SIMPLIFIED BASELINE AND MONITORING METHODOLOGIES FOR SELECTED SMALL-SCALE AFFORESTATION AND REFORESTATION (A/R) CDM PROJECT ACTIVITY CATEGORIES

I. Introduction

1. This document contains simplified baseline and monitoring methodologies for selected small-scale afforestation and reforestation (A/R) CDM project activity categories. Specifically it covers:

a) A simplified baseline methodology and default factors for small-scale A/R project activities implemented on grasslands or croplands.
b) A simplified monitoring methodology based on appropriate statistical methods to estimate, measure and monitor the actual net greenhouse gas removals by sinks and leakage.

2. The most likely baseline scenario of the small-scale A/R CDM project activity is considered to be the land-use prior to the implementation of the project activity, whichever is the case grasslands or croplands. Project activities implemented on settlements or wetlands are not included in this methodology.[1]

3. The methodology is not applicable to cropland or grassland that has been ploughed before the plantation. Also the methodology does not apply to project activities where displacement of households or activities due to the implementation of the A/R CDM project activity is estimated to be larger than 50%.

4. Cases that are very specific have not been addressed by the present methodologies given that some could add complications, and that simplifications may not be possible. In accordance with decision 14/CP.10, project participants may propose new simplified methodologies or amendments to these simplified monitoring methodologies for project activities that would not fall under the applicability conditions of these baseline and monitoring methodology. Such proposed new methodologies will be subject to the consideration of the CDM Executive Board.

5. Before using simplified methodologies, project participants shall:

a) Determine whether the land of the project activity is eligible using **attachment A;**
b) Determine whether the project activity is additional using **attachment B**

II. General guidance

6. **Carbon pools** to be considered by these methodologies are above ground biomass and below ground biomass, named “living biomass pool” hereafter. Values chosen for parameters to estimate changes in carbon stocks in the baseline and monitoring methodologies, as well as the choice of approaches whenever this methodology proposes options, shall be documented, including sources and references, and justified in the CDM-SSC-AR-PDD. The choice of equations and values for parameters shall be conservative (i.e., the net anthropogenic greenhouse gas removals by sinks is not overestimated).

7. **Emissions of greenhouse gases as part of the actual net GHG removals by sinks** do not need to be accounted for.

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[1] Wetlands and settlements are not covered by the present methodologies for two reasons. First, methodologies for wetlands are still under development and given the state of knowledge, simplification is not yet possible. On the other hand, conversions from settlements and wetlands to forests are unlikely for several reasons, including the social and environmental impacts that such conversions can cause.

III. Simplified Baseline Methodologies for small scale A/R CDM Project Activities

Baseline net greenhouse gas removals by sinks

8. Simplified methodologies for estimating the baseline net GHG removals by sinks are based on the baseline approach specified by paragraph 22 (a) of the modalities and procedures for A/R under the CDM: "Existing or historical, as applicable, changes in carbon stock in the carbon pools within the project boundary".

9. According to decision 14/CP.10:

"*If project participants can provide relevant information that indicates that, in the absence of the small-scale afforestation or reforestation project activity under the CDM, no significant changes in the carbon stocks within the project boundary would have occurred, they shall assess the existing carbon stocks prior to the implementation of the project activity. The existing carbon stocks shall be considered as the baseline and shall be assumed to be constant throughout the crediting period..*"

"If significant changes in the carbon stocks within the project boundary would be expected to occur in the absence of the small-scale afforestation or reforestation project activity, project participants shall" use this simplified baseline methodology.

10. In order to assess if significant changes in the baseline carbon stocks within the project boundary have occurred in absence of the project activity, project participants shall assess whether changes in carbon stocks in the baseline land-use type (grassland or cropland), in particular the living biomass of woody perennials[2] (above- and below-ground biomass) and below-ground biomass of grasslands, are expected to be significant and provide documentation to prove this, for example, by expert judgement. Based on the results of this assessment:

a) If significant changes in the carbon stocks, in particular the living biomass of woody perennials (above- and belowground biomass) and below-ground biomass in grasslands, are not expected to occur in the absence of the project activity, the changes in carbon stocks shall be assumed to be equal to zero.
b) If the carbon stock in the living biomass of woody perennials (above- and belowground biomass) or below-ground biomass in grasslands is expected to decrease in the absence of the project activity, the baseline net greenhouse gas removals by sinks shall be assumed to be equal to zero,
   In above case, the baseline carbon stocks in the carbons pools is constant at the level of existing carbon stock measured at the start of the project activity.
c) Otherwise, baseline net greenhouse gas removals by sinks shall be equal to the changes in carbon stocks from the living biomass of woody perennials (above- and below-ground biomass) or below-ground biomass in grasslands that are expected to occur in the absence of the project activity and shall be estimated using the methodology below.

