Draft simplified baseline and monitoring methodology for small-scale silvopastoral - afforestation and reforestation project activities under the clean development mechanism

I. Applicability conditions, carbon pools and project emissions

1. This simplified baseline and monitoring methodology is applicable if the conditions (a)-(d) below are met.

(a) Project activities are implemented on degraded croplands or grasslands subjected to grazing activities[1];

(b) Project activities lead to establishment of forest (according to area, height and crown cover thresholds reported to the EB by the host Party) in a silvopastoral system;

(c) The pre-project crown cover of trees within the project boundary is less than twenty per cent of the threshold for crown cover reported to the EB by the host Party.

2. **Carbon pools** to be considered by this methodology are above-ground and below-ground tree biomass and soil organic carbon (SOC).

3. Under applicability conditions of this simplified methodology, the increase in emissions attributable to the project activity above those that occur in the baseline is expected to be insignificant. **Project emissions** are therefore accounted for as zero.

4. Before using simplified methodologies, project participants (PPs) shall demonstrate whether:

(a) The project area is eligible for the A/R CDM project activity. Eligibility of the A/R CDM project activities shall be demonstrated by applying the latest version of the "Procedures to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities" as approved by the Executive Board;

(b) The project activity is additional, using the procedures for the assessment of additionality contained in **Appendix A**.

II. Baseline net greenhouse gas removals by sinks

5. The most plausible baseline scenario of the small-scale A/R CDM project activity is continuation of the land-use prior to the implementation of the project activity.

6. In accordance with applicability conditions of this methodology, the baseline net GHG removals by sinks are assumed to be insignificant and are accounted for as zero therefore:

$$\Delta C_{BSL,t} = 0 \qquad \textbf{(1)}$$

where:

$\Delta C_{BSL,t}$ The sum of the changes in carbon stocks in the living biomass of trees and soil organic carbon in the absence of the project activity for year t; t CO_2-e yr^{-1}

t $1, 2, 3, \ldots t^*$ years elapsed since the start of the A/R CDM project activity

[1] Cropland also includes lands which are currently under a fallow state as part of the agricultural cycle (eg., slash and burn).

III. Actual net greenhouse gas removals by sinks

7. Stratification of the project area should be carried out to improve the accuracy and precision of biomass estimates. Stratification should be made according to the project planting plan that is, at least by tree species (or groups of them if several tree species have similar growth habits), and age classes and silvopastoral practices (if they are expected to differ in impact on sinks or sources of greenhouse gases. PPs shall use stratified random sampling for establishing sample plots when planted vs. non-planted areas follow a regular pattern.

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

9. The **actual net greenhouse gas removals by sinks** in year *t* are equal to:

$$\Delta C_{ACTUAL,t} = \Delta C_{PJ,t} \qquad \textbf{(2)}$$

where:

$\Delta C_{ACTUAL,t}$	Actual net greenhouse gas removals by sinks in year *t*; t CO_2-e yr^{-1}
$\Delta C_{PJ,t}$	Project GHG removals by sinks in year *t*; t CO_2-e yr^{-1}

10. Project GHG removals by sinks are calculated using:

$$\Delta C_{PJ,t} = \sum_{i=1}^{I} \Delta C_{project,i,t} * 44/12 \qquad \textbf{(3)}$$

$$\Delta C_{project,i,t} = \frac{C_{trees,i,t_2} - C_{trees,i,t_1}}{T} + \Delta C_{soil,t} \qquad \textbf{(4)}$$

where:

$\Delta C_{PJ,t}$	Project GHG removals by sinks in year *t*; t CO_2-e yr^{-1}
$\Delta C_{project,i,t}$	Average GHG removals by living biomass of trees and soil for stratum *i*, for year ; t C yr^{-1}
$C_{trees,i,t}$	Carbon stock in living biomass of trees for stratum *i*, at time *t*; t C
$\Delta C_{soil,t}$	Average annual change in carbon stock in soil organic matter for stratum *i*, for year *t*; t C yr^{-1}
T	Number of years between times t_2 and t_1; year

Estimation of carbon stock in living biomass of trees at the stratum level

11. The carbon stock in living biomass of trees for stratum *i* ($C_{trees,i,t}$) is estimated using the following approach:

The mean carbon stock in above-ground biomass per unit area is estimated based on field measurements in permanent sample plots. Two methods are available: the Biomass Expansion Factors (*BEF*) method and the Allometric Equations method.

