INNER MONGOLIA WU'ERQIHAN IFM (CONVERSION OF LOGGED TO PROTECTED FOREST) PROJECT

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1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

The **Inner Mongolia Wu'erqihan IFM (conversion of logged to protected forest) Project** *(*hereafter "the project activity") is implemented in Wu'erqihan Town, Yakeshi City, Inner Mongollia Autonomous Region of China, by China Inner Mongolia Forest Industry Group Wu'erqihan Forest Industry Co., Ltd., the geo-coordinate of the project proponent is 121°12′25″E~122°50′43″E and 49°15′04″N~49°58′30″N, the total area is 576,006 ha, which includes the Improved Forest Management (IFM) of the forests in from the conversion of logged to protected forest.

The area of the project activity is 43,167 ha, including 3,491 subcompartments spreading over Kukou department, Meitian department, Wushijiu department, Moguai department, Bolatu department, Wulikeqi department, Mendeli department, Kelihe department, Muyang department, Wenkutu Department, Ergenhe department , Nemen department , Xiriteqi department of China Inner Mongolia Forest Industry Group Wu'erqihan Forest Industry Co., Ltd. All these departments are state-owned forests and have the legal right to forest ownership. The species involved in the project are Birch (Betula platyphylla) and Larch (Larix gmelinii).

Before the implementation of the project activity, the trees are logged based on a valid and verifiable government-approved timber management plan for harvesting the project area. The implementation of the project activity converses the trees to protected forest to reduce the GHG emissions for about 11,282,629 tCO_2e in 30 years, the average annual emission reduction is 376,087 tCO2e and Verified Carbon Units with buffer deduction is about 8,800,436 tCO_2e in 30 years, the average annual VCUs with buffer deduction is 293,347 tCO_2e.

The project generated 1,095,069 tCO_2e emission reductions within the crediting period from 01/01/2013 to 30/06/2017 with the average annual emission reductions of 243,348 tCO_2e.

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

From 01/01/2013, the project has strictly cancelled the annual commercial timber harvest and only allowed the tending and managing. In order to control the annual forest timber volume and achieve reliable and verified carbon sequestration, a forest protection plan will be issued by local forest authority, and strictly executed by the project owner. The forest growth amount and forest second class investigation will be monitored by local forestry bureau periodically.

1.2 Sectoral Scope and Project Type

Sectoral scope 14 (AFOLU)

Improved Forest Management: Logged to Protected Forest (LtPF)

1.3 Project Proponent

Organization name	China Inner Mongolia Forest Industry Group Wu'erqihan Forest Industry Co., Ltd.
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1.4 Other Entities Involved in the Project

N/A

1.5 Project Start Date

The project start date is 01/01/2013, which is announced by the Wu'erqihan Forestry Bureau. The document shows that commercial timber harvest was stopped since 01/01/2013 in China Inner Mongolia Forest Industry Group Wu'erqihan Forest Industry Co., Ltd.

1.6 Project Crediting Period

The project crediting period is from 01/01/2013 to 31/12/2042 with the total number of 30 years.

1.7 Project Location

The project is located in Wu'erqihan Town, Yakeshi City, Inner Mongollia Autonomous Region of P.R.China. The geo-coordinate range of the project is 121°12'25"E~122°50'43"E and 49°15'04"N~49°58'30"N. 3,491 subcompartments spreading over Kukou department, Meitian department, Wushijiu department, Moguai department, Bolatu department, Wulikeqi department, Mendeli department, Kelihe department, Muyang department, Wenkutu Department, Ergenhe department, Nemen department, Xiriteqi department of China Inner Mongolia Forest Industry Group Wu'erqihan Forest Industry Co., Ltd.

