

HENAN NANZHAO AFFORESTATION PROJECT



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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The Henan Nanzhao Afforestation Project (hereafter “the project”) is located in Nanzhao County, Nanyang City, Henan Province, China. The project is to establish forest on the barren hills to generate GHG emission reductions or removals and contribute to local sustainable development.

Two tree species (Magnolia and Oak) have been planted on barren hills, the total area of this project is 28,391.8 ha and the area of this monitoring period is 21,725.13ha. The area of Magnolia is 3844.93ha(840 plant/ha), Oak is 10721.6ha (1650 plant/ha), Mixed tree is 7158.6ha(1500 plant/ha).

The project activity aims to:

- Sequester greenhouse gas and mitigate climate change;
- Enhance biodiversity conservation by increasing the connectivity of forests;
- Improve soil and water conservation and contribute to sustainable development;
- Generate income and job opportunities for local communities.

There is no natural renewal and reforestation and all sites were barren hills at least 10 years prior to the implementation of the project. With the implementation of the project activity, total GHG emission reductions or removals are about 29,628,383 tCO₂e in 60 years the average annual emission reduction is 493,806 tCO₂e and total GHG emission reductions or removals with buffer deduction is about 26,665,545 tCO₂e in 60 years, the average annual GHG emission reductions or removals with buffer deduction is 444,425 tCO₂e.

The project has generated 464,780 tCO₂e emission reductions within the crediting period from 20/10/2014 to 30/06/2019 with the average annual emission reductions of 96,227 tCO₂e. And total GHG emission reductions or removals with buffer deduction is about 418,299 tCO₂e within the crediting period from 20/10/2014 to 30/06/2019, the average annual GHG emission reductions or removals with buffer deduction is 86,604 tCO₂e.

The project activity will contribute to the environment (biodiversity conservation and soil erosion control), thus contribute to sustainable development.

1.2 Sectoral Scope and Project Type

The activity implemented by the project is the establishment of forests on land that were barren hills and the project is a non-grouped project.. Therefore the project corresponds to VCS scope 14 “Agriculture, Forestry and Other Land Use” as an Afforestation, afforestation and Revegetation (ARR).

1.3 Project Proponent

Organization name	Beijing Pingtougou Forestry Carbon Technology Development Co.,Ltd
Contact person	Qi Zhijian
Title	General Manager
Address	Room 1804, Block B,Level 18, NO.3, Qingzhiyuan, Xicheng District, Beijing, CHINA
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1.4 Other Entities Involved in the Project

Zhong Che (Beijing) Environment Energy Technology Development Co.Ltd.

1.5 Project Start Date

The project start date is 20/10/2014, when the planting started.¹

1.6 Project Crediting Period

The project crediting period is from 20/10/2014 to 19/10/2074 with the total number of 60 years.

1.7 Project Location

The project is located in Nanzhao County, Nanyang City, Henan Province, China. The geographical coordinates of the project is between 111°55' and 112°51' east longitude and between 33°12' and 33°43' north latitude.

The schematic diagram of the location of the project is shown in figure 1 below:

¹ The evidence from "Planting Construction Contract"