[2] Woody perennials consist of the non-tree vegetation (e.g. coffee, tea, rubber plant or oil palm) and shrubs that are present in croplands and grasslands below the threshold (in terms of canopy cover, minimum area and tree height) used to define forests.

Estimating the baseline net GHG removals by sinks

11. Baseline net GHG removals by sinks will be determined by the equation:

$$B_{(t)} = \sum_i \left(B_{A(t),i} + B_{B(t),i}\right) \cdot A_i \qquad (1)$$

where:

$B_{(t)}$ = Carbon stock in the living biomass pools within the project boundary at time "t" that would have occurred in the absence of the project activity (t C)
$B_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time "t" of stratum i that would have occurred in the absence of the project activity (t C/ha)
$B_{B\,(t)\,i}$ = Carbon stocks in belowground biomass at time "t" of stratum i that would have occurred in the absence of the project activity (t C/ha)
A_i = Project activity area of stratum i (ha)

12. Stratification of the project activity for the purposes of estimating the baseline net GHG removals by sinks shall proceed in accordance with section 4.3.3.2 of the "Good Practice Guidance for Land Use, Land-Use Change and Forestry" of the Intergovernmental Panel on Climate Change (2003) (hereafter referred as IPCC GPG for LULUCF). For each stratum, the following calculations shall be performed:

For above-ground biomass

13. $B_{A(t)}$ is calculated as follows:

$$B_{A(t)} = M_{(t)} * 0.5 \qquad (2)$$

where:

$M_{(t)}$ = Above-ground biomass at time "t" that would have occurred in the absence of the project activity (t dry matter/ha)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

14. Values for $M_{(t)}$ shall be estimated using average biomass growth rates specific to the region and the age of the woody perennial using the following equation:

if $a < m$, then $M_{(t)} = g * a$ (3)
else, $M_{(t)} = g * m$

where:

"g" is the annual biomass growth rate of the woody perennial (t dry matter/ha/yr)
"m" is the time to maturity of the woody perennial (years)
"a" is the average age of the woody perennial (years)

15. Documented local values for "g" should be used. In the absence of such values, national default values should be used. If national values are also not available, the values should be obtained from table 3.3.2 of IPCC GPG for LULUCF.

16. Values for "m" considered by the project activity shall be specified by project participants for each species considered to be part of the baseline. These values shall be identified in the CDM-SSC-AR-PDD.

For below-ground biomass

17. $B_{B(t)}$ is calculated as follows:

$$B_{B(t)} = M_{(t)} * R * 0.5 \quad (4)$$

where:

R = Root to shoot ratio (t d.m./ t d.m.)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

18. Documented local values for R should be used. In the absence of such values, national default values should be used. If national values are also not available, the values should be obtained from table 3.4.3 of IPCC CPG for LULUCF.

Actual net greenhouse gas removals by sinks

19. *"Actual net GHG removals by sinks"* only considers the changes in carbon pools for the project scenario (please refer to paragraph 8 above). The stocks of carbon for the project scenario at the starting date of the project activity[3] (i.e. t=0) shall be the same as for the projection of the baseline net greenhouse gas removals by sinks at t=0. For all other years, the carbon stocks within the project boundary at time "t" ($N_{(t)}$) shall be calculated as follows:

$$N_{(t)} = \sum((N_{A(t)\,i} + N_{B\,(t)\,i}) * A_i) \quad (5)$$

where:

$N_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time "t" of stratum i under the project scenario (t C/ha)
$N_{B(t)\,i}$ = Carbon stocks in belowground biomass at time "t" of stratum i under the project scenario (t C/ha)
A_i = Project activity area of stratum i (ha)

20. Stratification for the project scenario shall be undertaken in accordance with section 4.3.3.2 of the IPCC GPG for LULUCF. The following calculations shall be performed for each stratum:

For above-ground biomass

$$N_{A(t)} = T_{(t)} * 0.\,5 \quad (6)$$

where:

$T_{(t)}$ = Above-ground biomass at time "t" under the project scenario (t dry matter/ha)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

$$T_{(t)} = SV_{(t)} * BEF * WD \quad (7)$$

where:

$SV_{(t)}$ = Stem volume at time "t" for the project scenario (m^3/ha)
WD = Basic wood density (t dry matter/ m^3).
BEF = Biomass expansion factor (over bark) from stem volume to total volume (dimensionless)

[3] The starting date of the project activity should be considered to be the point in time when the land is prepared for the initiation of the afforestation or reforestation project activity. In accordance with paragraph 23 of the modalities and procedures for afforestation and reforestation project activities under the CDM, the crediting period shall begin at the start of the afforestation or reforestation project activity under the CDM.