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

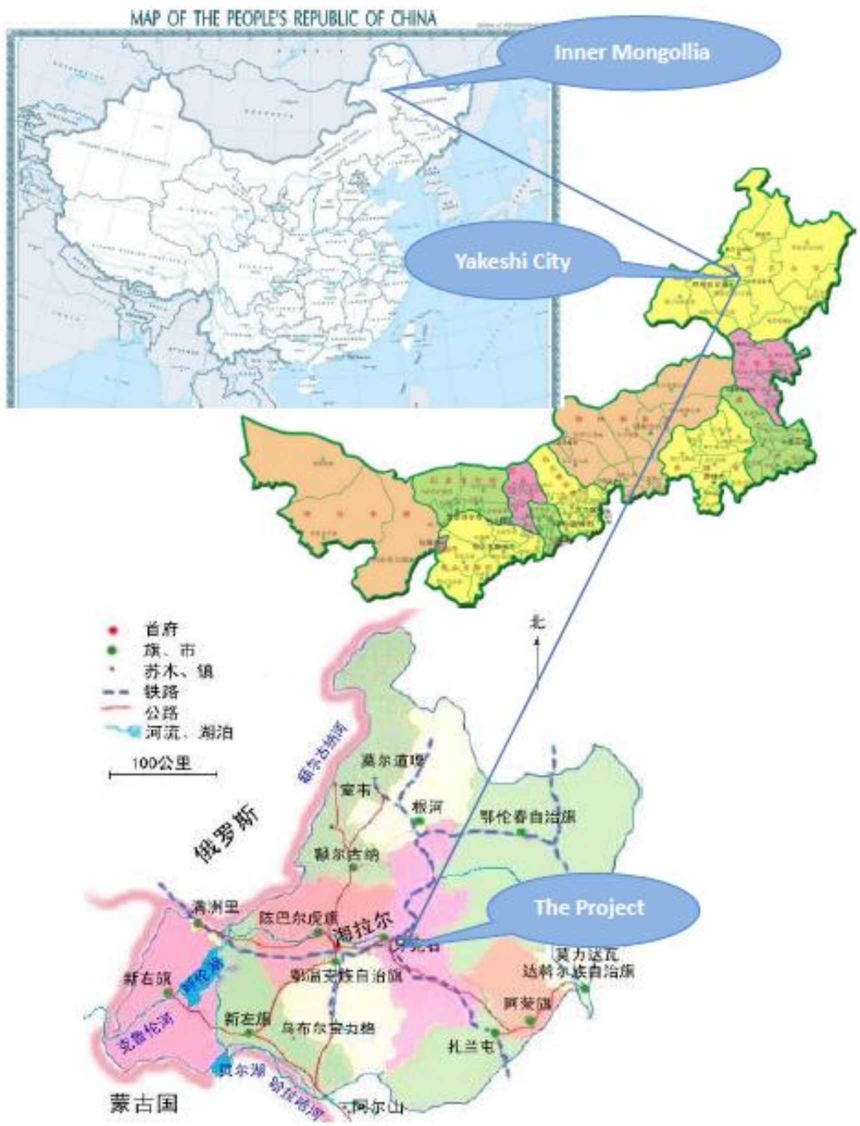


Figure 1: The project location

1.8 Title and Reference of Methodology

VM0010 version 1.3: Methodology for Improved Forest Management: Conversion of Logged to Protected Forest

This methodology uses the latest versions of the following methodologies, modules and tools:

- *CDM Tool for Calculation of the Number of Sample Plots for Measurements within A/R CDM Project Activities*

- *VCS tool VT0001 Tool for the Demonstration and Assessment of Additionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) Project Activities*

- *VCS tool for AFOLU Non-Permanence Risk Tool.*

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.

The project will promote local sustainable development by the conversion of logged to protected forest. Major contributions of the project are as follows:

1) The implementation of the project will control soil and water erosion and land degradation in the project areas;

2) The implementation of the project will enhance biodiversity conservation by increasing forest cover and nature habitat connectivity;

3) The implementation of the project will absorb and fix carbon dioxide every year by conversion of logged to protected forest, and reduce GHG emission.

4) The implementation of the project will generate income for the local farmers by regular forest management. Local people’s standard of living has been developed.

2 IMPLEMENTATION STATUS

2.1 Implementation Status of the Project Activity

- From 01/01/2013, the forests owner decided to converse the forest from logged to protected forest to improve the carbon stock. In the subsequent implementation, the forests are well protected without any harvest and disturbance.
- As the project activity area contains different forest types or forests with different carbon density, stratification is carried out in order to improve the accuracy and precision of carbon stock estimates. Based on the availability of data regarding the nature and composition of forest stocks in the project area, stratification is developed on the basis of existing vegetation stratification, where these are documented in the legal right to harvest. In the VCS-PD, 2 strata with the total area of 43,167 ha are specified according to the tree species.
- For the Non-permanence Risk, according to AFOLU Non-Permanence Risk Tool: VCS Version 3.2, the risks are analyzed in Non-permanence Risk Report. The risk value is 22.

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

Questionnaires were distributed by the project proponent to the residents who lives in the community and closely related to the project in Dec 2012. 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 Survey was conducted through distributing and collecting responses to a questionnaire. Totally 40 questionnaires returned out of 40 with 100% response. 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.

3 DATA AND PARAMETERS

3.1 Data and Parameters Available at Validation

Data / Parameter	$V_{l,j,i,sp}$
Data unit	m^3
Description	Merchantable volume for tree *l* of species *j* in sample plot *sp* in stratum *i*
Source of data	Calculated from volume tables or equations linking diameter at breast height (DBH, at typically 1.3 m aboveground level), and

