Methodology Category—F-V

Forestation of degraded land using species including bamboo

founders and co-founders:

INSTRUCTIONS:

Font: All items in cover page shall completed using: English and numbers- Times New Roman 24pt, black, regular (non-italic) font； Chinese- SongTi 24pt, black, regular (non-italic) font. The main content of this document shall completed using: English and numbers- Times New Roman 11pt, black, regular (non-italic) font； Chinese- SongTi 4th pt, black, regular (non-italic) font.

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Version	*01*
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Section 1: METHODOLOGY DESCRIPTION

1.1. Scope and Sources

This methodology is developed for forestation using species including bamboo for which none of approved PS-AFOLU methodologies can be applied.

This methodology is developed by jointly by The Nature Conservancy (TNC) China Program, Yunnan CDM Center, Yunnan Mengxiang Bamboo Co. Ltd, Agence Franaise de Développement (AFD) and China The Administrative Centre for China's Agenda 21. This methodology is based on PS-AFOLU_Project Form "Reforestation of degraded land using bamboo in Xishuangbana, Yunnan Province, China". The baseline study, monitoring and verification plan and project form were prepared by:

- Yunnan Mengxiang Bamboo Co. Ltd
- Yunnan CDM Center
- TNC China Program
- Yunnan Forestry Technical School
- Yunnan Forestry Inventory and Planning Institute
- Yunnan Green Development Fundation
- The Administrative Centre for China's Agenda 21
- AFD

This methodology, whenever feasible, is also based on the methodology "Afforestation and reforestation of degraded land"(AR-ACM0001 Version 5.1.0) approved by CDM Executive Board.

This methodology refers to the latest approved versions of the following procedures, tools, guidance and guidelines approved by CDM Executive Board:

- Procedures to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities;
- Tool for the identification of degraded or degrading lands for consideration in implementing A/R CDM project activities;
- Combined tool to identify the baseline scenario and demonstrate the additionality in A/R CDM project activities;
- Calculation of the number of sample plots for measurements within A/R CDM project activities;
- Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity;
- Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities;

- Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities;
- Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities;
- Guidance on the application of the definition of project boundary to A/R CDM project activities.

All the above-mentioned procedures, tools, guidance and guidelines are available at: <http://cdm.unfccc.int/Reference/Procedures/index.html>, <http://cdm.unfccc.int/Reference/tools> and <http://cdm.unfccc.int/Reference/Guidclarif/ar/index_guid.html>.

However, in case of any inconsistency between PS - AFOLU Sectoral Specification and PS Guidelines and tools/guidances approved by CDM Executive Board, PS-AFOLU Specification and PS Guidelines shall be applied in priority.

1.2. Definition

There are several hundreds of bamboo species in China. Many bamboo species are unable to reach minimum height in situ and or minimum diameter of bamboo culm for the definition of forests as adopted by the Chinese government. Therefore, it is necessary to distinguish bamboo forest and other bamboo vegetation (so called bamboo bush)[1].

Bamboo forest is a vegetation composed of bamboo that has a minimum 0.067 ha of area, minimum 20% in crown cover, minimum 2 meter in height at maturity in situ, and minimum 2 centimeter in diameter of bamboo culm for the definition of forest as adopted by the Chinese government. Bamboo forest is one of forest types in China.

Bamboo bush is vegetation composed of bamboo that has height lower than 2 m at maturity in situ and/or culm diameter less than 2 cm. Bamboo bush is not a forest.

Dead wood is a dead tree with a minimum diameter of 5 cm at breast height or at eyebrow height for bamboo, either standing or lying.

1.3. Applicability Conditions

This methodology is applicable to forestation project activities with species including bamboo that are implemented on degraded lands.

The conditions under which the methodology is applicable are:

(a) The PS project activity is implemented on degraded lands, which are expected to remain degraded or in a low carbon steady state, or to continue to degrade in the absence of the project, hence the land cannot be expected to revert to a non-degraded state without human intervention;

(b) The project activity is implemented on mineral soils without organic soils;

[1] Definitions here apply only for the use of this methodology.

(c) The land does not fall into wetland[2] category;

(d) Bamboo to be forested by the PS project activity has a potential to reach minimum 2 m height in situ and minimum 2 cm culm diameter for defining forests as adopted by the Chinese government.

(e) Water inundation is not allowed under project scenario;

(f) Project will not produce more forage compared to baseline scenario;

(g) Project will provide at least same benefit as baseline;

(h) Project will not result in the displacement of households or villages.

(i) Litter shall remain on site and not be removed in the PS project activity; and

(j) Ploughing/ripping/scarification attributable to the PS project activity, if any, is:

(i) Done in accordance with appropriate soil conservation practices, e.g. follows the land contour; and

(ii) Overall ploughing is not allowed

The latest version of the "Tool for the identification of degraded or degrading lands for consideration in implementing A/R CDM project activities" shall be applied for demonstrating that lands are degraded or degrading.

1.4. Project boundary and GHG Pools and Sources

The "project boundary" geographically delineates the project activity. The project activity may contain more than one discrete area of land. Each discrete area of land shall have a unique geographical identification. It shall be demonstrated that each discrete area of land to be included in the boundary is eligible for a Panda Standard project activity.

The carbon pools included in or excluded from the project boundary are shown in Table 1.

Table 1: Carbon pools accounted for in the PS project boundary

Carbon pools	Included / Optional / Excluded	Justification / Explanation
Above-ground live tree biomass including bamboo forest	**Yes**	Major carbon pool subjected to project activity
Below-ground live tree biomass including	**Yes**	Below-ground biomass stock is expected to increase due to

[2] "Wetlands" are land categories as defined in the *Good Practice Guidance for Land Use, Land-use Change and Forestry* (IPCC, 2003).

bamboo forest		the implementation of the PS forestation project activity
Above-ground live non-tree biomass including bamboo bush	**No**	Under the applicability conditions of this methodology, carbon stock in this pool is likely to decrease or remain in steady state under baseline scenario
Below-ground live non-tree biomass including bamboo bush	**No**	Under the applicability conditions of this methodology, carbon stock in this pool is likely to decrease or remain in steady state under baseline scenario
Dead wood	**Yes / No**	Under the applicability conditions of this methodology, carbon stock in this pool is likely to increase in project compared to the baseline. However, PPs may also conservatively choose not to account for changes in carbon stock in the pool.
Forest Floor(Litter)	**Yes/No**	Under the applicability conditions of this methodology, carbon stock in this pool is likely to increase in project compared to the baseline. However, PPs may also conservatively choose not to account for changes in carbon stock in the pool.
Soil organic carbon	**Yes/No**	Under the applicability conditions of this methodology, carbon stock in this pool is likely to increase in project compared to the baseline. However, if the applicability condition for soil organic carbon is not complied, this pool shall not be accounted for.
Harvested wood products including bamboo product	**Yes/No**	Under the applicability conditions of this methodology, carbon stock in this pool is likely to increase in project compared to the baseline. However, PPs may also conservatively choose not to account for changes in carbon stock in the pool.

