

**AR-AM0014**

## A/R Large-scale Methodology

---

# Afforestation and reforestation of degraded mangrove habitats

Version 02.0.0

Sectoral scope(s): 14



**United Nations**  
Framework Convention on  
Climate Change

<b>TABLE OF CONTENTS</b>	<b>Page</b>
<b>1. INTRODUCTION .....</b>	<b>3</b>
<b>2. SCOPE, APPLICABILITY, AND ENTRY INTO FORCE .....</b>	<b>3</b>
2.1. Scope .....	3
2.2. Applicability .....	3
2.3. Entry into force .....	3
<b>3. NORMATIVE REFERENCES .....</b>	<b>4</b>
<b>4. DEFINITIONS .....</b>	<b>4</b>
<b>5. BASELINE AND MONITORING METHODOLOGY .....</b>	<b>5</b>
5.1. Selection of carbon pools and greenhouse gases accounted .....	5
5.2. Identification of the baseline scenario and demonstration of additionality .....	6
5.3. Stratification .....	6
5.4. Baseline net GHG removals by sinks .....	6
5.5. Actual net GHG removals by sinks .....	7
5.6. Leakage .....	9
5.7. Net anthropogenic GHG removals by sinks .....	9
5.8. Calculation of tCERs and ICERs .....	9
<b>6. MONITORING PROCEDURE.....</b>	<b>10</b>
6.1. Monitoring plan.....	10
6.2. Monitoring of project implementation.....	10
6.3. Precision requirements.....	10
6.4. Data requirements under the methodology .....	11

## 1. Introduction

1. This methodology allows afforestation and reforestation of wetland that constitutes degraded mangrove habitat. The methodology allows use of mangrove species and non-mangrove species but in case of more than 10 per cent area being covered by planting of non-mangrove species it prohibits changes in the hydrology of the project area. The methodology restricts the extent of soil disturbance in the project to be no more than 10 per cent. Project activities applying this methodology may choose to exclude or include accounting of any of the carbon pools of dead wood and soil organic carbon, but cannot include the litter carbon pool.

## 2. Scope, applicability, and entry into force

### 2.1. Scope

2. This methodology applies to afforestation and reforestation (A/R) project activities implemented in degraded mangrove habitats.

### 2.2. Applicability

3. This methodology is applicable under the following conditions:
  - (a) The land subject to the project activity is degraded mangrove habitat;
  - (b) More than 90 per cent of the project area is planted with mangrove species. If more than 10 per cent of the project area is planted with non-mangrove species then the project activity does not lead to alteration of hydrology of the project area and hydrology of connected up-gradient and down-gradient wetland area;
  - (c) Soil disturbance attributable to the A/R clean development mechanism (CDM) project activity does not cover more than 10 per cent of area.<sup>1</sup>
4. A project activity applying this methodology shall also comply with the applicability conditions of the tools contained within the methodology and applied by the project activity.

### 2.3. Entry into force

5. The date of entry into force of the revision is the date of the publication of the EB 70 meeting report on 23 November 2012.

---

<sup>1</sup> For example, digging pits of size 0.50 m × 0.50 m (length × width) at a spacing of 3 m × 3 m is equal to a coverage of 2.78 per cent; continuous ploughing of land is equal to a coverage of 100 per cent.

### 3. Normative references

6. The following documents are indispensable for application of this methodology:<sup>2</sup>
- (a) Clean development mechanism project standard;
  - (b) A/R methodological tools:
    - (i) “Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities;”
    - (ii) “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities;”
    - (iii) “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities;”
    - (iv) “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities;”
    - (v) “Estimation of non-CO<sub>2</sub> GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity;”
    - (vi) “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity;”