BEF method

Step 1: Determine based on available data, e.g., volume tables (*ex ante*) and measurements (*ex post*), the diameter at breast height (*DBH,* at typically 1.3 m above-ground level), and also preferably height (*H*), of all the trees above some minimum *DBH* in the permanent sample plots.

Step 2: Estimate the volume of the commercial (merchantable) component of trees[2] based on available equations or yield tables. It is possible to combine Steps 1 and 2 if field instruments (e.g., a relascope) that measure the volume of each tree directly are applied.

Step 3: Choose appropriate values for *BEF*. See Section VII for guidance on source of data.

Step 4: Convert the volume of the commercial component of trees into carbon stock in above-ground biomass via basic wood density *D*, the *BEF* and the carbon fraction using Eq. (5). See Section VII for guidance on source of data for wood density.

$$C_{AB,i,sp,j,l,t} = V_{i,sp,j,l,t}\ D_j \cdot BEF_{2,j} \cdot CF_j \qquad \textbf{(5)}$$

where:

$C_{AB,i,sp,j,l,t}$	Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i*, at time *t*; t C
$V_{i,sp,j,l,t}$	Merchantable volume of tree *l* of species *j* in plot *sp* in stratum *i*, at time *t*; m^3 $tree^{-1}$
D_j	Basic wood density of species *j*; t d.m. m^{-3}
$BEF_{2,j}$	Biomass expansion factor for conversion of merchantable biomass to above-ground tree biomass for species *j*; dimensionless
CF_j	Carbon fraction of dry matter for species or group of species type *j*, t C $(t\ d.m.)^{-1}$;

Step 5: Convert the carbon stock in above-ground biomass to the carbon stock in below-ground biomass via root-shoot ratio, given by:

$$C_{BB,i,sp,j,l,t} = C_{AB,i,sp,j,l,t} \cdot R_j \qquad \textbf{(6)}$$

where:

$C_{BB,i,sp,j,l,t}$	Carbon stock in below-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C $tree^{-1}$
$C_{AB,i,sp,j,l,t}$	Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C $tree^{-1}$
R_j	Root-shoot ratio appropriate for biomass stock, for species *j*; dimensionless

See guidance in Section VII for selection of values of *R*.

Step 6: Calculate carbon stock in above-ground and below-ground biomass of all trees present in plot *sp* in stratum *i* at time *t* (i.e., summation over all trees *l* by species *j* followed by summation over all species *j* present in plot *sp*).

[2] For non commercial species and woody perennials such as coffee, 'merchantable volume' may refer to the actual volume for such species estimated using national inventory methods for which *BEFs* are applicable.

$$C_{tree,i,sp,t} = \sum_{j=1}^{S_{PS}} \sum_{l=1}^{N_{j,i,sp,t}} (C_{AB,i,sp,j,l,t} + C_{BB,i,sp,j,l,t}) \quad \textbf{(7)}$$

where:

$C_{tree,i,sp,t}$	Carbon stock in living biomass of trees on plot *sp* of stratum *i* at time *t*; t C
$C_{AB,i,sp,j,l,t}$	Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C $tree^{-1}$
$C_{BB,i,sp,j,l,t}$	Carbon stock in below-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C $tree^{-1}$
$N_{j,i,sp,t}$	Number of trees of species *j* on plot *sp* of stratum *i* at time *t*
l	*1, 2, 3, ...* $N_{j,i,sp,t}$ sequence number of tree of species *j* on plot *sp* of stratum *i* at time *t*

