CLEAN DEVELOPMENT MECHANISM

**AR-ACM0003**

# A/R Large-scale Methodology

# Afforestation and reforestation of lands except wetlands

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Sectoral scope(s): 14

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# 1. Introduction

1. This methodology allows afforestation and reforestation of any land that does not fall into the category of wetland. Where the land in its baseline land-use has soil organic carbon (SOC) content that is expected to be higher than that under the land-use of "forestry", the methodology restricts the extent of soil disturbance in the project to be no more than 10 per cent. The higher SOC content in the baseline may result either because of the nature of the soils (e.g. the soils are organic soils) or because of anthropogenic activities (e.g. soils are not tilled and external organic matter is added as inputs). Apart from this restriction on the extent of soil disturbance in certain types of soils and land-use practices, the methodology has a broad scope of application[1]. Project activities applying this methodology may choose to exclude or include accounting of any of the three carbon pools of dead wood, litter, and soil organic carbon.

# 2. Scope, applicability, and entry into force

## 2.1. Scope

2. This methodology excludes from its scope the land that falls into the category of wetland.

## 2.2. Applicability

3. This methodology is applicable under the following conditions:

   (a) The land subject to the project activity does not fall in wetland category;

   (b) Soil disturbance attributable to the afforestation and reforestation (A/R) clean development mechanism (CDM) project activity does not cover more than 10 per cent of area[2] in each of the following types of land, when these lands are included within the project boundary:

      (i) Land containing organic soils;

      (ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to this methodology.

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 draft methodology is the date of the publication of the EB 70 meeting report on 23 November 2012.

[1] For example, the land to be afforested or reforested does not have to be degraded land.

[2] 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:[3]

   (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-$CO_2$ greenhouse gas (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:[4]

   (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, "soil disturbance" is 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.

[3] These documents are available online at: <http://cdm.unfccc.int/Reference/index.html>.

[4] 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/gpglulucf/gpglulucf.html>.

# 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**

| Carbon pool | Whether selected | Justification/Explanation |
|---|---|---|
| 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 |
| Dead wood<br>Litter and<br>Soil organic carbon | Optional | Carbon stock in these pools may increase due to implementation of the project activity |

10. The emission sources and associated 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 | $CO_2$ | No | $CO_2$ emissions due to burning of biomass are accounted as a change in carbon stock |
| | $CH_4$ | Yes | Burning of woody biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology |
| | $N_2O$ | 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:

    (a) 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;

    (b) 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:

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

Where:

| | | |
|---|---|---|
| $\Delta C_{BSL,t}$ | = | Baseline net GHG removals by sinks in year *t*; t $CO_2$-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 $CO_2$-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 $CO_2$-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 $CO_2$-e |
| $\Delta C_{LI\_BSL,t}$ | = | Change in carbon stock in baseline litter 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 $CO_2$-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 $CO_2$-e

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t $CO_2$-e

$GHG_{E,t}$ = Increase in non-$CO_2$ 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-$CO_2$ GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t $CO_2$-e

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

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

Where:

$\Delta C_{P,t}$ = Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t $CO_2$-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 $CO_2$-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 $CO_2$-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 $CO_2$-e

$\Delta C_{LI\_PROJ,t}$ = Change in carbon stock in litter 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 $CO_2$-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 $CO_2$-e

## 5.6. Leakage

17. Leakage shall be estimated as follows:

$$LK_t = LK_{AGRIC,t} \quad \text{Equation (4)}$$

Where:

$LK_t$ = GHG emissions due to leakage, in year *t*; t $CO_2$-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 $CO_2$-e

## 5.7. Net anthropogenic GHG removals by sinks

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

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t \quad \text{Equation (5)}$$

Where:

$\Delta C_{AR-CDM,t}$ = Net anthropogenic GHG removals by sinks, in year *t*; t $CO_2$-e

$\Delta C_{ACTUAL,t}$ = Actual net GHG removals by sinks, in year *t*; t $CO_2$-e

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks, in year *t*; t $CO_2$-e

$LK_t$ = GHG emissions due to leakage, in year *t*; t $CO_2$-e

### 5.8. Calculation of tCERs and lCERs

19. The tCERs and lCERs 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:

$$tCER_{t_2} = \sum_{1}^{t_2} \Delta C_{AR-CDM,t} \quad \text{Equation (6)}$$

$$lCER_{t_2} = \sum_{t_1+1}^{t_2} \Delta C_{AR-CDM,t} \qquad \text{Equation (7)}$$

Where:

| | | |
|---|---|---|
| $tCER_{t_2}$ | = | Number of units of temporary Certified Emission Reductions issuable in year $t_2$ |
| $lCER_{t_2}$ | = | 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 $CO_2$-e |
| $t_1, t_2$ | = | The years of the start and the end, respectively, of the verification period |

20. If $lCER_{t_2} < 0$ then $lCER_{t_2}$ represents the number of *lCERs* 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

21. 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.