The emission sources included in or excluded from the project boundary are shown in Table 2. An emission source can be neglected, i.e. accounted as zero, if the application of the most recent version of the "Tool for testing significance of GHG emissions in A/R CDM project activities" leads to the conclusion that the emission source is insignificant.

Table 2: Emission sources and GHGs included in or excluded from accounting

Gas	Source	Included / Optional/ Excluded	Justification / Explanation
CO_2	Burning of woody biomass including bamboo	**Excluded**	Carbon stock decreases due to burning are accounted as a change in carbon stock

	Fossil combustion	**Excluded**	Potential emission is negligible.
CH_4	Burning of woody biomass including bamboo	**Included**	Burning of woody biomass or bamboo biomass for the purpose of site preparation or as part of forest management can lead to significant levels of emissions of methane
	Fossil combustion	**Excluded**	Potential emission is negligible.
	Water inundation	**Excluded**	Water inundation is not allowable
	Live stock and manure	**Excluded**	Grazing is not allowed under project scenario
N_2O	Burning of woody biomass including bamboo	**Included**	Burning of woody biomass or bamboo biomass for the purpose of site preparation or as part of forest management can lead to significant levels of emissions of N2O
	Fossil combustion	**Excluded**	Potential emission is negligible.
	Fertilizer application	**Excluded**	Potential emission is negligible.
	Live stock and manure	**Excluded**	Given that project will not produce more forage compared to baseline scenario, live stock and manure of project will not increase above baseline scenario.

1.5. Leakage Sources

The leakage sources included in or excluded from the project boundary are shown in Table 3.

Table 3: Leakage sources and GHGs included in or excluded from accounting

Leakage Source		Included / Optional / Excluded	Justification / Explanation
Activity-Shifting	Timber Harvesting	**Excluded**	Under the applicability conditions, project will provide at least same benefit as baseline, therefore the potential activity shifting is very low
	Fuel wood	**Excluded**	
	Crop production	**Excluded**	
	Livestock	**Excluded**	
	Forage Production	**Excluded**	Under the applicability condition, emissions from forage production is unlikely to increase compared to baseline scenario
	Households or villages	**Excluded**	Under the applicability condition, emissions are unlikely to occur
	Other		
Market Effects	Timber	**Excluded**	

Fuel wood	**Excluded**	
Other	**Excluded**	

Section 2: PROJECT ELIGIBILITY

2.1. Land Eligibility

It shall be demonstrated that each discrete area of land to be included in the boundary is eligible for a PS forestation project activity. Project participants shall provide evidence that the land within the planned project boundary is eligible for a PS forestation project activity by following the steps outlined below.

(a) Demonstrate that the land at the moment the project starts does not contain forest by providing transparent information at the Start Date of the PS forestation project activity:

(i) Vegetation on the land is below the forest thresholds: 20% tree crown cover, 2 m in tree height, 0.067 ha in land area, and 2 cm in diameter of bamboo culm in case of bamboo species, as adopted for the definition of forest by the Chinese government;

(ii) All young natural stands and all plantations on the land are not expected to reach the 20% crown cover and 2m height, and 2 cm diameter of bamboo culm in case of bamboo vegetation, as adopted by the Chinese government to define forest; and

(iii) The land is not temporarily unstocked, as a result of human intervention such as harvesting or natural causes.

(b) The Project Proponent must provide documented evidence in the Project Form of the historic land use within the Project geographic boundaries over the 10 years prior to the Start Date. If land use within the Project geographic boundary has changed within the last 10 years, documentation must be included to demonstrate that the motivation of such land use change was not the pursuit of emission credit creation.

(c) In order to demonstrate steps (a) and (b), project participants shall provide information that reliably discriminates between forest and non-forest land according to the particular thresholds adopted by the Chinese government, as well as possible land use changes:

(i) Aerial photographs or satellite imagery complemented by ground reference data; or

(ii) Land use or land cover information from maps (e.g., local forest maps) or digital spatial datasets; or

(iii) Ground based surveys (land use or land cover information from permits, plans, or information from local registers such as cadastre, owners registers, or other land registers).

If options (i), (ii), and (iii) are not available/applicable, project participants shall submit a written testimony which was produced by following a Participatory Rural Appraisal (PRA) methodology as practised in the China.

2.2. Geographic Boundary

GIS shape file and spreadsheet that lists GPS coordinates of corners for each parcel of lands shall be provided.

2.3. Temporary Boundary

The Project Proponent must list an explicit Project Start Date within the Project Form. The Project Start Date is the day when land preparations began for planting in the Project Boundary.

The Project Start Date shall not be earlier than 1 January 2005. Documentation justifying the chosen Start Date must be included. All projects with a Start Date greater than one year prior to the submission of the Project Form must document GHG mitigation as an original objective by presenting verifiable evidence based on (preferably official, legal and/or other corporate) documentation that was available to third parties at, or prior to, the Project Start Date.

The Crediting Period is the finite length of time for which a Project can generate PS credits for registration under a given Baseline. The Crediting Period Start Date is equal to the Project Start Date. A new Crediting Period can be initiated following a new Baseline Validation.

The minimum length of the Project Term is 30 years. The PPs shall choose the time for the first monitoring and verification, after which monitoring and verification shall be conducted every 3-10 years.

2.4. Additionality

To demonstrate the additionality of a PS project activity, PPs shall use either the most recent version of the Three-Prong Test, or alternatively the latest version of "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities".

2.5. Permanence and Risk Mitigation

Project Proponents shall conduct the risk assessment using the Panda Standard Risk Analysis Tool. The output of the risk assessment is a percentage of net GHG reductions. The risk assessment is subject to be assessed by validators and verifiers. Project shall apply one of two options for mitigating risk as presented in Section 7.3 of the PS-AFOLU Specification.