Step 7: Calculate the mean carbon stock in tree biomass for each stratum:

$$C_{tree,i,t} = \frac{A_i}{Asp_i} \sum_{sp=1}^{P_i} C_{tree,i,sp,t} \quad \textbf{(8)}$$

where:

$C_{tree,i,t}$	Carbon stock in living biomass of trees in stratum *i*, at time *t*; t C
$C_{tree,i,sp,t}$	Carbon stock in living biomass of trees on plot *sp* of stratum *i* at time *t*; t C
Asp_i	Total area of all sample plots in stratum *i*; ha
A_i	Area of stratum *i*; ha
sp	*1, 2, 3, ...* P_i sample plots in stratum *i* in the project scenario
i	*1, 2, 3, ...* M_{PS} strata in the project scenario
t	*1, 2, 3, ...* t^* years elapsed since the start of the A/R CDM project activity

Method based on allometric equations

Step 1: As in Step 1 of *BEF* method.

Step 2: Calculate the above-ground biomass for each individual tree of a species, using allometric equations appropriate to the tree species (or groups of them if several tree species have similar growth habits) in the stratum. In the absence of species-specific allometric equations use equations in accordance with guidance provided in Section VII.

Step 3: Estimate carbon stock in above-ground biomass for each individual tree *l* of species *j* in the sample plot located in stratum *i* using the selected or developed allometric equation applied to the tree dimensions resulting from Step 1, and sum the carbon stocks in the sample plot.

$$C_{AB,i,sp,j,t} = \sum_{l=1}^{N_{l,sp}} CF_j \cdot f_j(DBH, H) \quad \textbf{(9)}$$

where:

$C_{AB,i,sp,j,t}$	Carbon stock in above-ground biomass of trees of species *j* on sample plot *sp* for stratum *i*; t C
CF_j	Carbon fraction of dry matter for species or group of species type *j*, t C (t d.m.)$^{-1}$;
$f_j(DBH,H)$	An allometric equation linking above-ground biomass of a living tree (d.m.) to mean diameter at breast height (*DBH*) and possibly tree height (*H*) for species *j*, at time *t*; t d.m Note: For *ex ante* estimations, mean *DBH* and *H* values should be estimated for stratum *i,* at time *t* using a growth model or yield table that gives the expected tree dimensions as a function of tree age. The allometric relationship between above-ground biomass and *DBH* and possibly *H* is a function of the species considered.
i	*1, 2, 3, ...* M_{PS} strata in the project scenario
j	*1, 2, 3, ...* S_{PS} tree species in the project scenario
l	*1, 2, 3, ...* $N_{j,sp}$ sequence number of individual trees of species *j* in sample plot *sp*
t	*1, 2, 3, ...* t^* years elapsed since the start of the A/R CDM project activity

Step 4: Convert the carbon stock in above-ground biomass to the carbon stock in below-ground biomass via root-shoot ratio, given by:

$$C_{BB,i,sp,j,t} = C_{AB,i,sp,j,t} \cdot R_j \qquad \textbf{(10)}$$

Where

$C_{BB,i,sp,j,t}$	Carbon stock in below-ground biomass of trees of species *j* in plot *sp* in stratum *i* at time *t*; t C
$C_{AB,i,sp,j,t}$	Carbon stock in above-ground biomass of trees of species *j* in plot *sp* in stratum *i* at time *t*; t C
R_j	Root-shoot ratio appropriate for biomass stock, for species *j*; dimensionless

See guidance in Section VII for selection of values of *R*.