### 4. Definitions

7. The definitions contained in the following documents shall apply:<sup>3</sup>
- (a) “Glossary of CDM terms”;
  - (b) “Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism (A/R CDM modalities and procedures) as contained in the annex to decision 5/CMP.1”;
  - (c) “IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry, 2003”.
8. For the purpose of this methodology, the following specific definitions also apply:
- (a) **Degraded mangrove habitat** - means wetlands where, in their natural state, mangrove vegetation can grow and have soil or sediment that is usually water-logged with water that is saline or brackish, and that were subjected to impacts resulting in decrease of forest cover below that reported by the host Party to the

---

<sup>2</sup> These documents are available online at: <http://cdm.unfccc.int/Reference/index.html>

<sup>3</sup> These documents are available online at the following URLs:

(a) <<http://cdm.unfccc.int/Reference/index.html>>;

(b) <<http://cdm.unfccc.int/Reference/COPMOP/index.html>>;

(c) <<http://www.ipcc.nggip.iges.or.jp/public/gpoglulucf/gpoglulucf.html>>.

Executive Board (hereinafter referred to as the Board) of the CDM according to paragraph 8 of annex to the decision 5/CMP.1 (A/R CDM modalities and procedures);

- (b) **Soil disturbance** - means any activity that results in a decrease in soil organic carbon (SOC), for example ploughing, ripping, scarification, digging of pits and trenches, stump removal, etc.

## 5. Baseline and monitoring methodology

### 5.1. Selection of carbon pools and greenhouse gases accounted

9. The carbon pools selected for accounting of carbon stock changes are shown in Table 1.

**Table 1. Carbon pools selected for accounting of carbon stock changes**

<b>Carbon pool</b>	<b>Whether selected</b>	<b>Justification/Explanation</b>
Above-ground biomass	Yes	This is the major carbon pool subjected to project activity
Below-ground biomass	Yes	Carbon stock in this pool is expected to increase due to the implementation of the project activity
Litter	No	Litter biomass is subjected to high turnover and displacement due to tidal currents. It is a conservative choice to exclude the pool from accounting because the project activity will not decrease the rate of accumulation of litter
Dead wood and Soil organic carbon	Optional	Carbon stock in these pools may increase due to implementation of the project activity

10. The emission sources and associated greenhouse gases (GHGs) selected for accounting are shown in Table 2.

**Table 2. Emission sources and GHGs selected for accounting**

Sources	Gas	Whether Selected	Justification/Explanation
Burning of woody biomass	CO <sub>2</sub>	No	CO <sub>2</sub> emissions due to burning of biomass are accounted as a change in carbon stock
	CH <sub>4</sub>	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology
	N <sub>2</sub> O	Yes	Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology

## 5.2. Identification of the baseline scenario and demonstration of additionality

11. The “Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities” shall be applied for the purpose of identification of the baseline scenario and demonstration of additionality.

## 5.3. Stratification

12. If biomass distribution over the project area is not homogeneous, stratification should be carried out to improve the precision of biomass estimation. Different stratifications may be appropriate for the baseline and project scenarios in order to achieve optimal precision of estimation of net GHG removals by sinks. In particular:
- For baseline net GHG removals by sinks, it is usually sufficient to stratify the area according to major vegetation types and their crown cover and/or land use types;
  - For actual net GHG removals by sinks the stratification for ex ante estimations is based on the project planting/management plan and the stratification for ex post estimations is based on the actual implementation of the project planting/management plan. If natural or anthropogenic impacts (e.g. local fires) or other factors (e.g. soil type) significantly alter the pattern of biomass distribution in the project area, then the ex post stratification is revised accordingly.