Before the publication of the Panda Standard Risk Analysis Tool, method below may be applied (The Panda Standard Risk Analysis Tool shall be applied upon its approval by the Panda Standard Association):

$$RISK = RISK_{fire} + \frac{PT}{30} \times 5\% \quad \textbf{(1)}$$

$$RISK_{fire} = PT \times F_{fire} \quad \textbf{(2)}$$

Where:

$RISK$	Project risk; %
$RISK_{fire}$	Forest fire risk; %
PT	Project term; year
F_{fire}	Forest fire risk factor; %

The forest fire risk factor is calculated as the percentage of annual mean forest area damaged by fire in the past 10 years in total forest area in the minimum administration region (county, city, prefecture) that a proposed Panda Standard project is located. Project Proponents may also select default factor from table 4 below. In case of no forest fire has occurred after each verification, the forest fire risk may be adjusted as follow:

$$RISK_{fire} = (PT - t) \times F_{fire}$$

where:

t $1, 2, 3, \ldots t^*$ years elapsed since the start of the PS project activity

Table 4 Default values of forest fire risk factor

Provinces	Forest fire risk factor	Provinces	Forest fire risk factor
Beijing	0.028%	Hubei	0.064%
Tianjing	0.022%	Hunan	0.088%
Hebei	0.016%	Guangdong	0.043%
Shanxi	0.063%	Guangxi	0.104%
Inner Mongolia	0.231%	Hainan	0.030%
Liaoning	0.007%	Chongqing	0.031%
Jilin	0.003%	Sichuan	0.020%
Heilongjiang	0.776%	Guizhou	0.141%
Shanghai	0.000%	Yunnan	0.079%
Jiangshu	0.088%	Tibet	0.012%
Zhejiang	0.126%	Shaanxi	0.011%
Anhui	0.027%	Ganshu	0.016%
Fujian	0.111%	Qinghai	0.019%
Jiangxi	0.077%	Ningxia	0.016%
Shandong	0.012%	Xinjiang	0.061%
Henan	0.022%	**National average**	**0.150%**

Section 3: BASELINE SCENARIO

3.1. Baseline Identification

Under the applicability conditions of this methodology, PPs shall select from the following approaches the one deemed most appropriate for the PS project activity to identify the baseline scenario:

(a) "Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary";

(b) "Changes in carbon stocks in the pools within the project boundary from the most likely land use at the time the project starts".

PPs shall use the most recent version of the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" to demonstrate the most plausible baseline.

3.2. Baseline Stratification (if applicable)

For estimation of baseline net removals, it will usually be sufficient to stratify according to area of major vegetation types and/or land use types because baseline removals for degraded (or degrading) land or land in a steady-state are expected to be small in comparison to project removals. PPs may use remotely sensed data acquired close to the Project Start Date for baseline stratification.

3.3. Baseline Net Removals/Emission Reductions

The baseline net removals are the sum of the changes in carbon stocks in the selected carbon pools within the project boundary that would have occurred in the absence of the PS forestation project activity. Under the applicability conditions of this methodology:

- Changes in carbon stock of above-ground and below-ground biomass of non-tree vegetation[3] may be conservatively assumed to be zero for all strata in the baseline scenario;
- It is expected that the baseline dead wood and litter carbon pools will not show a permanent net increase. It is therefore conservative to assume that the sum of the changes in the carbon stocks of dead wood and litter carbon pools is zero for all strata in the baseline scenario;
- Since carbon stock in soil organic carbon (SOC) is unlikely to increase in the baseline, the change in carbon stock in SOC may be conservatively assumed to be zero for all strata in the baseline scenario.

Therefore, the baseline net removals by will be determined as:

[3] For the purpose of this methodology, the non-tree vegetation include shrub, herbaceous plants and bamboo bush..

$$\Delta C_{BSL} = \sum_{t=1}^{t^*} \Delta C_{TREE\_BSL,t} \quad \textbf{(3)}$$

where:

ΔC_{BSL} Baseline net removals; t CO_2-e

$\Delta C_{TREE\_BSL,t}$ Change in carbon stock in tree biomass in baseline within the project boundary in year t, as estimated in the latest version of tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e

In the application of the tool, baseline trees include existing bamboo vegetation with height up to 2 meter and culm diameter up to 2 centimeter, but crown cover less than 20% and/or land area less than 0.067 hectare. However, as bamboo trees usually achieves steady-state in a few years, changes in carbon stock of above-ground and below-ground biomass of existing bamboo trees may be conservatively assumed to be zero for all strata in the baseline scenario.

t *1, 2, 3, … t^** years elapsed since the start of the PS project activity

The baseline net removals, if greater than zero, shall be estimated using the above-mentioned method until steady state is reached under the baseline conditions. Under steady state:

$$\Delta C_{BSL} = 0 \quad \textbf{(4)}$$

PPs may, on a project specific basis, assess when a steady state is reached during the crediting period. This shall be estimated on the basis of transparent and verifiable information originating as appropriate from available literature, data from comparable areas, from field measurements in the planned project area, or from other sources relevant to the baseline circumstances. If no data is available, a default period of 20 years since commencement of the PS forestation project activity will be applied.

3.4. Estimation of Baseline Uncertainty

Under the applicability conditions of this methodology, the baseline net removals are expected to be small compared to project net removals, therefore baseline uncertainty need not to be monitored.

Section 4: PROJECT SCENARIO

4.1. Project Stratification

If the project area and project activities is not homogeneous, stratification should be carried out to improve the accuracy and precision of biomass estimates. Stratifications for project scenario may be different from the baseline scenario in order to achieve optimal accuracy of the estimates of net removals. For estimation of project net removals, the stratification for ex ante estimations shall be based on the project planting/management plan. The stratification for ex post estimations shall be based on the actual implementation of the project planting/management plan. However, for both ex ante and ex post stratification, two or more species and/or bamboo plantation planted in two or more years can be merged if they have similar carbon stock and same values of carbon accounting parameters (e.g., biomass expansion factor, root-shoot ratio, carbon fraction and allometric equation), aiming to reduce internal-stratum variability and enlarge cross-stratum variability as a result to reduce number of sampling plots at required precision level. If natural or anthropogenic impacts (e.g. local fires, harvesting) or other factors (e.g. soil type) add variability to the growth pattern of the biomass in the project area, then the ex post stratification shall be revised accordingly from one verification to another.

PPs may use remotely sensed data acquired close to the time of project commencement and/or the occurrence of natural or anthropogenic impacts for ex ante and ex post stratification.

4.2. Ex-ante Actual Net Removals/Emission Reductions

Under the applicability conditions of this methodology, changes in carbon stock of above-ground and below-ground biomass of non-tree vegetation[3] may be conservatively assumed to be zero for all strata in the project scenario.