Step 5: Calculate total carbon stock in the living biomass of all trees present in the sample plot *sp* in stratum *i* at time *t*.

$$C_{tree,i,sp,t} = \sum_{j=1}^{S_{PS}} (C_{AB,i,sp,j,t} + C_{BB,i,sp,j,t}) \qquad \textbf{(11)}$$

where:

$C_{tree,i,sp,t}$	Carbon stock in living biomass of trees on plot *sp* of stratum *i* at time *t*; t C
$C_{AB,i,sp,j,t}$	Carbon stock in above-ground biomass of trees of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}
$C_{BB,i,sp,j,t}$	Carbon stock in below-ground biomass of trees of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}

i	*1, 2, 3, …* M_{PS} strata in the project scenario
j	*1, 2, 3, …* S_{PS} tree species in the project scenario
t	*1, 2, 3, …* t^* years elapsed since the start of the A/R CDM project activity

Step 6: Calculate the mean carbon stock in living biomass of trees for each stratum, as per Eq. (8) - i.e., Step 7 of the *BEF* method.

Soil organic carbon

12. For strata that do not contain organic soils, *ex ante* and *ex post* $\Delta C_{soil,i,t}$ is estimated from the following equation:

$$\Delta C_{soil,i,t} = A_i \cdot \Delta C_{agroforestry,i} \text{ for } t \le t_{equilibrium,i}$$
$$\Delta C_{soil,i,t} = 0 \text{ for } t > t_{equilibrium,i} \quad \textbf{(12)}$$

where:

$\Delta C_{soil,i,t}$	Average annual change in carbon stock in soil organic matter for stratum *i*, for year *t*; t C yr^{-1}
A_i	Area of stratum *i*; hectare (ha)
$\Delta C_{agroforestry,i}$	Average annual increase in carbon stock in soil organic carbon pool for agroforestry system in stratum *i*; t C ha^{-1} yr^{-1}
$t_{equilibrium,i}$	Time from start of the project activity until a new equilibrium in carbon stock in soil organic matter is reached for agroforestry system in stratum *i*; years

The default value of $\Delta C_{agroforestry,i} = 0.5$ t C ha^{-1} yr^{-1} and a $t_{equilibrium,i}$ of 20 years shall be used. Changes in carbon stock in soil organic matter are not monitored *ex post*.

IV. Leakage

13. According to decision 6/CMP.1, annex, Appendix B, paragraph 9: "If PPs 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".

14. In accordance with applicability conditions of this methodology, possible displacement of activities or people that would be attributable to the small-scale afforestation or reforestation project activity under the CDM is assumed to be insignificant and the leakage is accounted for as zero.

$$LK_t = 0 \quad \textbf{(13)}$$

where:

LK_t	Leakage attributable to the project activity at time *t* (t CO_2-e yr^{-1})
t	*1, 2, 3, …* t^* years elapsed since the start of the A/R CDM project activity

V. Net anthropogenic greenhouse gas removals by sinks

15. The actual net anthropogenic greenhouse gas removals by sinks is the actual net GHG removals by sinks minus the baseline net GHG removals by sinks minus leakage.

16. The net anthropogenic GHG removals by sinks for each year are calculated as:

$$C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t \qquad \textbf{(14)}$$

where:

$C_{AR\text{-}CDM,t}$	Net anthropogenic GHG removals by sinks; t CO_2-e yr^{-1}
$\Delta C_{ACTUAL,t}$	Actual net greenhouse gas removals by sinks in year *t*; t CO_2-e yr^{-1}
$\Delta C_{BSL,t}$	The sum of the changes in carbon stocks in the living biomass of trees in the absence of the project activity for year *t*; t CO_2-e yr^{-1}
LK_t	Leakage attributable to the project activity at time *t*, t CO_2-e yr^{-1}

VI. Certified Emission Reductions

17. The resulting temporary certified emission reductions (tCERs), are calculated as follows:

$$tCER_{tv} = \sum_{t=0}^{tv} C_{AR-CDM,t} \cdot \Delta t \qquad \textbf{(15)}$$

18. lCERs are calculated as follows:

$$lCER_{tv} = \sum_{t=0}^{tv} C_{AR-CDM,t} \cdot \Delta t - lCER_{tv-k} \qquad \textbf{(16)}$$

where:

$tCER_{tv}$	Units of t-CERs issued at year of verification *tv*; t CO_2-e
$C_{AR\text{-}CDM,t}$	Net anthropogenic GHG removals by sinks; t CO_2-e yr^{-1}
$lCER_{tv}$	Units of lCERs issued at year of verification *tv*; t CO_2-e
tv	Year of verification
k	Time span between two verifications (year)
Δt	Time increment = 1 year

VII. Data and parameters not monitored (default or possibly measured one time)

19. In choosing key parameters or making important assumptions based on information that is not specific to the project circumstances, such as in use of existing published data, PPs should retain a conservative approach: that is, if different values for a parameter are equally plausible, a value that does not lead to over-estimation of net anthropogenic GHG removals by sinks should be selected.

Data / parameter:	$BEF_{2,j}$,
Data unit:	Dimensionless
Used in equations:	(5)
Description:	Biomass expansion factor for conversion of merchantable biomass to above-ground tree biomass for tree species *j*
Source of data:	The source of data shall be either of the following : (a) Existing local and species-specific or group of species-specific; (b) National and species-specific or group of species-specific (e.g., from national GHG inventory); (c) Species-specific or group of species-specific from neighbouring countries with similar conditions; (d) Globally species-specific or group of species-specific (e.g., Table 3A.1.10 of IPCC GPG-LULUCF 2003).[3]
Measurement procedures:	N/A
Any comment:	Consistent application of *BEF* should take into account the definition of stem volume (e.g., total stem volume or thick wood stem volume requires different *BEF*s).[4] To be conservative, the lower value in the specified range of BEF_2 values should be used and the selected *BEF* values justified.

Data / parameter:	CF_j
Data unit:	t C t^{-1} d.m.
Used in equations:	(5), (9)
Description:	Carbon fraction of dry matter for species of type *j*
Source of data:	The source of data shall be either of the following: (a) National and species-specific or group of species-specific (e.g., from national GHG inventory); (b) Species-specific or group of species-specific from neighbouring countries with similar conditions; (c) Globally species-specific or group of species-specific (e.g., IPCC GPG_LULUCF 2003). (d) A default IPCC value of 0.5 t C t^{-1} d.m.
Measurement procedures:	N/A
Any comment:	

[3] Although the *BEF* in Table 3A.1.10 apply to biomass, the dimensionless factors can be equally applied for wood volume expansions. The BEF_2 values for growing stock data include bark and are given for a certain minimum diameter at breast height.

[4] The 2006 IPCC guidelines (chapter 8.2.1.1) recommend to give preference to allometric methods based on individual tree diameter at breast height, adjusted for open grown trees, instead of unspecific *BEFs*.

Data / parameter:	D_j
Data unit:	t d.m. m^{-3}
Used in equations:	(5)
Description:	Basic wood density for species *j*
Source of data:	The source of data shall be either of the following: (a) National and species-specific or group of species-specific (e.g., from national GHG inventory); (b) Species-specific or group of species-specific from neighbouring countries with similar conditions; (c) Globally species-specific or group of species-specific (e.g., Table 3A.1.9 IPCC GPG-LULUCF 2003).
Measurement procedures:	N/A
Any comment:	

Data / parameter:	$f_j(DBH, H)$
Data unit:	t d.m. $tree^{-1}$
Used in equations:	(9)
Description:	Allometric equation for species *j* linking diameter at breast height (*DBH*) and possibly tree height (*H*) to above-ground biomass of living trees
Source of data:	Whenever available, use allometric equations that are species-specific or group of species-specific, provided the equations have been derived using a wide range of diameters and heights, based on datasets that comprise at least 20 trees. If species-specific allometric equations are not available then use default allometric equations included in **Appendix B** or default equations from IPCC literature, national inventory reports or published peer-reviewed studies —such as those provided in Tables 4.A.1 to 4.A.3 of the GPG-LULUCF (IPCC 2003).
Measurement procedures:	N/A
Any comment:	If default allometric equations are available for conditions that are similar to the project (same vegetation genus; same climate zone; similar forest type), then the equation may be used and considered conservative.