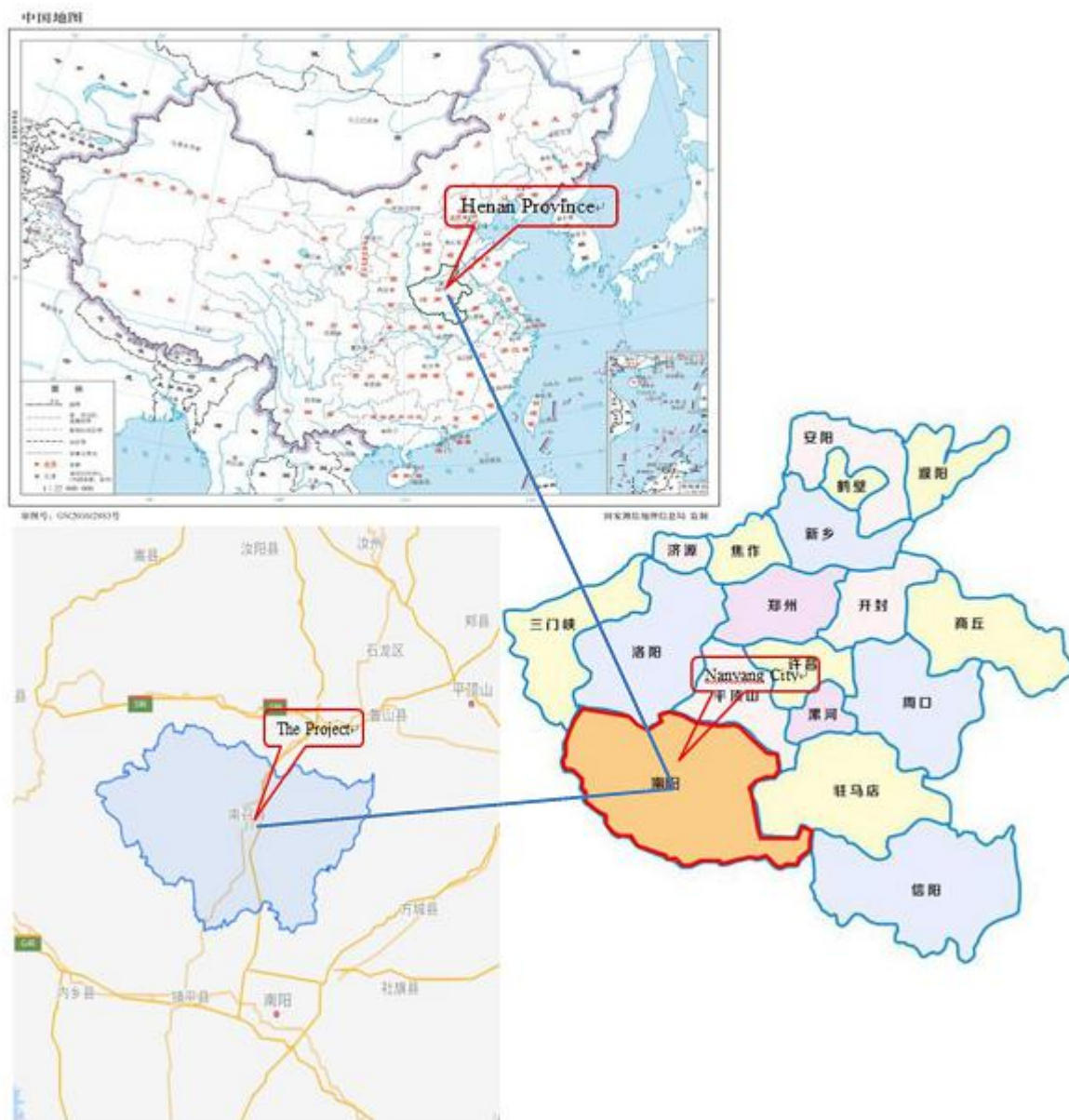


Figure 1: The project location

All sites were barren hills at least 10 years prior to the implementation of the project, the project will not convert native ecosystems to create GHG emission reductions or removals. The project is to establish forest on the barren hills to generate GHG emission reductions or removals and contribute to local sustainable development. The project is implemented by about 28,391.8 ha of forest is to be established by direct planting on barren hills in Nanzhao county, Nanyang City, Henan Province. The project involves 15 towns of Nanzhao Country, which are Chengguan Town, Chengjiao Town, Liushan Town, Xiaodian Town, Yunyang Town, Huanghou Town, Taishanmiao Town, Shimen Town, Sikeshu Town, Nanhedian Town, Baitugang Town, Banshanping Town, Qiaoduan Town, Mashiping Town, Cuizhuang Town. Aiming to contribute to the local sustainable development, especially to mitigating the water and soil erosion, 28,391.8 ha

of forest would be established by direct planting on the barren hills in these 15 towns. Considering the goal of the project activity, the native species Magnolia and Oak tree are chosen as the target species. Seedling planting is chosen as the forestation method. Seedling must be robust with developed root system, has no mechanical damage and no diseases, and has complete crown.

Table 1-1 Afforestation time (2014-2018) for the Project Area²

Town	Afforestation Time	Land ID	Area(ha)
Chengguan	2014\2015\2017	X= 633321 Y=3710193	378.67
Chengjiao	2014-2018	X=639705 Y=3695012	656.87
Liushan	2014-2018	X=643094 Y=3712452	1672.93
Xiaodian	2014-2018	X=654427 Y=3702904	3211.67
Yunyang	2014-2018	X=654320 Y=3699906	938.87
Huanghou	2014-2018	X=667492 Y=3718333	1226.60
Taishanmiao	2014-2018	X=650765 Y=3689954	869.53

² The source of "Design of afforestation operation in Nanzhao County". Due to the afforestation of 2019 and 2020 have not been begun ,so the area are not counted in this table.

Shimen	2014-2018	X=638870 Y=3688610	645.73
Sikeshu	2014-2018	X=615713 Y=3692053	648.80
Nanhedian	2014-2018	X=629930 Y=3692738	1349.93
Baitugang	2014-2018	X=624187 Y=3701275	951.67
Banshanping	2014-2018	X=621295 Y=3705596	2072.07
Qiaoduan	2014-2018	X=598983 Y=3710626	873.00
Mashiping	2014-2018	X=616517 Y=3715577	2823.33
Cuizhuang	2014-2018	X=631075 Y=3729138	3405.47
Total	21725.13		

The ownership of the forest land of the afforestation project belongs to the local village committee, and the right to use the forest land belongs to the farmers. The local village committee authorizes Beijing Pingtougou Forestry Carbon Technology Development Co.,Ltd.³ (hereafter “the project proponent”) to use the land for afforestation, and the project proponent is responsible for the forest management. Beijing Pingtougou Forestry Carbon Technology Development Co.,Ltd was

³ Business license is submitted as evidence.

the project proponent, which was established in May 2008. The project proponent has the ownership and legal right of the carbon sink credit of this project.

1.8 Title and Reference of Methodology

Consolidated afforestation and reforestation baseline and monitoring methodology AR-ACM0003/Version 02.0 "Afforestation and reforestation of lands except wetlands" is applied.

<http://cdm.unfccc.int/methodologies/DB/C9QS5G3CS8FW04MYYXDFOQDPXWM4OE>

The following methodological tools, to which the selected methodology refers to, are used:

- [Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities](#) (Version 01)
- [Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities](#) (Version 04.2).
- [Calculation of the number of sample plots for measurements within A/R CDM project activities](#) (Version 02.1.0)
- ["Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity"](#) (Version 02.0)
- ["Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities"](#) (Version 01.0.1)
- ["AFOLU Non-Permanence Risk Tool"](#), (Version 3.3)
- ["Estimation of non-CO₂ GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"](#) (Version 04.0.0)
- Demonstrating appropriateness of allometric equations for estimation of aboveground tree biomass in A/R CDM project activities (Version 01.0.0)

1.9 Other Programs

- *Emissions Trading Programs and Other Binding Limits*

N/A

- *Other Forms of Environmental Credit*

The project has neither intends to generate any other form of GHG-related environmental credit for GHG emission reductions or removals claimed under the VCS Program, nor any such credit has been or will be cancelled from the relevant program.

- *Participation under Other GHG Programs*

The project has not registered under any other GHG programs.

1.10 Sustainable Development

The project activity will contribute to the environment (biodiversity conservation and soil erosion control), thus contribute to sustainable development.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

During this monitoring period, the tree species, total area of the project have not changed and no events that may impact the GHG emission reduction happened.

Fire can be alleviated through technical and awareness training to local farmers, strengthening patrolling and monitoring. In this monitoring period, forest rangers have been hired from local residents who were responsible for daily patrolling and monitoring. In case there is a potential forest fire, they shall report to local Forest Bureau. During this monitoring period, no fire disaster occurred.

Upon routine overseeing, the diseases will be treated immediately by biological control once occurred. The chemical pesticides are allowed to be used only if there is a serious pest problem erupted in the project area, and the pesticides will be used in accordance with the National Pesticides Policy. Forest rangers were hired for daily patrolling and monitoring of diseases and insects. During this monitoring period, no significant diseases and insects disaster occurred.

For more detailed analysis of project risk please refer to Non-permanence Risk Report.

2.2 Deviations

2.2.1 Methodology Deviations

There is no methodology deviation applicable to the project activity during this monitoring period.

2.2.2 Project Description Deviations

There is no project description deviations applied during this monitoring period.

2.3 Grouped Project

This project is not relevant to the grouped project; there is no new instance of the project activity.

2.4 Safeguards

2.4.1 No Net Harm

There is no potential negative environmental or socio-economic impact due to the project.