21. Values for $SV_{(t)}$ shall be obtained from national sources (e.g. standard yield tables). Documented local values for BEF should be used. In the absence of such values, national default values should be used. If national values are also not available, the values should be obtained from table 3A.1.10 of IPCC GPG for LULUCF. Documented local values for WD should be used. In the absence of such values, national default values shall be consulted. If national default values are also not available, the values should be obtained from table 3A.1.9 of IPCC GPG for LULUCF.

For below-ground biomass

$$N_{B(t)} = T_{(t)} * R * 0.5 \qquad (8)$$

where:

R = Root to shoot ratio (dimensionless)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

22. Documented national values for R should be used. If national values are not available, appropriate values should be obtained from table 3A.1.8 of IPCC GPG for LULUCF

Leakage

23. According to decision 14/CP.10*:*

"*If project participants demonstrate that the small-scale afforestation or reforestation project activity under the CDM does not result in the displacement of activities or people, or does not trigger activities outside the project boundary, that would be attributable to the small-scale afforestation or reforestation project activity under the CDM, such that an increase in greenhouse gas emissions by sources occurs, a leakage estimation is not required. In all other cases leakage estimation is required."*

24. Project participants should assess the possibility of leakage from the displacement of activities or people considering the following indicators:

a) Percentage of families/households of the community involved in or affected by the project activity displaced due to the project activity, and
b) Percentage of total production of the main produce (e.g. meat, corn) within the project boundary displaced due to the CDM A/R project activity.

25. If the value of these two indicators is lower than 10%, then

$$L_{(t)} = 0$$

where:

$L_{(t)}$ = Leakage attributable to the project activity within the project boundary at time "t".

26. If the value of any of these two indicators is higher than 10% and less than or equal to 50%, then leakage shall be equal to 15% of the actual net GHG removals by sinks, that is:

$$L_{(t)} = N_t * 0.15 \qquad (9)$$

where:

$L_{(t)}$ = Leakage attributable to the project activity within the project boundary at time "t".

$N_{(t)}$ = Carbon stocks in the living biomass pools within the project boundary at time "t" under project scenario (ton C)

27. As indicated in section I, paragraph 4, if the value of any of these two indicators is larger than 50% net anthropogenic removals by sinks cannot be estimated.

28. If project participants consider that the use of fertilizers would be significant leakage of N_2O (>10% of the net anthropogenic GHG removals by sinks) emissions should be estimated in accordance with the "Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories" of the Intergovernmental Panel on Climate Change (2000) (hereafter referred as IPCC GPG).

Ex ante estimation of net anthropogenic GHG by sinks

29. *"Net anthropogenic greenhouse gas removals by sinks"* is the actual net greenhouse gas removals by sinks minus the baseline net greenhouse gas removals by sinks minus leakage.

Net anthropogenic GHG removals = actual net GHG removals by sinks– baseline net GHG removals - leakage

30. The resulting t-CERs at the year of verification "tv" are calculated as follows:

$$t\text{-}CER_{(tv)} = 44/12 * (N_{(tv)} - B_{(tv)} - L_{(tv)}) \qquad (10)$$

if changes in carbon stock are considered to be equal to zero, then $B_{(tv)} = B_{(t=0))}$ and

$$L_{(tv)} = 0.15 * N_{(tv)} \text{ (if required; see paragraph 27 above)} \qquad (11)$$

31. The resulting l-CERs at the year of verification "tv" are calculated as follows:

$$l\text{-}CER_{(tv)} = 44/12 * [(N_{(tv)} - N_{(tv-\kappa)}) - L_{(tv)}] \qquad (12)$$

$$\text{with } L_{(tv)} = 0.15 * (N_{(tv)} - N_{(tv-\kappa)}) \text{ (if required; see paragraph 27 above)} \qquad (13)$$

$$\text{and } N_{(tv-\kappa)} = N_{(t=0)} \text{ for the first verification} \qquad (14)$$

where:

