., hurricane, drought, pests or disease outbreaks) that affect differently various parts of an originally homogeneous stratum;
- Established strata may be merged if reasons for their establishment have disappeared.

Step 2. Monitoring project implementation

Information shall be provided and recorded in the monitoring plan as part of the GHG Project Plan, to establish that:

- The geographic position of the project boundary is recorded for all areas of land;
- The geographic coordinates of the project boundary (and any stratification inside the boundary) are established, recorded, and archived.
- Commonly accepted principles of wetland inventory and management are implemented;
- Standard operating procedures (SOPs) and quality control / quality assurance (QA/QC) procedures for wetland inventory including field data collection and data management shall be applied. Use or adaptation of SOPs already applied in wetland monitoring, or

available from published handbooks, or from the *IPCC GPG LULUCF 2003*, is recommended;

- The monitoring plan, together with a record of the plan as actually implemented during the project, shall be available for validation and verification, as appropriate.

Step 3. Monitoring of Carbon Stocks in Selected Pools

This modular methodology allows for the estimation of changes in carbon stocks in selected tree and soil pools. Monitoring methods can be found in CP-TB and CP-S. Information shall be provided, and recorded in the monitoring plan as part of the GHG Project Plan, to establish that professionally accepted principles of wetland inventory and management are implemented. Standard operating procedures (SOPs) and quality control/quality assurance (QA/QC) procedures for wetland inventory including field data collection and data management shall be applied. Use or adaptation of SOPs already applied in wetland monitoring, or available from published handbooks, or from the *IPCC GPG LULUCF 2003,* is recommended. The wetland management plan, together with a record of the plan as actually implemented during the project shall be available for verification, as appropriate.

The 90% statistical confidence interval (CI) of sampling can be no more than +/- 10% of the mean estimated amount of the combined carbon stock across all strata[1]. If the Project Proponents cannot meet the targeted +/- 10% of the mean at 90% confidence, then the reportable amount shall be the lower bound of the 90% confidence interval.

A 5-year monitoring frequency is considered adequate for the carbon pools included in this methodology. To ensure that the monitoring frequency adequately reflects the changes in the carbon pools, any changes observed for each pool during the monitoring interval shall be recorded. For a carbon pool that is likely to change slowly, the monitoring frequency can range from 5 to 20 years. In situations where the project adopts a 40-year renewable Crediting Period, the monitoring frequency can be fixed to coincide with the Crediting Period.

Step 4. Monitoring of Emission Sources

If project activities include moving sediments, fossil fuel combustion emissions must be quantified during project activities. Monitoring methods can be found in module E-FFC. Fossil fuel combustion emission sources due to moving of sediments shall be quantified using module E-FFC if determined to be significant using module T-SIG. *Ex-ante* an estimate shall be made of fuel consumption based on projected fuel usage.

Step 5. Estimation of Project Emission Reductions or Enhanced Removals

[1] For calculating pooled CI of carbon pools across strata, see equations in Barry D. Shiver, *Sampling Techniques for Forest Resource Inventory (John Wiley & Sons, Inc, 1996)*

This section describes how to calculate ΔC_P (cumulative total of the carbon stock changes and GHG emissions under the project scenario up to time t, in ton CO_2-e).

Under the applicability conditions of this methodology:

- It is recognized that above- and below-ground biomass of non-tree vegetation, dead wood and litter contribute to the SOC pool in wetlands. They are conservatively assumed to be zero for all strata in the project scenario and can be quantified in the SOC pool to prevent double counting.

The actual net GHG removals by sinks shall be estimated using the equations in this section. When applying these equations for the *ex-ante* calculation of actual net GHG removals by sinks, Project Proponents shall provide estimates of the values of those parameters that are not available before the start of the crediting period and commencement of monitoring activities. Project Proponents should retain a conservative approach when making these estimates.

$$\Delta C_{ACTUAL} = \Delta C_p - E_{FC,i,t} \quad (1)$$

where:

ΔC_{ACTUAL}	Cumulative total of carbon stock changes and greenhouse gas emissions under the project scenario up to time *t*; t CO_2-e
ΔC_p	Cumulative total of carbon stock changes under the project scenario up to time *t*; t CO_2-e
$E_{FC,i,t}$	Emission from fossil fuel combustion in stratum *i* in year *t;* t CO_2-e (E-FFC).[2]

Note: In this methodology, equation 1 is used to estimate actual net GHG removals by sinks for the period of time elapsed between project start ($t = 1$) and the year $t = t^*$, t^* being the year for which actual net GHG removals by sinks are estimated. The 'stock change' method should be used to determine annual or periodical values.

Estimation of changes in the carbon stocks

The verifiable changes in the carbon stock in tree biomass and soil organic carbon within the project boundary are estimated using the following approach:

$$\Delta C_p = \Delta C_{TREE} + \Delta C_{SOC} \quad (2)$$

[2] Only include in equation if project activities include moving sediment and fossil fuel combustion emissions have been determined to be significant using module T-SIG.

where:

ΔC_p Cumulative total of carbon stock changes under the project scenario; t CO_2-e.

ΔC_{TREE} Cumulative tree carbon stock for the project scenario; t CO_2-e (CP-TB)

ΔC_{SOC} Cumulative soil carbon stock for the project scenario; t CO_2-e (CP-S)

PARAMETERS ORIGINATING IN OTHER MODULES

Data /parameter:	$E_{FC,i,t}$
Data unit:	t CO_2-e
Used in equations:	1
Description:	Emission from fossil fuel combustion in stratum *i* in year *t*
Module parameter originates in:	E-FFC
Any comment:	Corresponding information shall be included in the GHG Project Plan

Data /parameter:	ΔC_{TREE}
Data unit:	t CO_2-e
Used in equations:	2
Description:	Cumulative total of the carbon stock changes of living tree biomass under the project scenario
Module parameter originates in:	CP-TB
Any comment:	Corresponding information shall be included in the GHG Project Plan

Data /parameter:	ΔC_{SOC}
Data unit:	t CO_2-e
Used in equations:	2
Description:	Cumulative total of the carbon stock changes of soils for the baseline scenario
Module parameter originates in:	CP-S
Any comment:	Corresponding information shall be included in the GHG Project Plan