2.4.2 Local Stakeholder Consultation

Questionnaires⁴ were distributed by the project proponent to the residents who lives in the community and closely related to the project. The questions aimed to find out their concerns and opinions about the project. The questionnaires covered areas of economic, social benefit and environmental effect etc. The content of the questionnaire includes the following information :

1. The purpose of the questionnaire
2. Basic information of the participants
3. Questions
 - 1) Do you know the proposed project?
 - 2) What do you think the proposed project will bring to you?
 - 3) Do you support the implementation of the proposed project?
 - 4) What is your concern about the proposed project?
 - 5) What is your opinion and suggestion regarding the proposed project?

The following is a summary of the key findings based on returned questionnaires.

1. The education background of the participants

The targets of this investigation are the people who will be affected by the project. A part of them finished the middle high school education, the rest of them graduated from college.

2. Attitude towards the proposed project

All of them support the implementation of the project, they think the protection of forest instead of cutting is good the environment, and will benefit the sustainable development.

3. The concern about the proposed project

The participants particularly hoping that the proposed project can improve local environmental situation and increase employment opportunities at the same time.

4. Conclusion

The survey shows that the proposed project is 100% supported by local people. It is because they believe the implementation of the project will bring multiple benefits.

⁴ Forty questionnaires were sent out and 40 were recovered.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	BEF _j
Data unit	Dimensionless
Description	Biomass expansion factor for conversion of stem biomass to above-ground biomass
Source of data	National database:"Land Use Change and Forestry GHG Inventory(2013)" of "Second National Information Notification on China Climate Change", issued by NDRC and local forestry bureau
Value applied:	Magnolia : 1.765 Oak tree: 1.56
Justification of choice of data or description of measurement methods and	N/A
Purpose of Data	The parameter is used to calculate biomass of trees within the boundary and then calculate actual net GHG emission reductions or removals by sinks.
Comments	N/A

Data / Parameter	CF _j
Data unit	t C(t*d*m) ⁻¹
Description	Carbon fraction of tree biomass for species or group of species j
Source of data	National database:"Land Use Change and Forestry GHG Inventory(2013)" of "Second National Information Notification on China Climate Change", issued by NDRC and local forestry bureau
Value applied:	Magnolia : 0.5 Oak tree: 0.5
Justification of choice of data or description of measurement methods and	N/A
Purpose of Data	The parameter is used to calculate actual net GHG emission reductions or removals by sinks.
Comments	N/A

Data / Parameter	Dj
Data unit	td.m.m ⁻³
Description	Basic wood density
Source of data	National database:"Land Use Change and Forestry GHG Inventory(2013)" of "Second National Information Notification on China Climate Change", issued by NDRC and local forestry
Value applied:	Magnolia : 0.598 Oak tree: 0.676
Justification of choice of data or description of measurement methods and	N/A
Purpose of Data	The parameter is used to calculate actual net GHG emission reductions or removals by sinks.
Comments	N/A

Data / Parameter	Rj
Data unit	Dimensionless
Description	Root-shoot ratio
Source of data	National database:"Land Use Change and Forestry GHG Inventory(2013)" of "Second National Information Notification on China Climate Change", issued by NDRC and local forestry bureau
Value applied:	Magnolia : 0.398 Oak tree: 0.292
Justification of choice of data or description of measurement methods and	N/A
Purpose of Data	The parameter is used to calculate actual net GHG emission reductions or removals by sinks.
Comments	N/A

3.2 Data and Parameters Monitored

Data / Parameter	A_i ; $A_{PLOT,i}$
Data unit	ha
Description	Area of stratum i ; Size of sample plot in stratum i
Source of data	Field measurements
Description of measurement methods and procedures to be applied	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. 2003, are applied.
Frequency of monitoring/recording	Before every verification event
Value applied:	A_i : Refer to Table 3-3 "Selected Sample Number of 20 Strata" $A_{PLOT,i} = 0.04$ ha
Monitoring equipment	N/A
QA/QC procedures to be applied	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 IPCC GPG LULUCF 2003 may be applied.
Purpose of data	The parameter is used to calculate volume of trees, and then calculate project removals.
Calculation method	N/A
Comments	N/A

Data / Parameter	DBH
Data unit	cm
Description	Diameter at breast height of tree
Source of data	Field measurements in sample plots
Description of measurement methods and procedures to be applied	Usually the diameter at breast height of the tree, but it could be any other diameter or dimensional measurement (e.g. basal diameter, root-collar diameter, basal area, etc.) applicable for the model or data source used. 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

Frequency of monitoring/recording	Before every verification event
Value applied:	Refer to MR-ER calculation sheet
Monitoring equipment	N/A
QA/QC procedures to be applied	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 IPCC GPG LULUCF 2003 may be applied.
Purpose of data	The parameter is used to calculate volume of trees, and then calculate project removals.
Calculation method	N/A
Comments	N/A

Data / Parameter	H
Data unit	m
Description	Height of trees
Source of data	Field measurements in sample plots
Description of measurement methods and procedures to be	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 of monitoring/recordin	Before every verification event
Value applied:	Refer to MR-ER calculation sheet
Monitoring equipment	N/A
QA/QC procedures to be applied	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 IPCC GPG LULUCF 2003 may be applied.
Purpose of data	The parameter is used to calculate volume of trees, and then calculate project removals.
Calculation method	N/A
Comments	N/A

Data / Parameter	t
Data unit	Year
Description	Time period elapsed between two successive estimations of carbon stock

Source of data	Record time
Description of measurement methods and procedures to be	N/A
Frequency of monitoring/recording	N/A
Value applied:	N/A
Monitoring equipment	N/A
QA/QC procedures to	N/A
Purpose of data	Calculation of project removals $\Delta C_{\text{TREE_PROJ},t} = C_{\text{TREE},t} - C_{\text{tree},0}$
Calculation method	N/A
Comments	N/A

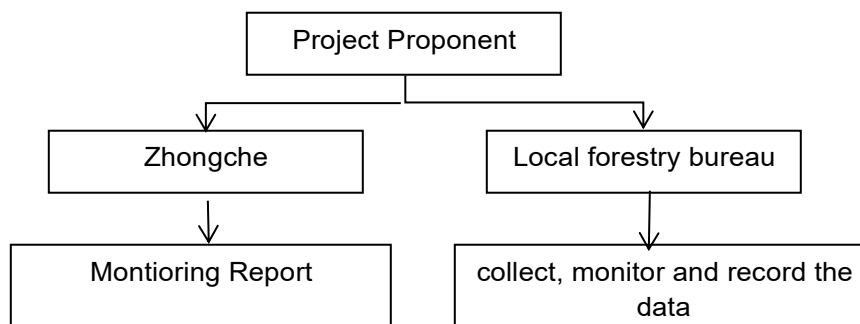
Data / Parameter	$B_{\text{TREE},j}; B_{\text{TREE},l,p,j,i}$
Data unit	t d.m.
Description	Biomass of tree species j; Stem volume of tree l of species j in sample plot p of stratum i
Source of data	Calculated
Description of measurement methods and procedures to be applied	For the ex-post estimation during verification, allometric equations of each tree species are used to calculate the stem volume.
Frequency of	Before every verification event
Value applied:	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	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 IPCC GPG LULUCF 2003 may be applied.
Purpose of Data	The parameter is used to calculate actual net GHG emission reductions or removals .