	merchantable height (MH), to commercial (merchantable) volume of trees in the sample plots above the minimum DBH set in the timber harvest plan. If locally derived equations or yield tables are not available use relevant regional, national or default equations from IPCC literature, national inventory reports or published peer-reviewed studies– such as those provided in Tables 4.A.1 to 4.A.3 of the GPG-LULUCF (IPCC 2003).
Value applied	See the detailed excel spreadsheet
Justification of choice of data or description of measurement methods and procedures applied	It is necessary to verify the applicability of equations used. Allometric equations can be verified by both: 1. Verification of equation conditions Justification should be provided for the applicability of the equation to the project locations. Such justification should include identification of climatic, edaphic, geographical and taxonomic similarities between the project location and the location in which the equation was derived. Any equation used should have an r2 value of greater than 0.5 (50%) and a p value that is significant (<0.05 at the 95% confidence level). 2. Additional field verification The following limited measures method must be used for field verification: select at least 10 trees per species distributed across the age range (but excluding trees less than 15 years old for which there is rarely a great relative inaccuracy in equations) ; measure DBH, and height to a 10 cm diameter top or to the first branch; calculate stem volume from measurements; and plot the estimated volume of all the measured trees along with the curve of volume against diameter as predicted by the allometric equation. If the estimated volume of the measured trees are distributed both above and below the curve (as predicted by the allometric equation) the equation may be used. The equation may also be used if the measured individuals have a volume consistently higher than predicted by the equation. The equation may not be used if >75% of the measured trees have a volume lower than the predicted curve. In this instance another equation must be selected.
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	CF_j

Data unit	tC·td.m.$^{-1}$
Description	Carbon fraction of dry matter for species j
Source of data	According to VM0010 version 1.3, the default value 0.5 tC·t d.m.$^{-1}$ is used and the same value is used in all instances where this parameter is used.
Value applied	0.5
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	D_j
Data unit	t d.m. m^{-3}
Description	Basic wood density of species j in t d.m. m^{-3}
Source of data	According to VM0010 version 1.3, it must be chosen with priority from higher to lower preference as follows: National species-specific or group of species-specific values (eg, from National GHG inventory); Species-specific or group of species-specific values from neighboring countries with similar conditions. When species-specific data from neighboring countries is of higher quality, being more representative of the species in the project scenario, it may be preferable to use these values than lower quality national data; Global species-specific or group of species-specific (eg, IPCC 2006 AFOLU Chapter 4 Tables 4.13 and 4.14). Species-specific wood densities may not always be available, and may be difficult to apply with certainty in the typically species rich forests of the humid tropics, hence it is acceptable practice to use wood densities developed for forest types or plant families or species groups. "Land Use Change and Forestry GHG Inventory(2013)" of "Second National Information Notification on China Climate Change" matches the first choice.
Value applied	Tree species: D_j Birch: 0.541 Larch: 0.490
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions

Comments	N/A

Data / Parameter	$f_j(X, Y…)$
Data unit	t d.m. tree^{-1}
Description	Allometric equation(s) for species j linking measured tree variable(s) to aboveground biomass of living trees
Source of data	Equations must have been derived using a wide range of measured variables (eg, DBH, Height, etc.) based on datasets that comprise at least 30 trees. Equations must be based on statistically significant regressions and must have an r2 that is ≥ 0.8. The source of equation(s) must be chosen with priority from higher to lower preference, as available, as follows: a) National species-, genus-, family-specific; b) Species-, genus-, family-specific from neighbouring countries with similar conditions (ie, broad continental regions); c) National forest-type specific; d) Forest-type specific from neighbouring countries with similar conditions (ie, broad continental regions); e) Forest type-specific such as those provided Tables 4.A.1 to 4.A.3 of the GPG-LULUCF (IPCC 2003); or in Pearson, T., Walker, S. and Brown, S. 2005. Sourcebook for Land Use, Land-Use Change and Forestry Projects. Winrock International and the World Bank Biocarbon Fund. 57pp.; or in Chave, J., C. Andalo, S. Brown, M. A. Cairns, J. Q. Chambers, D. Eamus, H. Folster, F. Fromard, N. Higuchi, T. Kira, J.-P. Lescure, B. W. Nelson, H. Ogawa, H. Puig, B. Riera, T. Yamakura. 2005. Tree allometry and improved estimation of carbon stocks and balance in tropical forests. Oecologia 145: 87-99. Species-, genus- and family-specific allometric equations may not always be available, and may be difficult to apply with certainty in the typically species rich forests of the humid tropics. Hence it is acceptable practice to use equations developed for regional forest types, provided that their accuracy has been validated with direct site-specific data following guidance given below. If a forest-type specific equation is used, it should not be used in combination with species-specific equation(s) (ie, it must be used for all tree species).
Value applied	N/A
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	It is necessary to validate the applicability of equations used. Source data from which equation(s) was derived should be reviewed and confirmed to be representative of the forest

	type/species and conditions in the project and covering the range of potential independent variable values. Allometric equations can be validated either by: 1. Limited Measurements select at least 30 trees (if validating forest type-specific equation, selection should be representative of the species composition in the project area, ie, species representation in roughly in proportion to relative basal area). Minimum diameter of measured trees must be 20cm and maximum diameter must reflect the largest trees present or potentially present in the future in the project area (and/or leakage belt); measure DBH, and height to a 10 cm diameter top or to the first branch; calculate stem volume from measurements and multiplying by species-specific density to gain biomass of bole; apply a biomass expansion factor to estimate total aboveground biomass from stem biomass37; and plot the estimated biomass of all the measured trees along with the curve of biomass against diameter as predicted by the allometric equation. If the estimated volume of the measured trees are distributed both above and below the curve (as predicted by the allometric equation) the equation may be used. The equation may also be used if the measured individuals have a biomass consistently higher than predicted by the equation. If >75% of the measured trees have a biomass lower than the predicted curve, destructive sampling must be undertaken or another equation must be selected. 2. Destructive Sampling select at least 5 trees (if validating forest type-specific equation, selection should be representative of the species composition in the project area, ie, species representation in roughly in proportion to relative basal area) at the upper end of the range of independent variable values existing in the project area; measure DBH and commercial height and calculate volume using the same procedures/equations used to generate commercial volumes to which BCEFs will be applied; fell and weigh the aboveground biomass to determine the total (wet) mass of the stem, branch, twig, leaves, etc. Extract and immediately weigh subsamples from each of the wet stem and branch components, followed by oven drying at 70 degrees C to determine dry biomass; determine the total dry weight of each tree from the wet weights and the averaged ratios of wet and dry weights of the stem and branch components; and