$t\text{-}CER_{(tv)}$ = t-CERs emitted at time of verification "tv" (t CO_2)
$l\text{-}CER_{(tv)}$ = l-CERs emitted at time of verification "tv" (t CO_2)
$N_{(tv)}$ = Carbon stocks in the living biomass pools within the project boundary at time of verification "tv" under project scenario (t C)
$B_{(tv)}$ = Carbon stock in the living biomass pools within the project boundary at time of verification "tv" that would have occurred in the absence of the project activity (t C)
$L_{(tv)}$ = Leakage attributable to the project activity within the project boundary at time of verification "tv" (t C)
tv = Year of verification
κ = Time span between two verifications
44/12 = Conversion factor from ton C to ton CO_2 equivalent (t CO_2/t C)

32. Project participants should provide in the CDM-SSC-AR-PDD a projection of the net anthropogenic GHG removals as t-CERs or l-CERs for all crediting periods.

IV. Simplified Monitoring Methodology for Small-scale A/R CDM Projects

Ex post estimation of the baseline net GHG removals by sinks

33. In accordance with paragraph 6 of appendix B to decision 14/CP.10, no monitoring of the baseline is requested. Baseline net greenhouse gas removals by sinks for the monitoring methodology will be the same as the projection of this element using the simplified baseline methodology above.

Ex post estimation of the actual net GHG removals by sinks

34. Before performing the sampling to determine any changes in carbon stocks, project participants need to measure and monitor the area that has been planted. This can be performed through, for example, on-site visits, analysis of cadastral information, aerial photographs or satellite imagery of adequate resolution.

35. Once project participants have selected the method to monitor the area that has been planted, this method should be used to monitor the performance of the planted areas throughout the project activity. If significant underperformance is detected, changes in carbon stock from such areas shall be assessed as a separate stratum.

36. Carbon stocks shall be estimated through stratified random sampling procedures and the following equations:

$$P_{(t)} = \sum((P_{A(t)\,i} + P_{B(t)\,i}) * A_i) \quad (15)$$

where:

$P_{(t)}$ = Carbon stocks within the project boundary at time "t" achieved by the project activity (ton C)
$P_{A(t)\,i}$ = Carbon stocks in aboveground biomass at time "t" of stratum i achieved by the project activity during the monitoring interval (ton C/ha)
$P_{B(t)\,i}$ = Carbon stocks in belowground biomass at time "t" of stratum i achieved by the project activity during the monitoring interval (ton C/ha)
A_i = Project activity area of stratum i (ha)

37. Stratification for sampling shall be the same as the stratification for the ex ante estimation of the actual net GHG removals by sinks, above. The following calculations will be performed for each stratum:

For above-ground biomass

$$P_{A(t)} = E_{(t)} * 0.5 \quad (16)$$

where:

$E_{(t)}$ = Above-ground biomass (tonnes of dry matter/ha) at time "t" achieved by the project activity
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

38. $E_{(t)}$ shall be estimated through the following steps:

a) **Step 1:** Design a statistically sound sampling procedure. Such procedures should be designed according to the standard methods described in the IPCC GPG for LULUCF section 4.3.3.4. Additional strata should be considered subsequently for areas affected by fires and pests. This procedure includes the specification of the number, type and size of permanent plots and should be described in the CDM-SSC-AR-PDD. In doing so, the allowed precision target for monitoring shall be not larger than +/- 10% , at a 95% confidence level for the mean.

b) **Step 2:** Establish and mark permanent plots and document their location in the first monitoring report.

c) **Step 3**: Perform measurements of DBH or DBH and tree height, as appropriate, which should be reflected in the monitoring reports.

d) **Step 4:** Estimate the above ground biomass (AGB) using allometric equations developed locally or nationally. If these allometric equations are not available:

i) Option 1: Use of allometric equations included in Attachment C to this report or in Annex 4A.2 of IPCC GPG for LULUCF.

ii) Option 2: Use of Biomass Expansion Factors and stem volume as follows:

$$E_{(t)} = SV * BEF * WD \quad (17)$$

where:

SV = Stem volume (in m^3/ha)
WD = Basic wood density (in tonnes of dry matter/m^3).
BEF = Biomass expansion factor (over bark) from stem volume to total volume (dimensionless)

39. Project participants shall use the default BEF proposed by IPCC GPG for LULUCF, specifically for tropical broad-leaved species, in order to obtain a conservative estimate of total biomass.

40. SV shall be estimated from on site measurements using the appropriate parameters (such as DBH or DBH and height). Consistent application of BEF should be secured on the definition of stem volume (e.g. total stem volume or thick wood stem volume require different BEFs).