Calculation method	For the ex-post estimation during the following verification, using allometric equations based on tree dimensions to calculate the stem volume. The tree dimensions usually comprise of height and diameter at breast height.
Comments	N/A

Data / Parameter	$A_{BURN,i,t}$
Data unit	ha
Description	Area burnt in stratum i in year t
Source of data	Field measurement or remote sensing measurement
measurement	The area shall be delineated either on the ground using GPS
Monitoring frequency:	This area is measured whenever forest fire has occurred
Value applied:	0
Monitoring equipment	N/A
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
Purpose of data	The parameter is used to calculate the emissions resulting from burning
Calculation method	N/A
Comments	N/A

3.3 Monitoring Plan

The project proponent, consultant and the local forestry bureau set up a team together to conduct the monitoring. The project proponent is the project manager, which is in charge of maintaining and managing, Zhongche is the consultant, who prepares the monitoring report, and the local forestry bureau is in charge of collect, monitor and record the data. The team has received professional training before the start of the project. The findings should be reported to the project manager and work out a solution. The operational and management structure is as follows:



Monitoring is required to

- a) determine changes in forest carbon stocks and greenhouse gas emissions from project activity;
- b) confirm project activity; and
- c) determine changes in forest carbon stocks and greenhouse gas emissions from disturbance and illegal logging.

In some cases monitoring may also be implemented to update stratification.

The monitoring plan addresses the monitoring of project implementation, the monitoring of actual carbon stock changes from project activity.

General requirements for monitoring

All data collected as part of monitoring will be archived electronically and be kept at least for 2 years after the end of the project crediting period. All measurements will be conducted according to relevant standards.

Data archiving shall take electronic or paper forms, and copies of all data shall be provided to each project participant.

All electronic data and reports shall also be copied on durable media such as CDs and copies of the CDs are to be stored in multiple locations.

The archives shall include:

- Copies of all original field measurement data, laboratory data, data analysis spreadsheets;
- Estimates of the carbon stock changes in all pools and non-CO₂ GHG and corresponding calculation spreadsheets;
- GIS products; and

- Copies of the measuring and monitoring reports.

Monitoring of project implementation

Information must be provided, and recorded in the VCS-PD, to establish that:

- The geographic position of the project boundary is recorded for all areas of land;
- The geographic coordinates of the project boundary (and any stratification inside the boundary) are established, recorded and archived. This will be achieved by field survey (e.g. using GPS) or by using geo-referenced spatial data (e.g. maps, GIS datasets, aerial photography, or geo-referenced remote sensing images);
- Commonly accepted principles of forest inventory and management are implemented;
 - The project plan, together with a record of the plan as actually implemented during the project, shall be available for validation or verification as appropriate.

Stratification

An ex ante stratification of the project area in the project scenario is developed by project proponents through sampling in the project area according to the species.

Sampling to adjust the number and boundaries of the strata defined ex ante where an update is required because of

- unexpected disturbances occurring during the project crediting period affecting differently various parts of an originally homogeneous stratum and/or
- forest management activities that are implemented in a way that affects the existing stratification in the project scenario.

Established strata may also be merged if the reasons for their establishment have disappeared.

Describe the carbon pools and non-CO₂ GHGs selected for monitoring

As there will be no slash and burn site preparation, overall plough and flood irrigation as well as no machinery tools to be used within the project boundary, hence no significant GHG emission reductions or removals by sources as results of the proposed project activity.

Table 3-1 Selection of carbon pools

Carbon pool	Selected	Justification
Above ground	Yes	Major carbon subject to the project activity
Below ground	Yes	Major carbon subject to the project activity
Dead wood	No	The implementation of these 3 carbon pool project activities will

Litter	No	
Soil organic carbon	No	

Table 3-2 GHG emission reductions or removals by Sources other than Those Resulting from Changes in Carbon Pools

Source	Gas	Included/Excluded	Justification
Combustion of fossil fuels used for vehicles	CO ₂	Excluded	Potential emission is negligibly small.
	CH ₄	Excluded	Potential emission is negligibly small.
	N ₂ O	Excluded	Potential emission is negligibly small.

Carbon stocks are measured according to the stock assessment equations with field sampling based on forest inventory methods. Various sources exist to assist with the design of a verifiable forest field inventory based on best practice for sampling, data management and analysis.

In the project area the inventory plan is specified as below:

- a) adequate forest stratification, sample size estimation methods and consider uncertainty:

The forest stratification is based on the species, which is adequate according to the methodology. The sample size estimation methods, allocation among strata and uncertainty consideration is according to the "Calculation of the number of sample plots for measurements within A/R CDM project activities" (version 02.1.0) approved by the CDM Executive Board.

- b) a sampling framework including sample size, plot size, plot shape and information to determine plot location:

The design of a verifiable forest field inventory based on best practice for sampling, data management and analysis are selected from methodology. The sample size estimation methods, allocation among strata and uncertainty consideration is according to the most recent version of the tool for the "Calculation of the number of sample plots for measurements within A/R CDM project activities" (version 02.1.0) approved by the CDM Executive Board.

For the baseline scenario, the calculation process is shown below:

Parameter	Unit	Description
n	dimensionless	Number of sample plots required for estimation of biomass stocks within the project boundary

n_i	dimensionless	Number of sample plots allocated to stratum i for estimation of biomass stocks within the project boundary
-------	---------------	--

The sample plot will be 0.04 ha and at least 3 sample plots will be selected in 1 stratum. The total sample plot area is small than 5% of the total project area ($28391.8 \times 5\% = 1419.59$ ha). So we can conclude that the area sampled will be less than 5% of the project area, which means a small sampling fraction.