The actual net removals shall be calculated as:

$$\Delta C_{WP} = \Delta C_P - GHG_E \quad \textbf{(5)}$$

where:

ΔC_{WP}	Actual net removals; t CO_2-e
ΔC_P	Sum of the changes the carbon stock in the selected carbon pools within the project boundary; t CO_2-e
GHG_E	Increase in GHG emissions within the project boundary as a result of the implementation of the PS forestation project activity; t CO_2-e

4.2.1 Estimation of changes in the carbon stocks

The verifiable changes in the carbon stock in the selected carbon pools within the project boundary are estimated using the following equation:[4]

$$\Delta C_P = \sum_{t=1}^{t^*} \Delta C_t \quad \textbf{(6)}$$

where:

ΔC_P	Sum of the changes in carbon stock in all selected carbon pools in stratum *i,* since start of the project; t CO_2-e
ΔC_t	Change in carbon stock in all selected carbon pools, in year *t*; t CO_2-e
t	*1, 2, 3, … t^** years elapsed since the start of the PS project activity; yr
44/12	Ratio of molecular weights of CO_2 and carbon; dimensionless

Change in carbon stock in all selected carbon pools, in year *t*, is calculated as:

$$\Delta C_t = \Delta C_{BAMBOO\_PROJ,t} + \Delta C_{TREE\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta C_{SOC\_AL,t} + \Delta C_{HWP\_PROJ,t} \quad \textbf{(7)}$$

where:

ΔC_t	Change in carbon stock in all selected carbon pools in the project scenario, in year *t*; t CO_2-e
$\Delta C_{BAMBOO\_PROJ,t}$	Change in carbon stock in bamboo tree biomass in project, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	Change in carbon stock in non-bamboo 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 CO2-e
$\Delta C_{DW\_PROJ,t}$	Change in carbon stock in dead wood biomass of bamboo and trees 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 biomass 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

[4] IPCC GPG-LULUCF 2003, Equation 3.2.3.

$\Delta C_{SOC\_AL,t}$ Change in carbon stock in SOC in project, in year *t*, in areas of land meeting the applicability conditions of the "Tool 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

$\Delta C_{HWP\_PROJ,t}$ Change in carbon stock in harvest wood product in project, in year *t*; t CO_2-e

t *1, 2, 3, … t** years elapsed since the start of the PS project activity

(1) Carbon stock in living trees at the start of the project activity

Carbon stock in living trees at the start of the project activity, C_{TREE_BSL}, is calculated as provided in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"[5]

(2) Change in carbon stock in bamboo biomass in project（$\Delta C_{BAMBOO\_PROJ,t}$）

Due to annual harvesting or natural mortality supplemented by annual regrowth of new bamboo culm, above-ground biomass of bamboo plantation usually reach equilibrium within ten years after planting. Therefore, for the ex ante estimation in case that bamboo biomass yield table/curve is unavailable,

$$\Delta C_{BAMBOO\_PROJ,t} = \sum_i \begin{cases} A_{Bamboo,i,t} \cdot \dfrac{C_{BAMBOO_{equilibrium},i} - C_{Tree\_BSL,i}}{T_{equilibrium,i}} & for \quad t \le T_{equilibrium,i} \\ 0 & for \quad t > T_{equilibrium,i} \end{cases} \quad (8)$$

where:

$\Delta C_{BAMBOO\_PROJ,t}$ Change in carbon stock in bamboo tree biomass within the project boundary in year *t*; t CO_2-e

$A_{Bamboo,i,t}$ Area of bamboo planted in stratum i, ha

$C_{BAMBOO\ equilibrium,i}$ Carbon stock in bamboo tree biomass of stratum i at equilibrium; t CO_2

$C_{TREE\_BSL,i}$ Carbon stock in tree biomass (including bamboo tree biomass) of stratum i within the project boundary at the start date of the project; t CO_2-e

$T_{equilibrium,i}$ Time elapsed before bamboo tree biomass of stratum i reach steady state; yr

[5] In the application of the tool, baseline living trees include existing bamboo vegetation with height up to 2 meter and culm diameter up to 2 centimeter, but crown cover less than 20% and/or land area less than 0.067 hectare.

(3) Change in carbon stock in harvest wood product in project（$\Delta C_{HWP\_PROJ,t}$）

In case of harvest, part of harvest timber will store, long or short, in products, rather than emit to atmosphere immediately. For bamboo plantation, harvest usually begins in the 4th - 5th years after planting. Even though living biomass may reach equilibrium after certain time period after planting, harvesting and coppice will continue. This means that harvest wood products (HWP) will be the main carbon credit at the equilibrium period. This methodology assume that permanent carbon stock changes in HWP to be equal to the proportion in use at the end of a PS project or 30 years after initial generation, whichever is later. Remaining proportion is considered to be emitted instantly in the year of generation. Biomass carbon extracted that remains sequestered in long-term HWP after the end of a PS project or 30 years after initial generation can be estimated using formula:

$$\Delta C_{HWP\_PROJ,t} = \sum_{ty} C_{Stem} \cdot (1 - TOR_{ty}) \cdot (1 - WW_{ty}) \cdot (1 - SLF_{ty}) \cdot (1 - OF_{ty}) \quad (9)$$

Where

$\Delta C_{HWP\_PROJ,t}$	Change in carbon stock in harvest wood product in project, in year *t*; t CO_2-e
C_{Stem}	Carbon stock in stem biomass to be extracted; t CO2-e
TOR_{ty}	Wood output ratio by class of wood product ty; dimension
WW_{ty}	Proportion of wood waste: The fraction immediately emitted through mill inefficiency by class of wood product ty; dimensionless
SLF_{ty}	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product ty; dimensionless
OF_{ty}	Fraction of wood products that will be emitted to the atmosphere between 5 and 30 years (or the end of project, whichever is later) of timber harvest by class of wood product ty; dimensionless
ty	Wood product class – defined here as sawnwood, wood-based panels, other industrial roundwood, paper and paper board, and other
i	1, 2, 3, …*I*, project stratum

(4) Calculating the Long-Term Average Carbon Stock

In accordance with PS AFOLU specification, PS credits to be issued shall not be more than long-term average carbon stock. Therefore project proponents shall estimate the long-term average carbon stock that subjects to be assessed by the third party that conducts validation and verification. For bamboo stand to be established, the long-term average carbon stock is the carbon stock at the end of the project lifetime. However, for non-bamboo forestation, following approach shall be applied:

- *No thinning and final harvesting within project lifetime:* the long-term average carbon stock is the carbon stock at the end of the project lifetime;
- *No final harvesting but thinning (less than 25% of standing volume each thinning) for a purpose of improving forest growth within project lifetime:* the long-term average carbon stock equals the mean value of the carbon stock at the end of the project lifetime;
- *Final selective harvesting (less than 50% of standing volume each harvesting) within project lifetime:* the long-term average carbon stock equals the mean value of the carbon stock before and after the last selective harvesting before the end of the project lifetime;
- *Clear felling:* the long-term average carbon stock is assumed to be 50% of the carbon stock before last clear felling of the project lifetime.