Data / parameter:	R_j
Data unit:	kg d.m. (kg d.m.)$^{-1}$
Used in equations:	(6), (10)
Description:	Root-shoot ratio appropriate for biomass stock, for species *j*
Source of data:	The source of data shall be as follows: (a) Local values if available; (b) If local values are not available, values should be selected from Table 3A.1.8 of the GPG-LULUCF (IPCC 2003), or equivalently Table 4.4 of the AFOLU Guidelines (IPCC 2006). Alternately a default value of value of 0.3 kg d.m. (kg d.m.)^{1} may be used as a conservative generic root:shoot ratio for all trees and shrubs.
Measurement procedures:	N/A
Any comment:	

VIII. Simplified monitoring methodology for small-scale afforestation and reforestation projects under the clean development mechanism

20. In accordance with decision 6/CMP.1, **Appendix B**, paragraph 6, no monitoring of the baseline is requested. Baseline net GHG removals by sinks for the monitoring methodology will be the same as using the simplified baseline methodology in Section II above.

21. All data collected as part of monitoring should be archived electronically and be kept at least for 2 years after the end of the last crediting period. All data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted according to relevant standards.

Sampling design and stratification

22. Stratification of the project area into relatively homogeneous units can either increase the measuring precision without increasing the cost unduly, or reduce the cost without reducing measuring precision because of the lower variance within each homogeneous unit. PPs should present in the AR-CDM-PDD an *ex ante* stratification of the project area or justify the lack of it. The number and boundaries of the strata defined *ex ante* may change during the crediting period (*ex post*).

23. For estimation of project GHG removals by sinks, strata shall be defined by:

(i) Stratification approach that can be shown in the PDD to estimate biomass stocks according to good forest inventory practice in the host country in accordance with DNA indications; or

(ii) Other stratification approach that can be shown in the PDD to estimate the project biomass stocks to targeted precision level of ±10 per cent of the mean at a 90 per cent confidence level.

24. The *ex post* stratification shall be updated due to the following reasons:

(i) Unexpected disturbances occurring during the crediting period (e.g., due to fire, pests or disease outbreaks), affecting differently various parts of an originally homogeneous stratum;

(ii) Forest management activities (cleaning, planting, thinning, harvesting, coppicing, re-replanting) may be implemented in a way that affects the existing stratification.

25. Established strata may be merged if reasons for their establishing have disappeared.

IX. Data and parameters monitored

26. The following parameters should be monitored at the start of the project activity and every five years since the initial verification and certification of an A/R project activity under the CDM until the end of the crediting period. The initial verification and certification of an A/R project activity under the CDM may be undertaken at a time selected by the project participants.

27. When applying all relevant equations provided in this methodology for the *ex ante* calculation of net anthropogenic GHG removals by sinks, PPs shall provide transparent estimations for the parameters that are monitored during the crediting period. These estimates shall be based on measured or existing published data where possible and PPs should retain a conservative approach: that is, if different values for a parameter are equally plausible, a value that does not lead to over-estimation of net anthropogenic GHG removals by sinks should be selected.

Data / parameter:	A_i
Data unit:	ha
Used in equations:	(8), (12)
Description:	Area of stratum *i*
Source of data:	Monitoring of strata and stand boundaries shall be done preferably using a Geographical Information System (GIS), which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data)
Measurement procedures (if any):	
Monitoring frequency:	At the start of the project activity and every five years since the initial verification and certification of an A/R project activity under the CDM.
QA/QC procedures:	
Any comment:	

Data / parameter:	$Asp_{,i}$
Data unit:	ha
Used in equations:	(8)
Description:	Total area of all sample plots in stratum *i*
Source of data:	Field measurement
Measurement procedures (if any):	
Monitoring frequency:	At the start of the project activity and every five years since the initial verification and certification of an A/R project activity under the CDM.
QA/QC procedures:	
Any comment:	GPS can be used for field survey. Sample Plot location is registered with a GPS and marked on the project map.