	plot the estimated biomass of all the measured trees along with the curve of biomass against diameter as predicted by the allometric equation. If the estimated volume of the measured trees are distributed both above and below the curve (as predicted by the allometric equation) the equation may be used. The equation may also be used if the measured individuals have a biomass consistently higher than predicted by the equation. If >75% of the measured trees have a biomass lower than the predicted curve another equation must be selected. Details of destructive sampling measurements are given in: Brown, S. 1997. Estimating biomass and biomass change of tropical forests: a primer. FAO Forestry Paper 134, Rome, Italy. Available at http://www.fao.org/docrep/W4095E/W4095E00.htm If using species-specific equations, and new species are encountered in the course of monitoring, new allometric equations must be sourced from the literature and validated, if necessary, as per requirements and procedures above. Default values must be updated whenever new guidelines are produced by the IPCC

Data / Parameter	$BCEF_R$
Data unit	t d.m. m^{-3}
Description	Biomass conversion and expansion factor applicable to wood removals in the project area
Source of data	The source of data must be chosen with priority from higher to lower preference as follows: Existing local forest type-specific; National forest type-specific or eco-region-specific (eg, from national GHG inventory); Forest type-specific or eco-region-specific from neighboring countries with similar conditions. Sometimes (c) might be preferable to (b); Global forest type or eco-region-specific (eg, IPCC 2006 INV GLs AFOLU Chapter 4 Table 4.5). Alternatively: BCEFR = BEFR * D Where BCEF values are not directly available, they can be calculated as Biomass Expansion Factor (BEF)* basic wood density (D). Application of this equation requires caution because basic wood density and biomass expansion factors tend to be correlated. If the same sample of trees was used to determine D, BEF or BCEF, conversion will not introduce error, therefore, it is acceptable to use this equation. If, however, basic wood density is not known with certainty, transforming one into the other might introduce error, as BCEF implies a specific but unknown basic wood density, therefore,

	all conversion and expansion factors must be derived or their applicability checked locally. The value from the GHG inventory of "Land Use Change and Forestry GHG Inventory (2013)" of "Second National Information Notification on China Climate Change" matches the second choice.
Value applied	<table><tr><th>Tree species</th><th>BEF</th><th>D</th><th>BCEF_R</th></tr><tr><td>Birch</td><td>1.424</td><td>0.541</td><td>0.770</td></tr><tr><td>Larch</td><td>1.416</td><td>0.490</td><td>0.694</td></tr></table>
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	The combustion factor is a measure of the proportion of the fuel that is actually combusted, which varies as a function of the size and architecture of the fuel lcad (ie, a smaller proportion of large, coarse fuel such as tree stems will be burnt compared to fine fuels, such as grass leaves), the moisture content of the fuel and the type of fire (ie, intensity and rate of spread). Default values must be updated whenever new guidelines are produced by the IPCC

Data / Parameter	G_{gi}
Data unit	g kg^{-1} dry matter burnt
Description	Emission factor for stratum i for gas g
Source of data	Defaults can be found in Volume 4, Chapter 2, of the IPCC 2006 Inventory Guidelines in table 2.5
Value applied	Please refer to the spreadsheet
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	Default values shall be updated whenever new guidelines are produced by the IPCC

Data / Parameter	OF, SLF,WW
Data unit	Kg kg^{-1}
Description	OF = Fraction of wood products that will be emitted to the atmosphere between 3 and 100 years after production; SLF = Fraction of wood products that will be emitted to the

	atmosphere within 3 years of production; and WW = Fraction of extracted biomass effectively emitted to the atmosphere during production Wood waste fraction(WW): Winjum et al. 1998indicatethattheproportionofextracted biomass that is oxidized (burning or decaying) from the production of commodities to be equal to19% for developed countries, 24% for developing countries. Short-lived fraction (SLF) Winjumetal1998 give decay rates for proportions of wood products, which were converted to with short-term (<3yr) uses (applicable internationally) as below: Sawnwood 0.12 Woodbase panels 0.06 Other industrial roundwood 0.18 Paper and Paperboard 0.24 Additional oxidized fraction (OF) Winjum et al 1998 gives annual oxidation fractions for each class of wood products split by forest region (boreal, temperate and tropical). This methodology projects these fractions over 95 years to give the additional proportion that is oxidized between the 3rd and the 100th year after initial harvest:

Wood Product Class	*OF*		
	Boreal	Temperate	Tropical
Sawnwood	0.39	0.62	0.86
Woodbase panels	0.62	0.86	0.98
Other industrial roundwood	0.86	0.98	0.99
Paper and paperboard	0.39	0.62	0.99

Source of data	According to VM0010 version 1.3, the default values are chosen.
Value applied	(see table below)

Parameters	Species	Value
OF	Birch/Larch	0.62
SLF	Birch/Larch	0.12
WW	Birch/Larch	24%

Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	RGR_i
Data unit	$tC.ha^{-1}.yr^{-1}$

Description	Forest regrowth rate post timber harvest for stratum *i*
Source of data	Regrowth rate must be calculated from either a) data generated in a reference area using measurements of timber volume in a chronosequence of replicated sample plots; or b) published data on forest growth after timber harvest of the same forest type within the same region as the project; or c) the IPCC default values for aboveground net biomass growth in natural forests.
Value applied	<table><tr><th>Species</th><th>Value</th><th>Uint</th></tr><tr><td>Birch</td><td>1.56</td><td>$m^3.ha^{-1}.yr^{-1}$</td></tr><tr><td>Larch</td><td>2.54</td><td>$m^3.ha^{-1}.yr^{-1}$</td></tr></table>
Justification of choice of data or description of measurement methods and procedures applied	Method b is applied. The average annual regrowth is confirmed by Inner Mongolia autonomous region forestry survey and design institute based on their expertise. And the RGRi can therefore be calculated by the biomass expansion factor, density and carbon fraction of the separate species.
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$V_{EX,j,i\|BSL}$
Data unit	$m^3.ha^{-1}$
Description	Mean volume of extracted timber per unit area for species *j* in stratum *i*
Source of data	The timber harvest plan sets the allowable mean extracted volume from the merchantable volume of timber in the forest inventory ($V_{j,i\|BSL}$), based on legal limits.
Value applied	please refer to ER sheet
Justification of choice of data or description of measurement methods and procedures applied	The measurement method is from academic paper and equations developed for regional forest types. Please refer to ER sheet
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$A_{i,p}$
Data unit	Ha
Description	Area covered by stratum *i* over land parcel *p*
Source of data	Geodetic coordinates and/or Remote Sensing data and/or legal

	parcel records
Value applied	See the detailed Project Land Form
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	It must be assumed ex-ante that land parcel boundaries and strata areas must not change through time

Data / Parameter	$A_{1,i,p}$
Data unit	Ha
Description	The area of stratum *i* in land parcel *p* that was harvested 1 year ago
Source of data	Geodetic coordinates, GIS Files or legal parcel records
Value applied	See the detailed Project Land Form
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$A_{2\text{-}10,i,p}$
Data unit	Ha
Description	The area of stratum *i* in land parcel *p* that was harvested between 2 and 10 year ago
Source of data	Geodetic coordinates, GIS Files or legal parcel records
Value applied	See the detailed Project Land Form
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$A_{11\text{-}20,i,p}$
Data unit	Ha

Description	The area of stratum *i* in land parcel *p* that was harvested between 11 and 20 year ago
Source of data	Geodetic coordinates, GIS Files or legal parcel records
Value applied	See the detailed Project Land Form
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	A_{t*}
Data unit	Ha
Description	Cumulative area harvested until time t*
Source of data	Geodetic coordinates, GIS Files or legal parcel records
Value applied	See the detailed Project Land Form
Justification of choice of data or description of measurement methods and procedures applied	N/A
Purpose of the data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$A_{s,p}$
Data unit	Ha
Description	Area of sample plot s*p*
Source of data	Recording and archiving of size of sample plots
Value applied	please refer to ER sheet
Justification of choice of data or description of measurement methods and procedures applied	Standard procedures for plot delineation in forest timber inventory surveys shall be used
Purpose of the data	Calculation of baseline emissions
Comments	Ex-ante the size of the plots shall be defined and recorded in the monitoring plan.

3.2 Data and Parameters Monitored

Data / Parameter	Illegal Logging PRA Results
Data unit	Dimensionless
Description	N/A
Source of data	PRA
Description of measurement methods and procedures to be applied	The PRA must evaluate whether timber harvest may be occurring in the project area and shall consist of semi-structured interviews / questionnaires. If ≥ 10% of those interviewed/surveyed believe that illegal logging may be occurring within the project boundary then the limited on-the-ground illegal logging survey shall be triggered. An additional output of the PRA shall be a depth of penetration of illegal logging pressure. A maximum distance shall be recorded for penetration into the forest from access points (such as roads, rivers, already cleared areas) for the purpose of harvesting timber.
Frequency of monitoring/recording	Every two years
Value monitored	No illegal logging occurs during the monitoring period within the project boundary.
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	Ex ante estimation shall be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent illegal logging.