4.2.2 Estimation of GHG emissions within the project boundary

The increase in GHG emissions as a result of the implementation of the proposed PS project activity within the project boundary can be estimated as:

$$GHG_E = \sum_{t=1}^{t^*} E_{BIOMASS\_BURN,t} \quad (10)$$

where:

GHG_E	Increase in GHG emissions as a result of the implementation of the proposed PS project activity within the project boundary; t CO_2-e
$E_{BIOMASS\_BURN,t}$	Increase in non-CO_2 emissions due to burning of biomass during the project implementation in year *t*, as estimated in the latest version of tool " Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e
t	*1, 2, 3, … t** years elapsed since the start of the PS project activity

4.3. Estimation of Leakage

Under applicability conditions of this methodology leakage is unlikely to occur, therefore:

$$LK = 0 \quad \textbf{(11)}$$

where:

LK	Total GHG emissions due to leakage; t CO_2-e

4.4. Estimation of With-Project Uncertainty

The Within-Project uncertainty for living biomass in the project may be estimated following the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities". Carbon stock and carbon stock changes in soil organic matter, litter and dead wood as well as harvested wood product is relatively small compared to living biomass, thus their uncertainties need not to be estimated.

4.5. Self assessment of co-benefits and possible negative impacts

Bamboo plantations seemed to be highly comparable to fast-growing trees. Moreover, the benefits appear to extend to the ecosystem and regional level due to bamboo's carbon sequestration capacity, stemming from its re-growth capacity and annual harvesting regimes. Sustainable management and appropriate utilization of bamboo resources can increase the amount of carbon sequestered, through management changes which increase storage capacity within the ecosystem in the short-term, and through transformation of carbon into durable products in the long-term. Bamboo is managed and utilized by hundreds of millions of people globally, who rely on it for many different uses, from household uses and protection of riverbanks to being a source of income. Many bamboo farmers live in less developed regions and are affected by poverty. The promotion of bamboo as a sustainable carbon sequestration tool will not only create new opportunities for mitigating climate change but can improve and protect millions of rural livelihoods through investment in sustainable bamboo management, industry and technology[6].

[6] Lou Yiping, Li Yanxia,Kathleen Buckingham, Giles Henley, Zhou Guomo. 2010. Bamboo and Climate Change Mitigation: : a comparative analysis of carbon sequestration. International Network for Bamboo and Rattan (INBAR)

Section 5: NET GHG EMISSION REDUCTIONS

5.1. Calculation of Uncertainty

Under this methodology, the total project uncertainty is equal to uncertainty of living biomass, i.e.,

$$UNC = UNC_{LB} \quad \textbf{(12)}$$

Where:

UNC	Total project uncertainty, in %
UNC_{LB}	Uncertainty of living biomass, in %

5.2. Calculation of PS Credits

The following equations are mandatory for all methodologies:

$$C_t = (\Delta C_{WP} - \Delta C_{BSL} - \Delta C_{LK}) \cdot \begin{cases} 1 & if \quad UNC \leq 0.1 \\ 1-(UNC-0.1) & if \quad UNC > 0.1 \end{cases} \quad \textbf{(13)}$$

Where:

$C_{,t}$	Total net GHG emission reductions/removals at time t (t CO_2e)
ΔC_{WP}	Sum of the carbon stock changes and GHG emissions under the project scenario up to time t, in t CO_2e (Section 4.2.)
ΔC_{BSL}	Sum of the carbon stock changes and GHG emissions under the baseline scenario up to time t, in t CO_2e (Section 3.3.)
ΔC_{LK}	Sum of the carbon stock changes and GHG emissions due to leakage up to time t, in t CO_2e (Section 4.3.)
UNC	Total Project Uncertainty, in % (Section 5.1.).

$$PSC_t = \left(C_{t_2} - C_{t_1}\right) * \left(1 - BUF\right) \quad \textbf{(14)}$$

Where:

PSC_t	Number of PS Credits at time $t = t_2 - t_1$
C_{t2}	Cumulative total net GHG emissions reductions up to time t2, including all required deductions for Leakage and uncertainty

C_{t1} Cumulative total net GHG emissions reductions up to time t1, including all required deductions for Leakage and uncertainty

BUF Percentage of Project credits contributed to the Panda Buffer Pool as calculated by the method described in Section 2.5 above (BUF will be set to zero if PPs chose other option)

5.3. Data and Parameters not Monitored

Data / parameter:	$BEF_{2,j}$
Data unit:	Dimensionless
Used in equations:	Equation (1) and (14) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and equation (1) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Biomass expansion factor for conversion of stem biomass to above-ground biomass for tree species *j*
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing species-specific data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources of species-specific data (e.g. national forest inventory or national GHG inventory).
Measurement procedures (if any):	N/A
Comments:	*BEFs* in literature and national inventory are usually applicable to closed canopy forest. If applied to individual trees growing in an open field it is recommended that the selected *BEF* be increased by 30%

Data / parameter:	BDR_{SF}
Data unit:	Dimensionless
Used in equations:	Equation (30) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Ratio of biomass per unit area in land having a shrub crown cover of 1.0 and biomass per unit area in a fully stocked forest in the region where the PS forestation project is located
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources data (e.g. national forest inventory or national GHG inventory).
Measurement procedures (if any):	N/A
Comments:	

Data / parameter:	B_{FOREST}
Data unit:	t d.m. ha^{-1}

Used in equations:	Equation (27) and (30) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Default above-ground biomass content in plantation to be established in the region where the PS forestation project is located
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources data (e.g. national forest inventory or national GHG inventory).
Measurement procedures (if any):	N/A
Comments:	

Data / parameter:	ΔB_{FOREST}
Data unit:	t d.m. ha^{-1} yr^{-1}
Used in equations:	Equation (28) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Default average annual increment in above-ground biomass in plantation to be established in the region where the PS forestation project is located
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources data (e.g. national forest inventory or national GHG inventory).
Measurement procedures (if any):	N/A
Comments:	(i) Trees biomass may reach a steady state, when biomass growth becomes zero or insignificant – either because of biological maturity of trees or because the rate of anthropogenic biomass extraction from the area is equal to the rate of biomass growth. Therefore, this parameter should be taken to be zero after the year in which tree biomass in baseline reaches a steady state. The year in which tree biomass in baseline reaches steady-state is taken to be the 20th year from the start of the PS forestation project activity, unless transparent and verifiable information can be provided to justify a different value. (ii) When land is subjected to periodic slash-and-burn practices in the baseline, the average tree biomass is constant, and hence value of this parameter is set equal to zero.