Data / parameter:	*DBH*
Data unit:	cm
Used in following equations	Implicitly used in Eq. (9)
Description:	Diameter breast height of tree
Source of data:	Field measurements in sample plots

Measurement procedures (if any):	Typically measured 1.3 m above-ground. Measure all the trees above some minimum *DBH* in the permanent sample plots that result from the A/R project activity. The minimum *DBH* varies depending on tree species and climate; for instance, the minimum *DBH* may be as small as 2.5 cm in arid environments where trees grow slowly, whereas it could be up to 10 cm for humid environments where trees grow rapidly
Monitoring frequency:	At the start of the project activity and every five years since the initial verification and certification of an A/R project activity under the CDM.
QA/QC procedures:	
Any comment:	Note: For *ex ante* estimations, mean *DBH* and *H* values should be estimated for tree species *j* in stratum *i*, at time *t* using a growth model or yield table that gives the expected tree dimensions as a function of tree age. The allometric relationship between above-ground biomass and *DBH* and possibly *H* is a function of the species considered.

Data / parameter:	*H*
Data unit:	m
Used in equations:	Implicitly used in Eq. (9)
Description:	Height of tree
Source of data:	Field measurements in sample plots
Measurement procedures (if any):	At the start of the project activity and every five years since the initial verification and certification of an A/R project activity under the CDM.
Monitoring frequency:	At the start of the project activity and every five years since the initial verification and certification of an A/R project activity under the CDM.
QA/QC procedures:	
Any comment:	Note: For *ex ante* estimations, mean *DBH* and *H* values should be estimated for tree species *j* in stratum *i*, at time *t* using a growth model or yield table that gives the expected tree dimensions as a function of tree age. The allometric relationship between above-ground biomass and *DBH* and possibly *H* is a function of the species considered.

Appendix A

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 economic/financial barriers**, *inter alia*:

(a) Debt funding 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 relating to changes in government policies or laws;

(b) Lack of enforcement of legislation relating to forest or land-use.

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

(a) Lack of access to planting materials;

(b) Lack of infrastructure for implementation of the technology.

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

(a) Traditional knowledge or lack thereof, of 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);

(b) Catastrophic natural and/or human-induced events (e.g., land slides, fire);

(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 organization of local communities.

Appendix B

Default allometric equations for estimating above-ground biomass

Annual rainfall	**DBH limits**	**Equation**	**R^2**	**Author**
Broad-leaved species, tropical dry regions				
<900 mm	3–30 cm	$AGB = 0.229 * DBH^2$	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)
Broad-leaved 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)
Broad-leaved 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 * stem height*	0.90	Brown (1997)

Note: *AGB* = above-ground biomass (kg dry matter per tree); *DBH* = diameter at breast height (cm); H = height (m); *WD* = basic wood density ($t\ m^{-3}$ or grams cm^{-3}); ln = natural logarithm; exp = "e raised to the power of"

References:

Brown, S. 1997. *Estimating biomass and biomass change of tropical forests. A primer*. FAO Forestry Paper 134. Food and Agriculture Organization of the United Nations, Rome, Italy.

Brown, S., A.J.R. Gillespie, and A.E. Lugo. 1989. Biomass estimation methods for tropical forests with applications to forest inventory data. *Forest Science* 35: 881–902.

Martínez-Y., A.J., J. Sarukhan, A. Perez-J., E. Rincón, J.M. Maas, A. Solis-M, and L. Cervantes. 1992. Above-ground phytomass of a tropical deciduous forest on the coast of Jalisco, Mexico. *Journal of Tropical Ecology* 8: 87–96.

- - - - -

History of the document

Version	Date	Nature of revision
01	EB 47, Annex # 28 May 2009	To be considered at EB 47.