## 5.4. Baseline net GHG removals by sinks

13. The baseline net GHG removals by sinks shall be calculated as follows:

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} \quad \text{Equation (1)}$$

Where:

- $\Delta C_{BSL,t}$  = Baseline net GHG removals by sinks in year  $t$ ; t CO<sub>2</sub>-e
- $\Delta C_{TREE\_BSL,t}$  = Change in carbon stock in baseline tree biomass within the project boundary in year  $t$ , as estimated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO<sub>2</sub>-e
- $\Delta C_{SHRUB\_BSL,t}$  = Change in carbon stock in baseline shrub biomass within the project boundary, in year  $t$ , as estimated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO<sub>2</sub>-e
- $\Delta C_{DW\_BSL,t}$  = Change in carbon stock in baseline dead wood biomass within the project boundary, in year  $t$ , as estimated in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”; t CO<sub>2</sub>-e

## 5.5. Actual net GHG removals by sinks

14. GHG emissions resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero.
15. The actual net GHG removals by sinks shall be calculated as follows:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t} \quad \text{Equation (2)}$$

Where:

- $\Delta C_{ACTUAL,t}$  = Actual net GHG removals by sinks, in year  $t$ ; t CO<sub>2</sub>-e
- $\Delta C_{P,t}$  = Change in the carbon stocks in project, occurring in the selected carbon pools, in year  $t$ ; t CO<sub>2</sub>-e
- $GHG_{E,t}$  = Increase in non-CO<sub>2</sub> GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year  $t$ , as estimated in the tool “Estimation of non-CO<sub>2</sub> GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity”; t CO<sub>2</sub>-e

16. Change in the carbon stocks in project, occurring in the selected carbon pools in year  $t$  shall be calculated as follows:

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta SOC_{AL,t} \quad \text{Equation (3)}$$

Where:

- $\Delta C_{P,t}$  = Change in the carbon stocks in project, occurring in the selected carbon pools, in year  $t$ ; t CO<sub>2</sub>-e
- $\Delta C_{TREE\_PROJ,t}$  = Change in carbon stock in tree biomass in project in year  $t$ , as estimated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO<sub>2</sub>-e
- $\Delta C_{SHRUB\_PROJ,t}$  = Change in carbon stock in shrub biomass in project in year  $t$ , as estimated in the tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities”; t CO<sub>2</sub>-e
- $\Delta C_{DW\_PROJ,t}$  = Change in carbon stock in dead wood in project in year  $t$ , as estimated in the tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”; t CO<sub>2</sub>-e
- $\Delta SOC_{AL,t}$  = Change in carbon stock in SOC in project, in year  $t$ , in areas of land meeting the applicability conditions of the tool “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”, as estimated in the same tool; t CO<sub>2</sub>-e

17. The change in carbon stock in the SOC pool within the project boundary, in year  $t$ , shall be estimated as follows:

$$\Delta SOC_{PROJ,t} = \frac{44}{12} \times \sum_{t=1}^t A_{PLANT,t} \times dSOC_t \times 1 \text{ year} \quad \text{Equation (4)}$$

Where:

- $\Delta SOC_{PROJ,t}$  = Change in SOC stock within the project boundary, in year  $t$ ; t CO<sub>2</sub>-e
- $A_{PLANT,t}$  = Area planted in year  $t$ ; ha
- $dSOC_t$  = The rate of change in SOC stocks within the project boundary, in year  $t$ ; t C ha<sup>-1</sup> yr<sup>-1</sup>  
The following default value of is used, unless transparent and verifiable information can be provided to justify a different value:
- (i)  $dSOC_t = 0.50 \text{ t C ha}^{-1} \text{ yr}^{-1}$  for  $t = t_{PLANT}$  to  $t = t_{PLANT} + 20$  years, where  $t_{PLANT}$  is the year in which planting takes place;
  - (ii)  $dSOC_t = 0 \text{ t C ha}^{-1} \text{ yr}^{-1}$  for  $t > t_{PLANT} + 20$



## 5.6. Leakage

18. Leakage shall be estimated as follows:

$$LK_t = LK_{AGRIC,t} \quad \text{Equation (5)}$$

Where:

- $LK_t$  = GHG emissions due to leakage, in year  $t$ ; t CO<sub>2</sub>-e
- $LK_{AGRIC,t}$  = Leakage due to the displacement of agricultural activities in year  $t$ , as estimated in the tool “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity”; t CO<sub>2</sub>-e