Data / parameter:	CF_{TREE}
Data unit:	t C t^{-1} d.m.
Used in equations:	Equation (24) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and equation (3), (5) and (6) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Carbon fraction of tree (bamboo) biomass

Source of data:	The source of data, in order of preference, shall be the following: (a) National level species-specific data (e.g. from national GHG inventory); (b) Globally available species-specific data (e.g. IPCC GPG-LULUCF 2003); (c) The IPCC default value of 0.5 t C t^{-1} d.m.
Measurement procedures (if any):	N/A
Comments:	

Data / parameter:	CF_S
Data unit:	t C t^{-1} d.m.
Used in equations:	Equation (29) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Carbon fraction of shrub biomass
Source of data:	IPCC default value of 0.50 t C t^{-1} d.m. may be used
Measurement procedures (if any):	N/A
Comments:	

Data / parameter:	CF_{LI}
Data unit:	t C t^{-1} d.m.
Used in equations:	Equation (12) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Carbon fraction of litter biomass
Source of data:	IPCC default value of 0.37 t C t^{-1} d.m. may be used
Measurement procedures (if any):	N/A
Comments:	

Data / parameter:	D_j
Data unit:	t d.m. m^{-3}
Used in equations:	Equation (1) and (14) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and equation (1), (5) and (6) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Basic wood density for species *j*
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing species-specific data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources of species-specific data (e.g. national forest inventory or national GHG inventory).
Measurement procedures (if any):	N/A
Comments:	

Data / parameter:	R_j
Data unit:	Dimensionless
Used in equations:	Equation (1), (2), (14) and (15) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and equation (1), (2) and (5) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Root-shoot ratio for species *j*
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing species-specific data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources of species-specific data (e.g. national forest inventory or national GHG inventory). For bamboo trees, if none of the above sources are available, then the value of R_j may be chosen from following table:

Bamboo types	Bamboo species	Mean	No of data	Standard Error
Monopodial	all	0.707	71	0.065
	Phyllostachys pubescens	0.605	50	0.071
	Phyllostachys meyeri	0.688	16	0.023
Sympodial	all	1.183	57	0.138
	Dendrocalamopsis sp.	1.191	30	0.130
	Dendrocalamus sp.	1.560	11	0.424
Mixed Mono- and sympodial	all	0.928	14	0.162

Data sources: published bamboo biomass literature

Measurement procedures (if any):	N/A
Comments:	Coppice plantations including bamboo in general have higher root-shoot ratios than plantations established by direct planting, especially for coppices younger than 5-years-old. As the coppice plantation matures, the root-shoot ratio tends to decrease to a level close to planted forests. Therefore the carbon stock in below-ground biomass of harvested trees may be conservatively accounted as the level at the moment before harvesting and remain constant until replanting, rather than assumed as a carbon stock loss

Data / parameter:	R_S
Data unit:	Dimensionless

Used in equations:	Equation (29) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Root-shoot ratio for shrubs and bamboo bush
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing species-specific data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources of species-specific data (e.g. national forest inventory or national GHG inventory). If none of the above sources are available, then a default value of 0.40 may be used [Source: Table 4.4 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories] . For bamboo bush, if none of the above sources are available, root-shoot value for bamboo trees may be used.
Measurement procedures (if any):	N/A
Comments:	

Data / parameter:	$V_{TREE,j}$
Data unit:	m^3
Used in equations:	Equation (1) and (14) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Stem volume of trees of species or group of species *j* for trees of given age/ diameter/ height
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing species-specific data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources of species-specific data (e.g. national forest inventory or national GHG inventory).
Measurement procedures (if any):	N/A
Comments:	

Data / parameter:	$f_j(DBH_t, H_t)$
Data unit:	t d.m. $tree^{-1}$
Used in equations:	Equation (2) and (15) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Allometric function for species or group of species *j* linking a tree diameter (e.g. diameter at breast height or collar), age or age group of bamboo stem, and possibly tree height (*H*), to above-ground biomass of living trees/bamboo
Source of data:	The source of data shall be selected, in order of preference, from the following: (a) Existing species-specific data applicable to local situation (e.g. represented by similar ecological conditions); (b) National sources of species-specific data (e.g. national forest inventory or national GHG inventory).
Measurement procedures (if any):	N/A

Comments:	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:	$CC_{TREE\_BSL,i}$
Data unit:	Dimensionless
Used in equations:	Equation (27) and (28) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Crown cover of trees in the baseline, in baseline stratum *i*, expressed as a fraction (e.g. 10% crown cover implies $CC_{TREE\_BSL,i}$=0.10)
Source of data:	Field measurement
Measurement procedures (if any):	Considering that the biomass in trees in the baseline is smaller compared to the biomass in trees in the project, a simplified method of measurement may be used for estimating tree crown cover. Ocular estimation of tree crown cover may be carried out or any other method such as the line transect method or the relascope method may be applied
Frequency:	once at the project start
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied.

Data / parameter:	$A_{BSL,i}$
Data unit:	*ha*
Used in equations:	Equation (27) and (28) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Area of stratum *i* in the baseline, delineated on the basis of crown cover
Source of data:	Field measurement
Measurement procedures (if any):	
Frequency:	Once at the project start
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied.

Data / parameter:	$SOC_{REF,i}$
Data unit:	t C ha^{-1}
Used in equations:	Equation (1) and (6) in the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"
Description:	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation – normally forest) by climate region and soil type applicable to stratum i of the areas of land;
Source of data:	The source of data, in order of preference (i.e. the first-mentioned source is the most preferred): (a) Peer-reviewed scientific publications relating to local conditions; (b) Relevant national inventories (e.g. soil inventory, forest inventory, or GHG

	inventory); (c) Tables 1 of the tool.
Measurement procedures (if any):	N/A
Comments	

Data / parameter:	$f_{LU,i}$
Data unit:	dimensionless
Used in equations:	Equation (1) in the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"
Description:	Stock change factor for land-use in stratum i of the areas of land;
Source of data:	The source of data, in order of preference (i.e. the first-mentioned source is the most preferred): (a) Peer-reviewed scientific publications relating to local conditions; (b) Relevant national inventories (e.g. soil inventory, forest inventory, or GHG inventory); (c) Tables 2 and 4 of the tool.
Measurement procedures (if any):	N/A
Comments	

Data / parameter:	$f_{MG,i}$
Data unit:	dimensionless
Used in equations:	Equation (1) in the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"
Description:	Stock change factor for management regime in stratum i of the areas of land;
Source of data:	The source of data, in order of preference (i.e. the first-mentioned source is the most preferred): (a) Peer-reviewed scientific publications relating to local conditions; (b) Relevant national inventories (e.g. soil inventory, forest inventory, or GHG inventory); (c) Tables 2 and 4 of the tool.
Measurement procedures (if any):	N/A
Comments	

Data / parameter:	$f_{I,i}$
Data unit:	dimensionless
Used in equations:	Equation (1) in the "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities"
Description:	Stock change factor for input of organic matter in stratum;
Source of data:	The source of data, in order of preference (i.e. the first-mentioned source is the most preferred): (a) Peer-reviewed scientific publications relating to local conditions;