Data / Parameter	Result of Limited Illegal Logging Survey
Data unit	Dimensionless
Description	N/A
Source of data	Limited on-the-ground illegal logging survey
Description of measurement methods and procedures to be applied	Sampled by surveying multiple transects of known length and width across the access-buffer area to check whether new tree stumps are evident or not. The access-buffer area shall be equal in area to at least 1% of $A_{DIST\_IL,i}$
Frequency of monitoring/recording	Must to be repeated each time the PRA indicates a potential for illegal logging.
Value monitored	N/A

Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	Ex ante estimation shall be made of illegal logging in the with-project case. If the belief is that zero illegal logging will occur within the project boundaries then this parameter may be set to zero if clear infrastructure, hiring and policies are in place to prevent illegal logging.

Data / Parameter	$A_{burn,i,t}$
Data unit	Ha
Description	Area burnt in stratum i at time t
Source of data	Geodetic coordinates and / or Remote Sensing data
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Areas burnt must be monitored at least every five years
Value monitored	0
Monitoring equipment	N/A
QA/QC procedures to be applied	Standard quality control/quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	Ex ante estimations of areas burned shall be based on historic incidence of fire in the Project region

Data / Parameter	$A_{dist,i,t}$
Data unit	Ha
Description	Area disturbed in stratum i at time t
Source of data	Geodetic coordinates and / or Remote Sensing data
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Areas disturbed shall be monitored at least every five years

Value monitored	0
Monitoring equipment	N/A
QA/QC procedures to be applied	Standard quality control/quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	Ex ante estimations of areas burned must be based on historic incidence of fire in the Project region

Data / Parameter	$A_{DIST\_IL,i}$
Data unit	Ha
Description	Area potentially impacted by illegal logging in stratum i
Source of data	GIS delineation and ground truthing
Description of measurement methods and procedures to be applied	Must be composed of a buffer from all access points (access buffer), such as roads and rivers or previously cleared areas. The width of the buffer shall be determined by the depth of degradation penetration as defined as a PRA output
Frequency of monitoring/recording	Repeated each time the PRA indicates a potential for degradation
Value monitored	0
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	Ex ante a limited survey can be used to determine a likely depth of degradation penetration

Data / Parameter	$C_{DIST\_IL,i,t\|PRJ}$
Data unit	tCO_2-e
Description	biomass carbon of trees cut and removed through illegal logging in stratum i at time t
Source of data	Field measurements in sample plots
Description of measurement methods and procedures to be applied	The sampling plan must be designed using plots systematically placed over the buffer zone so that they sample at least 3% of the area of the buffer zone ($A_{DIST\_IL,i}$). The diameter of all tree stumps will be measured and conservatively assumed to be the same as the DBH. Where the stump is a large buttress,

	several individuals of the same species nearby shall be located and a ratio of the diameter at DBH to the diameter of buttress at the same height above ground as the measured stumps shall be determined. This ratio will be applied to the measured stumps to estimate the likely DBH of the cut tree. The aboveground carbon stock of each harvested tree will be estimated using the allometric regression equations chosen for forest growth in the project scenario. The mean aboveground carbon stock of the harvested trees is conservatively estimated to be the total emissions and to all enter the atmosphere
Frequency of monitoring/recording	Repeated each time limited sampling of A_{DIST_IL}, indicates illegal logging
Value monitored	0
Monitoring equipment	N/A
QA/QC procedures to be applied	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management must be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	If species-specific equations are used and species cannot be identified from stumps then it shall be assumed that the harvested species is the species most commonly harvested. A PRA shall be used to determine the most commonly harvested species.

Data / Parameter	AP_i
Data unit	Ha
Description	Total area of illegal logging sample plots in stratum i
Source of data	Ground measurement
Description of measurement methods and procedures to be applied	A sampling plan must be designed using multiple sample plots systematically placed across the buffer zone so that they sample at least 3% of the area of the buffer zone.
Frequency of monitoring/recording	Not more than five years
Value monitored	0
Monitoring equipment	N/A
QA/QC procedures to be applied	Standard quality control/quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national

	forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	Ex ante estimation should be made of area of plots. This should be set to exactly 3% of the buffer zone $A_{DIST\_IL,i}$

Data / Parameter	PMP_i
Data unit	%
Description	Merchantable biomass as a proportion of total aboveground tree biomass for stratum i within the project boundaries
Source of data	Within each stratum divide the summed merchantable biomass (defined as total gross biomass of a tree 15cm DBH or larger) by the summed total of aboveground tree biomass.
Description of measurement methods and procedures to be applied	N/A
Frequency of monitoring/recording	Not more than five years
Value monitored	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	Standard quality control/quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	Ex-ante a time zero measurement shall be made of this factor. The timber harvest plan sets the allowable mean extracted volume from the merchantable volume of timber in the forest inventory ($V_{j,i\|BSL}$), based on legal limits.