22. 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

23. 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

24. 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

25. Description of data and parameters can be found in the tools used in this methodology.

26. Data and parameters obtained from measurement shall be monitored as required in the tools.

# Appendix 1. Cropland in which soil disturbance is restricted

1. Cropland which is subjected, in the baseline, to the land-use, land management practices, and inputs listed in the following table attracts the restriction on the extent of soil disturbance as described in paragraph 3(b) of this methodology.

**Table 1. Cropland in which soil disturbance is restricted**[1]

| Region | Land use | Management | Inputs |
|---|---|---|---|
| Boreal | Long-term cultivated cropland | Full tillage | High with manure |
| | | Reduced tillage | High with manure |
| | | No-till | High without manure |
| | | | High with manure |
| | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | High with manure |
| | | No-till | High without manure |
| | | | High with manure |
| Temperate, cold, dry | Long-term cultivated cropland | Full tillage | High with manure |
| | | Reduced tillage | High with manure |
| | | No-till | High with manure |
| | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | High with manure |
| | | No-till | Medium |
| | | | High without manure |

[1] Adapted from "2006 IPCC Guidelines for National Greenhouse Gas Inventories". See table 5.5 on page 5.17 for a more complete description of the terms used in the table.

| Region | Land use | Management | Inputs |
|---|---|---|---|
| Temperate, cold, moist | Long-term cultivated cropland | Reduced tillage | High with manure |
| | | No-till | High with manure |
| | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | High with manure |
| | | No-till | High without manure |
| | | | High with manure |
| Temperate, warm, dry | Long-term cultivated cropland | Full tillage | High with manure |
| | | Reduced tillage | High with manure |
| | | No-till | High with manure |
| | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | High with manure |
| | | No-till | Medium |
| | | | High without manure |
| Temperate, warm, moist | Long-term cultivated cropland | Reduced tillage | High with manure |
| | | No-till | High with manure |
| | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | High with manure |
| | | No-till | High without manure |
| | | | High with manure |
| Tropical, dry | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | Medium |
| | | | High without manure |
| | | | High with manure |
| | | No-till | All |
| Tropical, moist | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | High without manure |

| Region | Land use | Management | Inputs |
|---|---|---|---|
| | | | High with manure |
| | | No-till | High without manure |
| | | | High with manure |
| Tropical, montane | Long-term cultivated cropland | No-till | High with manure |
| | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | High without manure |
| | | | High with manure |
| | | No-till | Medium |
| | | | High without manure |
| | | | High with manure |
| Tropical, wet | Short-term or set aside cropland | Full tillage | High with manure |
| | | Reduced tillage | High without manure |
| | | | High with manure |
| | | No-till | High without manure |
| | | | High with manure |

# Appendix 2. Grassland in which soil disturbance is restricted

1. Grassland which is subjected, in the baseline, to the land management practices and inputs listed in the following table attracts the restriction on the extent of soil disturbance as described in paragraph 3(b) of the methodology.

**Table 1. Grassland in which soil disturbance is restricted**[1]

| Temperature / Moisture Regime | Management | Inputs |
|---|---|---|
| Boreal | Improved | All |
| | Non-degraded | All |
| | Moderately degraded | High |
| Temperate, cold, dry | Improved | All |
| | Non-degraded | All |
| | Moderately degraded | High |
| Temperate, cold, moist | Improved | All |
| | Non-degraded | All |
| | Moderately degraded | High |
| Temperate, warm, dry | Improved | All |
| | Non-degraded | All |
| | Moderately degraded | High |
| Temperate, warm, moist | Improved | All |
| | Non-degraded | All |
| | Moderately degraded | High |
| Tropical, dry | Improved | All |
| | Non-degraded | All |
| Tropical, moist | Improved | All |
| | Non-degraded | All |
| | Moderately degraded | High |
| Tropical, montane | Improved | All |
| | Non-degraded | All |
| | Moderately degraded | High |
| Tropical, wet | Improved | All |
| | Non-degraded | High |
| | Moderately degraded | High |

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[1] Adapted from "2006 IPCC Guidelines for National Greenhouse Gas Inventories". See table 6.2 on page 6.16 for a more complete description of the terms used in the table.

## Document information

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