	(b) Relevant national inventories (e.g. soil inventory, forest inventory, or GHG inventory); (c) Table 3 of the tool.
Measurement procedures (if any):	N/A
Comments	

Data / parameter:	DF_{DW}
Data unit:	%
Used in equations:	equation (9) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Default factor for the relationship between carbon stock in dead wood and carbon stock in trees (bamboo)
Source of data:	**Region** / DF_{DW} Northeast and Inner Mongolia forest region: 3.88% Southwest high mountain forest region: 2.04% Southeast hilly forest region: 2.12% Northwest high mountain forest region: 3.48% Tropical forest region: 7.76% National average: 2.67% Defaults conservatively derived from standing volume and dead wood wolume of national forestry inventory 1994-1998 and 1999-2003.
Measurement procedures (if any):	N/A
Comments	

Data / parameter:	DF_{LI}
Data unit:	%
Used in equations:	equation (15) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Default factor for the relationship between carbon stock in litter and carbon stock in plantation (bamboo stand)
Source of data:	

Forest types	Mean	No. of data	SE
Larch	6.11%	11	1.480
Korean pine	11.09%	3	2.858
Spruce & Abies	9.03%	4	3.762
Chinese Pine	8.90%	12	1.341
Cypress	5.31%	26	1.045
Masson Pine	5.61%	39	0.775
Slash pine	7.10%	21	1.093

	Other pine	5.62%	9	1.559
	Chinese fir	4.56%	241	0.223
	Chinese fir and pine mixture	7.19%	5	1.329
	Subtropical pine and broadleaf mixture	6.81%	17	0.905
	Chinese fir and broadleaf mixture	4.82%	29	0.574
	Temperate broadleaf	7.64%	27	1.105
	Subtropical broadleaf	6.23%	59	0.609
	Tropical forests	3.16%	11	0.814
	Eucalyptus	5.74%	78	0.484
	Acacia	6.31%	9	0.815
	Monopodial bamboo	5.28%	13	0.932
	Sympodial bamboo	6.25%	11	0.840
	Data sources: Published biomass and litter liturature			
Measurement procedures (if any):	N/A			
Comments				

Data / parameter:	TOR_{ty}
Data unit:	dimensionless
Used in equations:	Equation (9) of this methodology
Description:	Wood output ratio by class of wood product ty
Source of data:	The source of data, in order of preference (i.e. the first-mentioned source is the most preferred): (a) data respectively for species, logging approach (final harvesting or thinning) and product type, used in local forest management; (b) data respectively for species, logging approach (final harvesting or thinning) and product type, used in national forest management;
Measurement procedures (if any):	N/A
Comments	

Data / parameter:	OF_{ty}
Data unit:	dimensionless
Used in equations:	Equation (9) of this methodology
Description:	Fraction of wood products that will be emitted to the atmosphere between 5 and 100 years of timber harvest by class of wood product ty
Source of data:	The source of data, in order of preference (i.e. the first-mentioned source is the most preferred): (a) Peer-reviewed scientific publications relating to local conditions and product type;

	(b) Relevant national product-specific data; If relevant data are unavailable, default data below may be used. Product type / OF_{ty} Buidling 0.40 Furniture 0.60 Pillar 0.70 Ship/vehicles 0.50 packing 0.75 Paper and board 0.80 fuelwood 1.00
Measurement procedures (if any):	N/A
Comments	

Data / parameter:	WW_{ty}
Data unit:	Equation (9) of this methodology
Used in equations:	dimensionless
Description:	Proportion of wood waste: The fraction immediately emitted through mill inefficiency by class of wood product ty
Source of data:	The source of data, in order of preference (i.e. the first-mentioned source is the most preferred): (a) Peer-reviewed scientific publications relating to local conditions and product type; (b) Relevant national product-specific data; In case above-mentioned data unavailable, the proportion of extracted biomass that is oxidized (burning or decaying) from the production of commodities to be equal to 20%.
Measurement procedures (if any):	N/A
Comments	

Data / parameter:	SLF_{ty}
Data unit:	dimensionless
Used in equations:	Equation (9) in this methodology
Description:	Fraction of wood products that will be emitted to the atmosphere within 5 years of timber harvest by class of wood product ty
Source of data:	The source of data, in order of preference (i.e. the first-mentioned source is the most preferred): (a) Peer-reviewed scientific publications relating to local conditions and product

<table>
<tr><td></td><td>type;
(b) Relevant national product-specific data;

In case above-mentioned data unavailable, PPs may choose from following table:

If relevant data are unavailable, default data below may be used.

<table><tr><th>Product type</th><th>SLF_{ty}</th></tr><tr><td>Buidling</td><td>0.10</td></tr><tr><td>Furniture</td><td>0.10</td></tr><tr><td>Pillar</td><td>0.15</td></tr><tr><td>Ship/vehicles</td><td>0.15</td></tr><tr><td>packing</td><td>0.40</td></tr><tr><td>Paper and board</td><td>0.50</td></tr><tr><td>fuelwood</td><td>1.00</td></tr></table></td></tr>
<tr><td>Measurement procedures (if any):</td><td>N/A</td></tr>
<tr><td>Comments</td><td></td></tr>
</table>

Section 6: MONITORING PLAN

All data collected as part of monitoring should be archived electronically and be kept at least for two years after the end of the last crediting period. One hundred percent of the data should be monitored if not indicated otherwise in the tables below. All measurements should be conducted according to relevant standards. In addition, the monitoring provisions in the tools referred to in this methodology apply.

6.1. Monitoring of Project Implementation

1. Monitoring of the baseline net removals

The baseline net removals do not need to be monitored under this methodology.

2. Monitoring of the boundary PS forestation project activity

- Field survey of the discrete areas of the project on which tree planting is undertaken.
- Measuring geographical positions (latitude and longitude of each corner of polygon sites) using GPS or other verifiable approaches.
- Check whether or not the actual boundary is consistent with the description in the PS project form.
- If the actual boundary falls outside of the boundary in registered PS project form, the part of lands that are outside the designed boundary will not be accounted as a part of the PS project activity..
- Input the measured geographical positions into GIS system and calculate the eligible area of each stratum.
- The project boundary will be monitored periodically through the crediting period. If the boundary is changed during the crediting period, for instance, because deforestation has occurred on the project area, the specific location and area of the deforested land will be identified, the boundary will be modified and reported to verifiers for subsequent verifications. The deforested area will then be excluded from the project monitoring. Similarly, if the planting on certain lands within the project boundary fails, and other land uses take the place, these lands will be documented and excluded from the project carbon monitoring. However, the reduced area as verified during the previous verification cannot be included again within the project boundary, and the carbon stock previously verified shall remain unchanged due to the reduction of project area.