41. Documented local values for WD should be used. In the absence of such values, national default values should be used. If national values are also not available, the values should be obtained from table 3A.1.9 of IPCC GPG for LULUCF.

For below-ground biomass

$P_{B(t)}$ shall be estimated as follows:

$$P_{B(t)} = E_{(t)} * R * 0.5 \quad (18)$$

where:

R = Root to shoot ratio (dimensionless)
0.5 = Carbon fraction of dry matter in tonnes of carbon per tonnes of dry matter

42. Documented national values for R should be used. If national values are not available, the values should be obtained from table 3A.1.8 of IPCC GPG for LULUCF.

43. If root-to-shoot ratios for the species concerned are not available, project proponents shall use the allometric equation developed by Cairns et al. (1997):

$$P_{B(t)} = \exp(-7747 + 0.8836 * \ln E_{(t)}) * 0.5 \quad (19)$$

Ex post estimation of leakage

44. In order to estimate leakage, project participants shall monitor, for each monitoring period, each of the following indicators:

a) Percentage of families/households of the community involved in or affected by the project activity displaced due to the implementation of the project activity;
b) Percentage of total production of the main produce (e.g. meat, corn) within the project boundary displaced due to the CDM A/R project activity.

45. If the value of these two indicators for the specific monitoring period is lower than 10%, then

$L_{(t)} = 0$

where:

$L_{(t)}$ = Leakage attributable to the project activity within the project boundary at time "t".

46. If the value of any of these two indicators is higher than 10% and less than or equal to 50%, then leakage shall be equal to 15% of the actual net GHG removals by sinks, that is:

$$L_{(t)} = P_{(t)} * 0.15 \qquad (20)$$

where:

$L_{(t)}$ = Leakage attributable to the project activity within the project boundary at time "t".
$P_{(t)}$ = Carbon stocks in the living biomass pools within the project boundary at time "t" under project scenario (ton C)

47. As indicated in section I, paragraph 4, if the value of any of these two indicators is larger than 50% net anthropogenic removals by sinks cannot be estimated.

48. If project participants consider that the use of fertilizers would be significant leakage of N_2O (>10% of the net anthropogenic removals by sinks) emissions should be estimated in accordance with the IPCC GPG.

Ex post estimation of the net anthropogenic GHG removals by sinks

49. *"Net anthropogenic greenhouse gas removals by sinks"* is the actual net greenhouse gas removals by sinks minus the baseline net greenhouse gas removals by sinks minus leakage.

Net anthropogenic GHG removals = Actual net GHG removals by sinks– baseline net GHG removals -leakage

50. The resulting t-CERs at the year of verification "tv" are calculated as follows:

$$t\text{-}CER_{(tv)} = 44/12 * (P_{(tv)} - B_{(tv)} - L_{(tv)}) \qquad (21)$$

if the changes in carbon stock in the baseline are considered to be zero, then $B_{(tv)} = B_{(t=0)}$ and

$$L_{(tv)} = 0.15 * P_{(tv)} \text{ (if required; see paragraph 27 above)} \qquad (22)$$

51. The resulting l-CERs at the year of verification "tv" are calculated as follows:

$l\text{-}CER_{(tv)} = 44/12 * [(P_{(tv)} - P_{(tv-\kappa)}) - L_{(tv)}]$ (23)

with $L_{(tv)} = 0.15 * (P_{(tv)} - P_{(tv-\kappa)})$ (if required; see paragraph 27 above) (24)

and $P_{(tv-\kappa)} = P_{(t=0)} = B_{(t=0)}$ for the first verification (25)

where:

$t\text{-}CER_{(tv)}$	= t-CERs emitted at time of verification "tv" (t CO_2)
$l\text{-}CER_{(tv)}$	= l-CERs emitted at time of verification "tv" (t CO_2)
$P_{(tv)}$	= Carbon stocks in the living biomass pools within the project boundary at time of verification "tv" under project scenario (t C)
$B_{(tv)}$	= Carbon stock in the living biomass pools within the project boundary at time of verification "tv" that would have occurred in the absence of the project activity (t C)
$L_{(tv)}$	= Leakage attributable to the project activity within the project boundary at time of verification "tv" (t C)
tv	= Year of verification
κ	= Time span between two verifications
44/12	= Conversion factor from ton C to ton CO_2 equivalent (t CO_2/t C)

Monitoring frequency

52. A 5-year monitoring frequency of the permanent sample plots established within the project boundary is needed for an appropriate monitoring of above-ground and below-ground biomass.