Therefore, the following simplified equation can be used for estimating the number of sample plots according to the CDM tool⁵:

$$n = \left(\frac{t_{VAL}}{E} \right)^2 \times (\sum_i w_i \times S_i)^2 \quad (1)$$

where:

n	Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless
t_{VAL}	Two-sided Student's t -value at infinite degrees of freedom for the required confidence level; dimensionless
E	Acceptable margin of error (i.e. one-half the confidence interval) in estimation of biomass stock within the project boundary; t d.m. (or t d.m. ha ⁻¹), i.e. in the units used for S_i
w_i	Relative weight of the area of stratum i (i.e. the area of the stratum i divided by the project area); dimensionless
S_i	Estimated standard deviation of biomass stock in stratum i ; t d.m. (or t d.m. ha ⁻¹)
i	1, 2, 3, ... biomass stock estimation strata within the project boundary

After the estimation of total number of sample plots (n), allocation of number of sample plots among strata is calculated as:

$$n_i = n \times \frac{w_i \times S_i}{\sum_i w_i \times S_i} \quad (2)$$

where:

n_i	Number of sample plots allocated to stratum i ; dimensionless
n	Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless
w_i	Relative weight of the area of stratum i (i.e. the area of the stratum i divided by the project area); dimensionless
S_i	Estimated standard deviation of biomass stock in stratum i ; t d.m. (or t d.m. ha ⁻¹)

⁵ A/R Methodological Tool "Calculation of the number of sample plots for measurements within A/R CDM project activities" (Version 02.1.0) formula 2

i 1, 2, 3, ... biomass stock estimation strata within the project boundary

Based on the data of biomass stocks in a carbon pool in the baseline scenario, the estimation of number of sample plots required is shown in table 3-3 below:

Table 3-3 Selected Sample Number of 14 Strata

Stratum	Species	Area (ha)	Selected sample number
Proj-1	Magnolia	566.4	3
Proj-2	Oak tree	2226.7	3
Proj-3	Mixed tree	2094.9	3
Proj-4	Magnolia	495.9	3
Proj-5	Oak tree	3708.5	4
Proj-6	Mixed tree	995.5	3
Proj-7	Magnolia	847.7	3
Proj-8	Oak tree	3000.0	3
Proj-9	Mixed tree	1361.0	3
Proj-10	Magnolia	705.6	3
Proj-11	Mixed tree	967.6	3
Proj-12	Magnolia	1229.3	3
Proj-13	Oak tree	1786.4	3
Proj-14	Mixed tree	1739.6	3
Total		21725.13	43

The forest management mode in the sample plot is exactly the same as that outside the sample plot. Detailed information of the sample plot is shown in the following table 3-4:

Table 3-4 Detailed information of the sample plot⁶

	County	Country	ID	Area (ha)	Afforestation time	Species	Y	X
--	--------	---------	----	-----------	--------------------	---------	---	---

⁶ Due to the afforestation of 2019 and 2020 have not been implemented in this monitoring period, so the area are not counted in this table, and there are 14 strata and 43 plots in this monitoring period.

PROJ-1	huanghou	guozhuang	R6-2014	0.04	2014	Magnolia	3712400	660988
PROJ-1	nanhedian	chengkouwan	R2-2014	0.04	2014	Magnolia	3690200	631485
PROJ-1	yunyang	yangxi	R4-2014	0.04	2014	Magnolia	3710942	657966
PROJ-2	baitugang	bailong	N2-2014	0.04	2014	Oak Tree	3700855	619410
PROJ-2	mashiping	jiaoyuan	N4-2014	0.04	2014	Oak Tree	3729748	606718
PROJ-2	xiaodian	bolin	N2-2014	0.04	2014	Oak Tree	3708220	651290
PROJ-3	chengjiao	chaigang	N2-2014	0.04	2014	Mixed Tree	3698804	639865
PROJ-3	cuizhuang	cangfang	R2-2014	0.04	2014	Mixed Tree	3723227	626714
PROJ-3	xiaodian	miaoxi	R1-2014	0.04	2014	Mixed Tree	3704745	654744
PROJ-4	mashiping	longtougou	N1-2015	0.04	2015	Magnolia	3719874	615833
PROJ-4	sikeshu	huazhuang	N1-2015	0.04	2015	Magnolia	3679690	627604
PROJ-4	xiaodian	chuandian	N1-2015	0.04	2015	Magnolia	3705063	648742
PROJ-5	baitugang	mazhuang	N1-2015	0.04	2015	Oak Tree	3704313	626003
PROJ-5	mashiping	yangpan	N5-2015	0.04	2015	Oak Tree	3728324	621296
PROJ-5	nanhedian	fanzhuang	N2-2015	0.04	2015	Oak Tree	3694346	632774
PROJ-5	qiaoduan	zhuyuan	N3-2015	0.04	2015	Oak Tree	3722344	600331
PROJ-6	chengjiao	beiyinpo	N1-2015	0.04	2015	Mixed Tree	3699279	637328
PROJ-6	cuizhuang	wangzhuang	R1-2015	0.04	2015	Mixed Tree	3717111	629819
PROJ-6	liushan	yangpa	N4-2015	0.04	2015	Mixed Tree	3696658	646407
PROJ-7	cuizhuang	jingzihe	N1-2016	0.04	2016	Magnolia	3717064	631216
PROJ-7	liushan	guopaidian	R8-2016	0.04	2016	Magnolia	3705268	647099
PROJ-7	xiaodian	bailu	N1-2016	0.04	2016	Magnolia	3703506	650014
PROJ-8	baitugang	bailong	N6-2016	0.04	2016	Oak Tree	3699798	616928
PROJ-8	liushan	dagou	N2-2016	0.04	2016	Oak Tree	3716935	645691
PROJ-8	sikeshu	baicaoduo	N3-2016	0.04	2016	Oak Tree	3683022	616016
PROJ-9	baitugang	jicun	N2-2016	0.04	2016	Mixed Tree	3699276	629300
PROJ-9	cuizhuang	caocun	N1-2016	0.04	2016	Mixed Tree	3714799	634911