Data / Parameter:	Ai
Data unit:	Ha
Description	Area covered by stratum i
Source of data	Geodetic coordinates and/or Remote Sensing data and/or legal parcel records

Description of measurement methods and procedures to be applied	The stratum is from the second class forestry inventory
Frequency of monitoring/recording:	Every ten years.
Value applied:	<table><tr><td>Serial number of strata</td><td>Area (ha)</td><td>Tree species</td></tr><tr><td>1</td><td>14,377</td><td>Birch</td></tr><tr><td>2</td><td>28,790</td><td>Larch</td></tr><tr><td>Total</td><td>43,167</td><td></td></tr></table>
Monitoring Equipment:	Tape Measure
QA/QC procedures to be applied:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Purpose of Data	For the calculation of the baseline and project emissions.
Calculation method:	N/A
Comments	In the baseline scenario strata areas must not change through time. In the project scenario it must be assumed ex-ante that stand boundaries and strata areas must not change through time. Ex post adjustments of the project scenario strata may be needed if unexpected disturbances occur during the project crediting period, severely affecting different parts of an originally homogenous stratum. This disturbance will be delineate as a separate stratum for the purpose of monitoring the carbon stock changes.

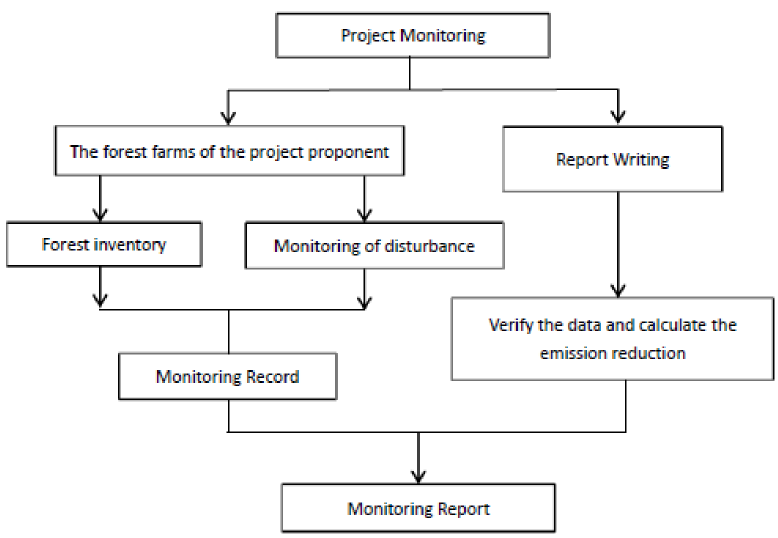
Data / Parameter:	DBH
Data unit:	cm
Description	Diameter at breast height of tree
Source of data	On site measuring on the sample spot.
Description of measurement methods and procedures to be applied	The National Forest Resource Continuous Investigation Technical Regulation issued by the State Forestry Bureau has detailed requirement of the measurement method.
Frequency of monitoring/recording:	Not more than five years
Value applied:	See the MR-ER calculation sheet
Monitoring Equipment:	Tape Measure

QA/QC procedures to be applied:	Standard quality control / quality assurance (QA/QC) procedures for forest inventory including field data collection and data management shall be applied. Use or adaptation of QA/QCs already applied in national forest monitoring, or available from published handbooks, or form the IPCC GPG LULUCF 2003, is recommended.
Purpose of the data	Calculation of tree volume, then to carbon stock change further to the project emissions.
Calculation method:	N/A
Comments	As for the project tree species, there are no allometric equation applied in the project area, the average annual growth and biomass expansion method is adopted for the estimated calculation of carbon stock change. Based on the DBH.and local volume table, the volume can be calculated, combined by the BCEF and CF, the carbon stock can be obtained.

3.3 Monitoring Plan

The project proponent and consultant have set up a team together to conduct the monitoring. The team is in charge of collecting, monitoring and verifying the data, while the project manager is assisted by the consultant company. The findings are reported to the project manager and work out a solution.

The structure of monitoring system is listed below:



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, and estimation of ex-post net carbon stock changes from the conversion of logged to protected forest.

All data collected as part of monitoring were archived electronically, and kept at least for 2 years after the end of the project crediting period. All the forest investigation is implemented according to the primary technical code for the forest resource planning, design and investigation issued by the State Forestry Administration in 2003.

Data archiving took both electronic and paper forms, and copies of all data are available to be provided to each project participant.

All electronic data and reports are copied on hard disk and stored in multiple locations.

The archives include:

Copies of all original sample spots recording sheet (including the detailed information of the spot location), forest volume table;

Estimates of the carbon stock changes in all pools and non-CO_2 GHG and corresponding calculation spreadsheets;

GIS products; and

Copies of the measuring and monitoring reports.

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, archived and achieved by using geo-referenced spatial data of maps.

Principles of forest inventory and management are implemented;

Standard operating procedures (SOPs) and quality control/quality assurance (QA/QC) procedures for forest inventory including field data collection and data management are applied by the Inner Mongolia forest resource inventory operation procedure and other relevant standards.

The project plan, together with a record of the plan as actually implemented during the project, is available for validation or verification as appropriate.

Based on the availability of data regarding the nature and composition of forest stocks in the project area, stratification is developed on the basis of existing vegetation stratification, where these are documented in the legal right to harvest. In the VCS-PD, 2 strata are specified according to the tree species.

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 (Box 3).