Data collection

53. Data collection shall be organized taking into account the carbon pools measured, the sample frame used and the number of permanent plots to be monitored in accordance with the section on QA/QC below. Table 1 and 2 outline the data to be collected to monitor the actual net GHG removals by sinks and leakage.

Table 1. Data to be collected or used in order to monitor the verifiable changes in carbon stock in the carbon pools within the project boundary from the proposed small-scale A/R CDM project activity, and how this data will be archived:

Data variable	Source	Data unit	Measured (m), calculated (c) or estimated (e)	Frequency	Proportion	Archiving	Comment
Location of the areas where the project activity has been implemented	Field survey or cadastral information or aerial photographs or satellite imagery	Lat-long	(m)	5 years	100%	Electronic, paper, photos	GPS can be used for field survey.
Ai - Size of the areas where the project activity has been implemented for each type of strata	Field survey or cadastral information or aerial photographs or satellite imagery or GPS	ha	(m)	5 years	100%	Electronic, paper, photos	GPS can be used for field survey.
Location of the permanent sample plots	Project maps and project design	Lat-long	defined	5 years	100%	Electronic, paper	Plot location is registered with a GPS and marked on the map.
Diameter at breast height (1.30 m)	Permanent plot	cm	(m)	5 years	Each tree in the sample plot	Electronic, paper	Measure diameter at breast height (DBH) for each tree that falls within the sample plot and applies to size limits
Height	Permanent plot	m	(m)	5 years	Each tree in the sample plot	Electronic, paper	Measure height (H) for each tree that falls within the sample plot and applies to size limits

Data variable	Source	Data unit	Measured (m), calculated (c) or estimated (e)	Frequency	Proportion	Archiving	Comment
Basic wood density	Permanent plots, literature	tonnes of dry matter per m^3 fresh volume	(e)	once	3 samples per tree from base, middle and top of the stem of three individuals	Electronic, paper	
Total CO_2	Project activity	Mg	(c)	5 years	All project data	Electronic	Based on data collected from all plots and carbon pools

Table 2. Data to be collected or used in order to monitor leakage and how this data will be archived:

Data variable	Source	Data unit	Measured (m), calculated (c) or estimated (e)	Frequency	Proportion	Archiving	Comment
Percentage of families/households of the community involved in or affected by the project activity displaced due to the implementation of the project activity	Participatory survey	Number of families or households	(e)	5 years	%	Electronic	
Percentage of total production of the main produce (e.g. meat, corn) within the project boundary displaced due to the CDM A/R project activity.	Survey	Quantity (volume or mass)	(e)	5 years	%	Electronic	

Quality Control and Quality Assurance

54. As stated in the IPCC GPG for LULUCF (page 4.111) monitoring requires provisions for quality assurance (QA) and quality control (QC) to be implemented via a QA/QC plan. The plan shall become part of project documentation and cover procedures as described below for:

a) Collecting reliable field measurements;
b) Verifying methods used to collect field data;
c) Verifying data entry and analysis techniques; and
d) Data maintenance and archiving. Especially this point is important, also for small-scale A/R CDM project activities, as time scales of project activities are much longer than technological improvements of electronic data archiving. Each point of importance for small-scale A/R CDM project activities are treated in the following section.

Procedures to ensure reliable field measurements

55. Collecting reliable field measurement data is an important step in the quality assurance plan. Those responsible for the measurement work should be trained in all aspects of the field data collection and data analyses. It is good practice to develop Standard Operating Procedures (SOPs) for each step of the field measurements, which should be adhered to at all times. These SOPs describe in detail all steps to be taken of the field measurements and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent fashion. To ensure the collection and maintenance of reliable field data, it is good practice to ensure that:

a) Field-team members are fully aware of all procedures and the importance of collecting data as accurately as possible;
b) Field teams install test plots if needed in the field and measure all pertinent components using the SOPs to estimate measurement errors;
c) The document will list all names of the field team and the project leader will certify that the team is trained;
d) New staff are adequately trained.

Procedures to verify field data collection

56. To verify that plots have been installed and the measurements taken correctly, it is good practice to re-measure independently every 10 plots and to compare the measurements. The following quality targets should be achieved for the re-measurements, compared to the original measurements:

Missed or extra trees	no error within the plot
Tree species or groups	no error
D.B.H.	< ± 0,1 cm or 1% whichever is greater
Height	< ± 5%
Circular plot radius/sides of rectangular plota	< ± 1% of horizontal (angle-adjusted)

57. At the end of the field work check independently 10-20% of the plots. Field data collected at this stage will be compared with the original data. Any errors found should be corrected and recorded. Any errors discovered should be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error.