PROJ-9	shimen	sishan	N1-2016	0.04	2016	Mixed Tree	3689828	639140
PROJ-10	chengguan	dongbei	N1-2017	0.04	2017	Magnolia	3709659	633289
PROJ-10	huanghou	liangshuiquan	N1-2017	0.04	2017	Magnolia	3704338	663622
PROJ-10	nanhedian	yanlinggou	N3-2017	0.04	2017	Magnolia	3692044	633443
PROJ-11	baitugang	shibanhe	N3-2017	0.04	2017	Mixed Tree	3700639	624453
PROJ-11	cuizhuang	cangfang	N3-2017	0.04	2017	Mixed Tree	3726831	633311
PROJ-11	mashiping	jiaoyuan	N1-2017	0.04	2017	Mixed Tree	3729037	605707
PROJ-12	banshanping	lianghua	N1-2018	0.04	2018	Magnolia	3707318	609421
PROJ-12	cuizhuang	xiaolongwan	N1-2018	0.04	2018	Magnolia	3711360	627973
PROJ-12	qiaoduan	shuijinghe	N4-2018	0.04	2018	Magnolia	3716833	607640
PROJ-13	banshanping	nanhe	N15-2018	0.04	2018	Oak Tree	3701528	608653
PROJ-13	mashiping	sanguanmiao	N15-2018	0.04	2018	Oak Tree	3724226	607230
PROJ-13	taishanmiao	taishanmiao	N3-2018	0.04	2018	Oak Tree	3699388	651676
PROJ-14	banshanping	qishugou	N1-2018	0.04	2018	Mixed Tree	3708382	606086
PROJ-14	shengjiao	dongdian	N1-2018	0.04	2018	Mixed Tree	3707996	636216
PROJ-14	cuizhuang	dongnanping	N3-2018	0.04	2018	Mixed Tree	3728463	631483

Carbon stock changes over time shall be estimated by taking measurements in plots at each monitoring event. Periodic verification will take place every 3-5 years, and quantitative monitoring of the project will take place before every verification event. Including monitoring all the parameters needed. Monitoring reports can use such extrapolated parameter values for the determination of net emissions by sources and removals resulting from the project.

Determine the sample location

The sample is fixed rectangle land with 20m*20m (400m²) each. When a sample on a slope is to be selected, the gradient must be monitored, and the horizontal long should be converted into oblique long. The management methodology (irrigation, fertilization, etc) within the samples must be the same as those outside the samples. If fire breaks out, another sample could be selected near the original sample.

Monitoring frequency

Periodic verification will take place every 3-5 years, and quantitative monitoring of the project will take place before every verification event.

Measuring carbon stock changes over time

The growth of individual trees on plots was measured at each monitoring event. Non-tree vegetation such as herbaceous plants, grasses, and shrubs will not be measured and accounted as per methodology applied. Measurements convert into tree biomass by using three methods: 1. using allometric equations based on tree dimensions; or 2. using biomass expansion factors; or 3. combination 1 and 2. For Magnolia, method 3 has been chosen, for Oak, method 1 has been chosen.

Step-wise procedures of the approved baseline and monitoring methodology AR-ACM0003/Version 02.0 was followed to monitor the verifiable carbon stock changes in the above-ground.

The equations of the afterwards trees biomass accumulation is calculated based on formulas confirmed and accepted by local forestry bureau. The equations are as follows:

Tree Species	The Volume of the afterwards trees accumulation ⁷
Magnolia ⁸	$V=0.00004827 \times \text{DBH}^1.70461591 \times H^1.22521857$
Oak ⁹	$C_{\text{TREE}} = C_0 + \sum_{i=1}^n C_i$ $\ln C_0 = 1.7271 + 0.0015 \times \ln(\text{DBH}^2 \times H)$ $\ln C_i = a_i + b_i \times \ln(\text{DBH}^2 \times H)$ $a_1 = -5.0662, a_2 = -4.5282, a_3 = -4.9172, a_4 = -0.2775$ $b_1 = 1.0506, b_2 = 0.8745, b_3 = 0.9257, b_4 = 0.4539$

V: Commercial volume of tree, $\text{m}^3 \cdot \text{tree}^{-1}$

DBH: Diameter at breast height of tree. cm

⁷ According to A/R Methodological Tool “Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities” (Version 01.0.1), the formula of Magnolia has been used in Guilin forestry bureau for more than 10 years, and the formula of Oak tree is derived from a data set of 224 sample trees, and the value of coefficient of determination (R^2) is 0.983, so the formulas are considered appropriate.

⁸ Due to the local forestry bureau has no relevant data, the data are from the literature of the neighboring areas. The formula of binary tree volume in Guilin from Guilin forestry bureau. The climate, geography and ecological environment of Guangxi is similar to that of Nanzhao. Nanzhao and Guilin both are subtropical monsoon climate, average annual temperature of Nanzhao and Guilin are 15.7°C and 16.7°C . Nanzhao and Guilin both are adjacent mountains, and there are abundant water resources in Nanzhao and Guilin.

⁹ The equation for the calculation of oak biomass of State Forestry Administration is from Section 2.1.1 of “Biomass and biomass models of Secondary Subtropical Vegetation in Tuojiang River Valley” Liu Xingliang, et

H: Height of trees, m

C_{TREE} : Tree biomass, kg d.m.

Put the result coming from the above equation into the formula in Section 3.2 formula (3), we can get the change in carbon stocks for the project.

Database management

Data management includes electronic version and printed version. All the data copy must be preserved by all the project stakeholders. The preserved documents include:

- The original monitored data, experiment data, results of data analysis and electronic database;
- All the estimated data covering change in carbon stock;
- All the maps including GIS maps;
- Monitoring reports.

Uncertainty

According to the method, the associated uncertainty of the change in carbon stock in trees is estimated as follows:

$$\Delta C_{TREE} = \frac{44}{12} \times CF_{TREE} \times \Delta B_{TREE} \quad (3)$$

$$\Delta B_{TREE} = A \times \Delta b_{TREE} \quad (4)$$

$$\Delta b_{TREE} = \sum_{i=1}^M w_i \times \Delta b_{TREE,i} \quad (5)$$

$$u_{\Delta C} = \frac{t_{VAL} \times \sqrt{\sum_{i=1}^M w_i^2 \times \frac{s_{\Delta,i}^2}{n_i}}}{|\Delta b_{TREE}|} \quad (6)$$

Where:

ΔC_{TREE} = Change in carbon stock in trees between two successive measurements;
t CO₂-e

CF_{TREE} = Carbon fraction of tree biomass; t C (t d.m.)⁻¹

A default value of 0.5 is used unless transparent and verifiable information can be provided to justify a different value.