## 5.7. Net anthropogenic GHG removals by sinks

19. The net anthropogenic GHG removals by sinks shall be calculated as follows:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t \quad \text{Equation (6)}$$

Where:

- $\Delta C_{AR-CDM,t}$  = Net anthropogenic GHG removals by sinks, in year  $t$ ; t CO<sub>2</sub>-e
- $\Delta C_{ACTUAL,t}$  = Actual net GHG removals by sinks, in year  $t$ ; t CO<sub>2</sub>-e
- $\Delta C_{BSL,t}$  = Baseline net GHG removals by sinks, in year  $t$ ; t CO<sub>2</sub>-e
- $LK_t$  = GHG emissions due to leakage, in year  $t$ ; t CO<sub>2</sub>-e

## 5.8. Calculation of tCERs and ICERs

20. The tCERs and ICERs for a verification period  $T = t_2 - t_1$ , (where  $t_1$  and  $t_2$  are the years of the start and the end, respectively, of the verification period) shall be calculated as follows:

$$tCER_{t_2} = \sum_1^{t_2} \Delta C_{AR-CDM,t} \quad \text{Equation (7)}$$

$$ICER_{t_2} = \sum_{t_1+1}^{t_2} \Delta C_{AR-CDM,t} \quad \text{Equation (8)}$$

Where:

$tCER_{t_2}$  = Number of units of temporary Certified Emission Reductions issuable in year  $t_2$

$ICER_{t_2}$  = Number of units of long-term Certified Emission Reductions issuable in year  $t_2$

$\Delta C_{AR-CDM,t}$  = Net anthropogenic GHG removals by sinks, in year  $t$ ; t CO<sub>2</sub>-e

$t_1, t_2$  = The years of the start and the end, respectively, of the verification period

21. If  $ICER_{t_2} < 0$  then  $ICER_{t_2}$  represents the number of *ICERs* that shall be replaced because of a reversal of net anthropogenic greenhouse gas removals by sinks since the previous certification.

## 6. Monitoring procedure

### 6.1. Monitoring plan

22. The monitoring plan shall provide for collection of all relevant data necessary for:
- (a) Verification that the applicability conditions listed under paragraphs 3 and 4 have been met;
  - (b) Verification of changes in carbon stocks in the pools selected; and
  - (c) Verification of project emissions and leakage emissions.
23. The data collected shall be archived for a period of at least two years after the end of the last crediting period of the project activity.

### 6.2. Monitoring of project implementation

24. Information shall be provided, and recorded in the project design document (PDD), to establish that the commonly accepted principles and practices of forest inventory and forest management in the host country are implemented. If such principles and practices are not known or available, standard operating procedures (SOPs) and quality control/quality assurance (QA/QC) procedures for inventory operations, including field data collection and data management, shall be identified, recorded and applied. Use or adaptation of SOPs available from published handbooks, or from the "IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry 2003", is recommended.

### 6.3. Precision requirements

25. For this methodology, the precision requirements are those listed in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities".

**6.4. Data requirements under the methodology**

26. Description of data and parameters can be found in the tools used in this methodology.
27. Data and parameters obtained from measurement shall be monitored as required in the tools.

-----

**Document information**

<i>Version</i>	<i>Date</i>	<i>Description</i>
02.0.0	23 November 2012	EB 70, Annex 34 The revision: <ul style="list-style-type: none"> <li>• Incorporates relevant decisions and clarifications issued by the Board up to the date of publication of the EB 69 report;</li> <li>• Simplifies the requirements for accounting for leakage by removing the reference to fuel wood collection, and by using the approved tool "Tool for calculation of GHG emissions due to leakage from increased use of non-renewable woody biomass attributable to an A/R CDM project activity".</li> </ul> <p>Due to overall modification of the document, no highlights of the changes are provided.</p>
01.0.0	03 June 2011	EB 61, Annex 14 Initial adoption

Decision Class:

Document Type: Standard

Business Function: Methodology

Keywords: wetland, afforestation reforestation

---