3. Monitoring of the forest management

- Harvesting (thinning): time, location (geographical boundary), area, tree species and intensity of harvested sites;
- Checking and confirming that the harvested sites in case of clear harvesting are re-planted immediately after harvesting if direct planting is used;
- Checking and ensuring that good conditions exist for natural regeneration if harvested lands are regenerated by natural re-sprouting.

Information shall be provided, and recorded in the PS project form, to establish that commonly accepted principles of forest inventory and management in China are implemented. 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 GPG LULUCF 2003, is recommended.

6.2. Sampling Design and Stratification

1. Stratification

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 PS project form 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).

2. Updating of strata

The *ex post* stratification shall be updated at the time of each monitoring event because of the following reasons:

- Planting activities (e.g., planting time and species cohort) divert from planned schedule presented in the PS project form;
- 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;
- Forest management activities (e.g., thinning, harvesting, coppicing, re-replanting) that are implemented in a way that affects the existing stratification;
- Land use changes;
- Variations in carbon stock and carbon stock changes in previous monitoring event: One stratum may be divided into two or more strata if too large variation was found in previous monitoring, or two or more strata may be merged into one stratum if previous monitoring found they have similar carbon stock, carbon stock changes and spatial variations.
- Established strata may be merged if reasons for their establishing have disappeared.

3. Precision requirements

The targeted precision level for tree biomass estimation shall be ± 10% of the mean at a 90% confidence level. PPs should use the latest version of the approved tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" to estimate precision level of bamboo biomass.

PPs may use the latest version of the approved tool for "Calculation of the number of sample plots for measurements within A/R CDM project activities" to determine the sample size and allocation of sample plots among strata.

6.3. Data and Parameters Monitored

Data / Parameter:	A_i

Data unit:	ha
Used in equations:	Equation (7)and (8) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and equation (7) nd (13) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Area of stratum *i*
Source of data:	Field measurement
Measurement procedures (if any):	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied. Delineation of boundaries should preferably be done in such way that it can be easily migrated to a Geographical Information System (GIS) which facilitates integration of data from different sources (including GPS coordinates and remotely sensed data)
Monitoring frequency:	Every 3-10 years since the year of the first verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In absence of these, QA/QC procedures from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Comments:	

Data / Parameter:	$A_{p,i}$
Data unit:	ha
Used in equations:	Equation (4) and (18) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and equation (7), (12) and (13) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Total area of sample plots in stratum *i*
Source of data:	Field measurement
Measurement procedures (if any):	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Monitoring frequency:	Every 3-10 years since the year of the first verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In absence of these, QA/QC procedures from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Comments:	Sample plot location is registered with a GPS and marked on the project map

Data / Parameter:	*DBH*
Data unit:	Inch/cm or any unit of length used in the model or data source used

Used in equations:	Implicitly used in equation (2) and (15) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and equation (1), (2) and (4) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Usually the diameter at breast height of the tree or eyebrow height of bamboo culm; but it could be any other diameter or dimensional measurement used in the model or data source used, e.g. basal diameter, root-collar diameter, basal area, etc.
Source of data:	Field measurements in sample plots. For *ex ante* estimations, *DBH* values should be estimated using a growth curve, a growth model, or a yield table that gives the expected tree dimensions as a function of tree age
Measurement procedures (if any):	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Monitoring frequency:	Every 3-10 years since the year of the first verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied

Data / Parameter:	*H*
Data unit:	m or any other unit of length
Used in equations:	Implicitly used in equation (2) and (15) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" and equation (1), (2), (4) and (5) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Height of tree (bamboo)
Source of data:	Field measurements in sample plots. For *ex ante* estimations, *H* values should be estimated using a growth curve, a growth model, or a yield table that gives the expected tree dimensions as a function of tree age
Measurement procedures (if any):	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In the absence of these, SOPs from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Monitoring frequency:	Every 3-10 years since the year of the first verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In absence of these, QA/QC procedures from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Comments:	Models used may be based on total tree height (top height) or height of stem (clear bole height). The relevant height should be measured/estimated and used

Data / Parameter:	*T*
Data unit:	year

Used in equations:	Equation (12) and (25) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Time period elapsed between two successive estimations of carbon stock in trees
Source of data:	Recorded time
Measurement procedures :	N/A
Comments:	If the two successive estimations of carbon stock in trees are carried out at different points of time in year t_2 and t_1, (e.g. in the month of April in year t_1 and in the month of September in year t_2), then a fractional value shall be assigned to T

Data / Parameter:	$a_{p,i}$
Data unit:	m^2
Used in equations:	Equation (12) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Area of litter sampling frame used in plot *p* in stratum *i*
Source of data:	Measurement
Measurement procedures:	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Monitoring frequency:	Every 3-10 years since the year of the initial verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In absence of these, QA/QC procedures from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Comments:	Often a litter sampling frame of 0.50 m^2 is used

Data / Parameter:	$B_{LI\_WET,p,i}$
Data unit:	Kg
Used in equations:	Equation (12) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Wet weight of the composite litter sample collected from plot *p* of stratum *i*
Source of data:	Field measurements in sample plots.
Measurement procedures:	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Monitoring frequency:	Every 3-10 years since the year of the initial verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied

Data / Parameter:	D_n
Data unit:	cm
Used in equations:	Equation (5) in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"
Description:	Diameter of the n^{th} piece of lying dead wood intersecting a transect line
Source of data:	Field measurements along transect lines in sample plots
Measurement procedures:	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied
Monitoring frequency:	Every 3-10 years since the year of the initial verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the *IPCC GPG LULUCF 2003*, may be applied

Data / parameter:	$A_{SHRUB,i,t}$
Data unit:	ha
Used in equations:	Equation (29) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Area of shrub (including bamboo bush) biomass stratum *i* at a given point of time in year *t*
Source of data:	Field measurement
Measurement procedures (if any):	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, may be applied
Frequency:	Every 3-10 years since the year of the initial verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied.

Data / parameter:	$CC_{SHRUB,i,t}$
Data unit:	Dimensionless
Used in equations:	Equation (30) in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"
Description:	Crown cover of shrubs (including bamboo bush) in shrub biomass stratum *i* at a given point of time in year *t*
Source of data:	Field measurement
Measurement procedures (if any):	Considering that the biomass in shrubs is smaller than the biomass in trees, a simplified method of measurement may be used for estimating shrub crown cover. Ocular estimation of crown cover may be carried out or any other method such as the line transect method or the relascope method may be applied
Frequency:	Every 3-10 years since the year of the initial verification
QA/QC procedures:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, may be

	applied
Comments	When land is subjected to periodic slash-and-burn practices in baseline, an average shrub crown cover equal to default value of 0.5 is used in Equation (30) unless transparent and verifiable information can be provided to justify a different value.

6.4. Monitoring of Leakage

N/A.