ΔB_{TREE}	=	Change in tree biomass within the biomass estimation strata; t d.m.
A	=	Sum of areas of the biomass estimation strata; ha
Δb_{TREE}	=	Mean change in tree biomass per hectare within the biomass estimation strata; t d.m. ha ⁻¹
W_i	=	Ratio of the area of stratum i to the sum of areas of biomass estimation strata (i.e. $W_i = A_i / A$); dimensionless
$\Delta b_{\text{TREE},i}$	=	Mean change in carbon stock per hectare in tree biomass in stratum i ; t d.m. ha ⁻¹
$u_{\Delta c}$	=	Uncertainty in ΔC_{TREE}
t_{val}	=	Two-sided Student's t -value for a confidence level of 90 per cent and degrees of freedom equal to $n-M$, where n is total number of sample plots within the tree biomass estimation strata, and M is the total number of tree biomass estimation strata
$S^2_{\Delta i}$	=	Variance of mean change in tree biomass per hectare in stratum i ; (t d.m. ha ⁻¹) ²
n_i	=	Number of sample plots, in stratum i , in which tree biomass was remeasured

Table 3-5 Calculation of Uncertainty

Strata	$A_{i,p}$ (ha)	S_i (tonnes C/ha)	W_i	Δb_{TREE} (t/ha)	$u_{\Delta c}$
PROJ-1	566	0.0510	0.026	0.042211633	
PROJ-2	2227	0.9142	0.102	2.276982895	
PROJ-3	2095	0.3632	0.096	1.088008531	
PROJ-4	496	0.1117	0.023	0.020953589	
PROJ-5	3709	1.0113	0.171	3.212123581	
PROJ-6	996	0.2505	0.046	0.451502526	
PROJ-7	848	0.0238	0.039	0.019659693	
PROJ-8	3000	0.6351	0.138	2.178297577	

PROJ-9	1361	0.2216	0.063	0.534873811	1.72%
PROJ-10	706	0.0036	0.032	0.007715329	
PROJ-11	968	0.6158	0.045	0.285444961	
PROJ-12	1229	0.0099	0.057	0.006816866	
PROJ-13	1786	0.1240	0.082	1.096463446	
PROJ-14	1740	0.3025	0.080	0.448209135	

According to the methodology, if $u_{\Delta c} \leq 10\%$ then no deduction will result for uncertainty, as $u_{\Delta c} < 10\%$, then no deduction will result from uncertainty.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

As described above, the baseline scenario is the continuation of existing land use i.e. lands remain barren. Based on the applied methodology AR-ACM0003 (Version 2.0.0), the baseline net GHG emission reductions or removals by sinks is estimated as follows:

$$\Delta C_{BSL,t} = \Delta C_{TREE-BSL,t} + \Delta C_{SHRUB-BSL,t} + \Delta C_{DW-BSL,t} + \Delta C_{LI-BSL,t} \quad (7)$$

Where:

- $\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks in year t; t CO₂-e
- $\Delta C_{TREE-BSL,t}$ = Change in carbon stock in baseline tree biomass within the project boundary in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO₂-e
- $\Delta C_{SHRUB-BSL,t}$ = Change in carbon stock in baseline shrub biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO₂-e
- $\Delta C_{DW-BSL,t}$ = Change in carbon stock in baseline dead wood biomass within the project boundary, in year t, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities"; t CO₂-e
- $\Delta C_{LI-BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary, in year t, as estimated in the tool

“Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities”; t CO₂-e

With baseline scenario, dead wood biomass and litter biomass would not be changed by local farmers. All the plots in this country have been barren and do not change after 1970s and before the project. Thus, the change in carbon stock in baseline dead wood biomass and litter biomass can be negligible.

$$GHG_{NET,BSL,t} = \Delta C_{BSL,t} = 0$$

Therefore, the baseline net GHG emission reductions or removals by sinks is 0.

4.2 Project Emissions

According to the applied methodology AR-ACM0003 (Version 02.0), GHG emission reductions or removals resulting from removal of herbaceous vegetation, combustion of fossil fuel, fertilizer application, use of wood, decomposition of litter and fine roots of N-fixing trees, construction of access roads within the project boundary, and transportation attributable to the project activity shall be considered insignificant and therefore accounted as zero.

The actual net GHG emission reductions or removals by sinks shall be calculated as the sum of the changes in carbon stocks in the project minus the increase in non-CO₂ GHG emissions within the project boundary, which is shown as follows:

$$\Delta C_{PRJ,t} = \Delta C_{P,t} - GHG_{E,t} \quad (8)$$

The use of fire for site preparation and/or to clear the land of harvest residue prior to replanting is specifically excluded from the project management and therefore non-CO₂ GHG emission reductions or removals are estimated as zero.

$$GHG_{E,t} = 0$$

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

$$\Delta C_{P,t} = \Delta C_{TREE-PROJ,t} + \Delta C_{SHRUB-PROJ,t} + \Delta C_{DW-PROJ,t} + \Delta C_{LI-PROJ,t} + \Delta SOC_{AL,t} \quad (9)$$

The only change within each project stratum are planted trees. In other words, change in carbon stock above the ground and below the ground are changes to be considered in the project. The tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity” (Version 04.2) is used to estimate the change in carbon stock in trees.

$$\Delta C_{TREE_PROJ,t} = C_{TREE,t2} - C_{TREE,t1} \quad (10)$$

$$C_{TREE,i,j} = \sum_{i,j} A_i \times \frac{44}{12} \times CF_j \times B_{TREE,j} \quad (11)$$

$$B_{TREE,j} = V_{TREE,j} * D_j * BEF_j * (1+R_j)^{10} \quad (12)$$

The net greenhouse gas emissions across in the project scenario since the start of the project activity is calculated as:

$$GHG_{NET,PRJ} = \sum_{t=1}^{t^*} \Delta C_{NET,t,PRJ} \quad (13)$$

4.3 Leakage

According to the applied methodology AR-ACM0003 (Version 2.0.0), leakage emission is estimated as follows:

$$LK_t = LK_{AGRIC,t} \quad (14)$$

Where:

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

According to the A/R Methodological tool "Estimation of the increase in GHG emission reductions or removals attributable to displacement of pre-project agricultural activities in A/R CDM project activity", leakage emission resulting from displacement of the activities is composed of decrease in carbon stock in the carbon pools of the land and change in soil organic carbon stock due to land-use change in the land.