Procedures to verify data entry and analysis

58. Reliable carbon estimates require proper entry of data into the data analyses spreadsheets. Possible errors in this process can be minimized if the entry of both field data and laboratory data are cross-checked and, where necessary, internal tests incorporated into the spreadsheets to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data should be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot should not be used in the analysis.

Data maintenance and storage

59. Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) will be an important component of the work. Data archiving should take several forms and copies of all data should be provided to each project participant.

60. Copies (electronic and/or paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports should all be stored in a dedicated and safe place, preferably offsite.

61. Given the time frame over which the project activity will take place and the pace of production of updated versions of software and new hardware for storing data, it is recommended that the electronic copies of the data and report be updated periodically or converted to a format that could be accessed by any future software application.

Table of abbreviations and parameters (in order of appearance):

Parameter or abbreviation	refers to	Units
ΔB	Annual changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of the project activity	ton C
$B_{(t)}$	Carbon stocks within the project boundary at time "t" that would have occurred in the absence of the project activity	ton C
$B_{A(t)\ i}$	Carbon stocks in aboveground biomass at time "t" of stratum i that would have occurred in the absence of the project activity	tonC/ha
$B_{B\ (t)\ i}$	Carbon stocks in belowground biomass at time "t" of stratum i that would have occurred in the absence of the project activity	tonC/ha
A_i	Project area of stratum I	ha
$M_{(t)}$	Aboveground biomass at time "t" that would have occurred in the absence of the project activity	tonnes dry matter/ha
0.5	Factor to convert tonnes of biomass (dry matter) to ton Carbon	tonne C/ tonne dry matter
G	Annual aboveground biomass growth in woody perennial vegetation	tonnes of dry matter/ha/yr
M	Time to maturity of the woody perennial vegetation	time
A	Age of the woody perennial vegetation	years
R	Root to shoot ratio	tonnes dry matter/tonnes dry matter
ΔN	Annual changes in carbon stocks in the carbon pools within the project boundary of the project scenario	ton C
$N_{(t)}$	Carbon stocks within the project boundary at time "t" under project scenario	ton C
$N_{A(t)\ i}$	Carbon stocks in aboveground biomass at time "t" of stratum i from project scenario (a notacao nao esta indexada em i)	ton C/ha
$N_{B(t)\ i}$	Carbon stocks in belowground biomass at time "t" of stratum i from project scenario (a notacao nao esta indexada em i)	ton C/ha
$T_{(t)}$	Aboveground biomass at time "t" for the project scenario	tonnes of dry matter/ha

Parameter or abbreviation	**refers to**	**Units**
$SV_{(t)}$	Stem volume at time "t" for the project scenario	m^3 /ha
WD	Basic wood density	tonnes of dry matter / m^3 (fresh volume)
BEF	Biomass expansion factor (over bark) from stem volume to total volume	Dimensionless
L_t	Leakage for the project scenario at time "t"	ton C
ΔP	Annual changes in carbon stocks in the carbon pools within the project boundary achieved by the project activity	ton C
$P_{(t)}$	Carbon stocks within the project boundary at time "t" achieved by the project activity	ton C
$P_{A(t)\ i}$	Carbon stock in aboveground biomass at time "t" of stratum i achieved by the project activity	ton C/ha
$P_{B(t)\ i}$	Carbon stocks in belowground biomass at time "t" of stratum i achieved by the project activity during the monitoring interval	ton C/ha
$E_{(t)}$	Aboveground biomass at time "t" achieved by the project activity	tonnes of dry matter/ha
DBH	Diameter at breast height (130 cm or 1.30 m)	cm or m
H	Height of tree or woody perennial	M
$L_{p(t)}$	Leakage resulting from the project activity at time „t"	ton C

Attachment A. Demonstration of land eligibility

1. Land to be reforested shall be demonstrated to have been non-forest since 1 January 1990, using the forest definition (numerical values for crown cover, tree height, minimum area, and minimum width as selected by the DNA).[4] In order to demonstrate the eligibility of land for afforestation and reforestation, project proponents shall demonstrate that the land did not meet the definition of forest around 1990, and before the project activity starts. In doing so, care must be taken that bare land could be a forest, if the continuation of current land use would lead to a future status where the forest definition thresholds could be exceeded.