$$LK_{AGRIC,t} = \frac{44}{12} \times (\Delta SOC_{LUC,t} + \Delta C_{BIOMASS,t}) \quad (15)$$

Where:

$$LK_{AGRIC,t} = \text{Leakage due to the displacement of agricultural activities in year t; t CO}_2\text{-e}$$

¹⁰ Equation (5) in page 25, The tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity" (Version 04.2)

$\Delta SOC_{LUC,t}$ = Decrease in carbon stock in the carbon pools of the land receiving the activity displaced in year t; t d.m

$\Delta C_{BIOMASS,t}$ = Change in soil organic carbon (SOC) stock due to land-use change in the land receiving the displaced activity in year t; t C ha

The project was implemented by manual operation, rather than mechanical operation. Besides, no weeding, chopping, pruning, intermediate cutting activities are going to be conducted during the crediting period because of the natural condition, the economic condition and the slow growth pattern. Fertilization and watering are not going to take place, neither.

This project forbids man-made burning of biomass such as land preparation and forest burning. Therefore, the increase of greenhouse gas emissions within the project boundary only considers the greenhouse gas emissions caused by forest fires and burning of aboveground biomass and dead organic matter.

Therefore, there is no expected leakage due to decrease in carbon stock in the carbon pools of the land and change in soil organic carbon stock. In other words, there is no expected leakage due to the displacement of agricultural activity from the project activity.

Therefore, leakage is zero for the proposed project.

4.4 Net GHG Emission Reductions and Removals

According to the equation in VCS-PD, the Net Project Greenhouse Gas Emission Reductions are calculated as:

$$GHG_{CREDITS,LTPF,t} = GHG_{NET,PRJ,t} - GHG_{NET,BSL,t} - GHG_{LK,LTPF,t} \quad (16)$$

$GHG_{NET|BSL}$ and $GHG_{NET|PRJ}$ is calculated in section 4.1 and 4.2 of the monitoring report.

$GHG_{LK|LTPF}$ is demonstrated in section 4.3. Therefore, table 7 shows a summary of

$GHG_{CREDITS|LTPF}$ for the monitoring period from 2014-2019. Detailed calculation could be seen in the excel version of emission calculation.

Table 4-1 Summary of total net GHG emission reductions or removals¹¹

¹¹ In fact, the total carbon stock change in project scenario from 20/10/2014 to 30/06/2019 is calculated based on the monitored growth during 2014 to 2019. In order to calculate the annual carbon stock change, the total carbon stock change is averaged by these 4.696 years (the period of 20/10/2018-30/06/2019 is 254 days, it's 0.696 year). This method is also commonly accepted in forestry. As stated in P169-171 of the professional college textbook "forest resource operation and management" published by Chinese Forest Press in 2001, the forest growth is divided into average growth and current annual increment, the latter is usually difficult to measure and have a high error,

Period	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)
20/10/2014-19/10/2015	0	-28,898	0	28,898
20/10/2015-19/10/2016	0	-68,605	0	68,605
20/10/2016-19/10/2017	0	-108,978	0	108,978
20/10/2017-19/10/2018	0	-115,863	0	115,863
20/10/2018-30/06/2019	0	-142,436 ¹²	0	142,436
Total	0	-464,780	0	464,780
Average annual value	0	-96,227	0	96,227

4.4.1 Adjustment for uncertainty

$$\Delta C_{TREE} = \frac{44}{12} \times CF_{TREE} \times \Delta B_{TREE} \quad (17)$$

$$\Delta B_{TREE} = A \times \Delta b_{TREE} \quad (18)$$

$$\Delta b_{TREE} = \sum_{i=1}^M w_i \times \Delta b_{TREE,i} \quad (19)$$

$$u_{\Delta C} = \frac{t_{VAL} \times \sqrt{\sum_{i=1}^M w_i^2 \times \frac{s_{\Delta,i}^2}{n_i}}}{|\Delta b_{TREE}|} \quad (20)$$

therefore, the former is commonly used to determine the forest growth. The results of carbon stock change are the same if calculated by these two methods, but the current annual increment is unavailable for the project, so the total carbon stock change is averaged to obtain the annual carbon stock change.

¹² The project scenario emission reduction of 20/10/2018-19/10/2019 is 65,304 tCO₂ as calculated in MR-ER sheet, the period of 20/10/2018-30/06/2019 is 254 days, so GHG_{NET,PRJ,t} of 20/10/2018-30/06/2019 is calculated by 204,649*0.696=142,436 tCO₂

According to Table 3-5, $u_{\Delta c} = 1.72\%$, then no deduction will result from uncertainty.

4.4.2 Calculation of verified carbon units

The amount of greenhouse gas credits estimated at Step 4.4.1 above should be adjusted to account for risk.

Based on the VCS Tool¹³ for AFOLU Non-Permanence Risk Analysis and Buffer Determination version 3.3, the amount of GHG emission reductions or removals with buffer deduction that can be issued at time $t=t_2$ (the date of verification) for monitoring period $T=t_2-t_1$, is calculated as the equation in VCS-PD:

$$GHG_{buffer} = (Credits_{total,t2|LiPF} - Credits_{total,t1|LiPF}) - Bu_{IFM-VCS} \quad (21)$$

Based on the analysis in section 2.1, the overall risk rating of 10 is converted to a percentage as 10%. This percentage is multiplied by the net change in the project's carbon stock. Therefore, the amount of GHG emission reductions or removals with buffer deduction of this crediting period is:

Table 4-2 GHG emission reductions or removals with buffer deduction

Year	Baseline emissions or removals (tCO ₂ e)	Project emissions or removals (tCO ₂ e)	Leakage emissions (tCO ₂ e)	Net GHG emission reductions or removals (tCO ₂ e)	Risk Score	Net GHG emission reductions or removals with buffer (tCO ₂ e)
20/10/2014-19/10/2015	0	-28,898	0	28,898	10	26,008
20/10/2015-19/10/2016	0	-68,605	0	68,605	10	61,744
20/10/2016-19/10/2017	0	-108,978	0	108,978	10	98,080
20/10/2017-19/10/2018	0	-115,863	0	115,863	10	104,276
20/10/2018-30/06/2019	0	-142,436	0	142,436	10	128,191
Total	0	-464,780	0	464,780		418,299
Average annual value	0	-96,227	0	96,227		86,604

¹³ AFOLU Non-Permanence Risk Tool, (Version 3.3)