2. To do this, project participants shall explain in the CDM-SSC-AR-PDD why the land is eligible and provide one of the following supporting evidence:

a) Aerial photographs or satellite imagery complemented by ground reference data; or
b) Ground based surveys (land use permits, land use plans or information from local registers such as cadastre, owners register, land use or land management register);
c) If options 1 and 2 are not available/applicable, project participants shall submit a written testimony which was produced by following a participatory rural appraisal methodology.

[4] According to decision 11/CP.7 (page 58) "for the first commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989 and were not temporarily unstocked".

Attachment B: Assessment of additionality

1. Project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

2. **Investment barriers, other than the economic/financial barriers**, *inter alia*:

a) Debt funding is not available for this type of project activity;
b) No access to international capital markets due to real or perceived risks associated with domestic or foreign direct investment in the country where the project activity is to be implemented;
c) Lack of access to credit;

3. **Institutional barriers**, *inter alia*:

a) Risk related to changes in government policies or laws;
b) Lack of enforcement of forest or land use-related legislation.

4. **Technological barriers**, *inter alia*:

a) Lack of access to planting materials
b) Lack of infrastructure for implementation of the technology.

5. **Barriers related to local tradition,** *inter alia:*

a) Traditional knowledge or lack thereof, laws and customs, market conditions, practices;
b) Traditional equipment and technology;

6. **Barriers due to prevailing practice**, *inter alia*:

a) The project activity is the "first of its kind": No project activity of this type is currently operational in the host country or region.

7. **Barriers due to local ecological conditions**, *inter alia*:

a) Degraded soil (e.g. water/wind erosion, salination, etc.);
b) Catastrophic natural and / or human-induced events (e.g. land slides, fire, etc);
c) Unfavourable meteorological conditions (e.g. early/late frost, drought);
d) Pervasive opportunistic species preventing regeneration of trees (e.g. grasses, weeds);
e) Unfavourable course of ecological succession;
f) Biotic pressure in terms of grazing, fodder collection, etc.

8. **Barriers due to social conditions**, *inter alia*:

a) Demographic pressure on the land (e.g. increased demand on land due to population growth);
b) Social conflict among interest groups in the region where the project activity takes place;
c) Widespread illegal practices (e.g. illegal grazing, non-timber product extraction and tree felling);
d) Lack of skilled and/or properly trained labour force;
e) Lack of organisation of local communities.

Attachment C: Default allometric equations for estimating aboveground biomass

Annual rainfall	DBH limits	Equation	R^2	Author
Broadleaved species, tropical dry regions				
<900 mm	3 – 30 cm.	$AGB = 10^{\{-0.535 + \log_{10}(\pi * DBH^2/4)\}}$	0.94	Martinez-Yrizar et al (1992)
900 – 1500 mm.	5 – 40 cm.	$AGB = \exp\{-1.996 + 2.32 * \ln(DBH)\}$	0.89	Brown (1997)
Broadleaved species, tropical humid regions				
< 1500 mm.	5 – 40 cm.	$AGB = 34.4703 - 8.0671*DBH + 0.6589*(DBH^2)$	0.67	Brown et al (1989)
1500 – 4000 mm.	< 60 cm.	$AGB = \exp\{-2.134 + 2.530 * \ln(DBH)\}$	0.97	Brown (1997)*
1500 – 4000 mm.	60 - 148 cm.	$AGB = 42.69 - 12.800*(DBH) + 1.242*(DBH)^2$	0.84	Brown et al (1989)*
1500 – 4000 mm.	5 - 130 cm.	$AGB = \exp\{-3.1141 + 0.9719*\ln(DBH^2*H)$	0.97	Brown et al (1989)
1500 – 4000 mm.	5 - 130 cm.	$AGB = \exp\{-2.4090 + 0.9522*\ln(DBH^2*H*WD)\}$	0.99	Brown et al (1989)
Broadleaved species, tropical wet regions				
> 4000 mm.	4 – 112 cm.	$AGB = 21.297 - 6.953*(DBH) + 0.740*(DBH^2)$	0.92	Brown (1997)
> 4000 mm.	4 – 112 cm.	$AGB = \exp\{-3.3012 + 0.9439*\ln(DBH^2*H)\}$	0.90	Brown et al (1989)
Coniferous trees				
n.d.	2 – 52 cm.	$AGB = \exp\{-1.170 + 2.119*\ln(DBH)\}$	0.98	Brown (1997)
Palms				
n.d.	> 7.5 cm.	$AGB = 10.0 + 6.4 * H$	0.96	Brown (1997)
n.d.	> 7.5 cm.	$AGB = 4.5 + 7.7 * WDH$	0.90	Brown (1997)

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