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 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. 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. As the sample size should be less than 200, then the total sample plot area should be less than 8 ha, which is small than 5% of the total project are(43167*5%=2158.4 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:

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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

错误!未找到引用源。	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:

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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
错误!未找到引用源。	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

Based on the data of biomass stocks in a carbon pool in the baseline scenario, the estimation of number of sample plots required in shown in the VCS-PD:

Strata No	Stratum Name	Area (ha)	Mean tonnes C/ha	Standard Deviation (t C/ha)	Plot size (ha)	Wi	W_i * Si
Strata 1	Birch	14377.00	72.91	47.53	0.04	0.33	15.83
Strata 2	Larch	28790.00	88.28	47.09	0.04	0.67	31.41

		Number of Plots	
STRATA NO	Stratum Name	Plot Quantity	Rounded Plot Quantity
Total Sample Size		123.95	
Strata 1	Birch	41.54	42
Strata 2	Larch	82.41	83

TOTAL NUMBER OF PLOTS	**125**

* Where the confidence level is 95% as required in the methodology VM0010 version 1.3 and D_f is ∞. Therefore, t_{VAL} is 1.96.

Carbon stock changes over time have been estimated by taking measurements in plots at each monitoring event measured in 2012 just before the projected started and re-measured in June 2017. The number of years between the monitoring intervals in 2012 and June 2017 is 4.5 years.

The monitoring campaign includes the ages, species, DBH and any parameters the needed.

4 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

Baseline projections are calculated ex-ante and are not adjusted through-out the project lifetime.

The net carbon stock change to be converted to emissions is equal to the carbon stock change as a result of timber harvest plus the carbon stock change resulting from conversion and retirement of wood products minus carbon sequestration from forest regrowth after harvest.

In order to generate the annual carbon stock change in the baseline scenario, the total net change in carbon stocks for parcels within is multiplied by the area of forest in the particular age class.

The annualized calculations vary between years 1, 2-10; 10-20; and all years since the start of the project activity, depending on which decay functions apply.

Therefore, the net change in carbon stock from wood products and logging slash across all parcels within the first year of harvest in the baseline is calculated as:

$$\Delta C_{NET,BSL(1)} = \sum_{i=1}^{M}\sum_{p=1}^{P} A_{1,i,p} * \left(\left(\frac{\Delta C_{DWSLASH,i,p,BSL}}{10}\right) + \Delta C_{WP0,i,p,BSL} + (\Delta C_{WP100,i,p,BSL}/20)\right) \quad (3)$$

The net change in carbon stock from wood products and logging slash across all parcels the years 2-10 since harvest in the baseline are calculated as:

$$\Delta C_{NET,BSL(2-10)} = \sum_{i=1}^{M}\sum_{p=1}^{P} A_{2-10,i,p} * \left(\left(\frac{\Delta C_{DWSLASH,i,p,BSL}}{10}\right) + (\Delta C_{WP100,i,p,BSL}/20)\right) \quad (4)$$

The net change in carbon stock from wood products across all parcels the years 11-20 since harvest in the baseline are calculated as:

$$\Delta C_{NET,BSL(11-20)} = \sum_{i=1}^{M} \sum_{p=1}^{P} A_{11-20,i,p} * (\Delta C_{WP100,i,p,BSL}/20) \quad (5)$$

The net change(sequestration) in carbon stock due to forest regrowth across all parcels in all years since harvest in the baseline scenario are calculated according to equation 6 below. Note that there will be no more emissions quantified from decay of logging slash or wood products.

$$\Delta C_{NET,BSL(1+)} = \sum_{i=1}^{M} \sum_{p=1}^{P} A_{i,p,t^*} * (-\Delta C_{RG,i,p,BSL}) \quad (6)$$

Therefore, net change in carbon stock across all parcels harvested over each year of the project crediting period in the baseline scenario since the start of the project activity is calculated as:

$$\Delta C_{NET,BSL,t^*} = \Delta C_{NET,BSL(1)} + \Delta C_{NET,BSL(2-10)} + \Delta C_{NET,BSL(11-20)} + \Delta C_{NET,BSL(1+)} \quad (7)$$

The net carbon stock change in the baseline scenario since the start of the project activity must be converted to net greenhouse gas emissions and is calculated as:

$$GHG_{NET,BSL,t^*} = \Delta C_{NET,BSL,t^*} * \frac{44}{12} \quad (8)$$

The baseline emission process has been demonstrated in the PD of the project, the outcome during this crediting period is listed in the following:

Period	$GHG_{NET,BSL,t}$ (tCO_2e)
01/01/2013-31/12/2013	17,449
01/01/2014-31/12/2014	149,647
01/01/2015-31/12/2015	30,686
01/01/2016-31/12/2016	110,506
01/01/2017-30/06/2017	44,832[1]
Total	**353,120**
Average annual $GHG_{NET\|BSL}$	**78,471[2]**

[1] The baseline scenario emission reduction of 2017 is 89,664 in VCS-PD, the period of 01/01/2017-30/06/2017 is half year, so $GHG_{NET,BSL,t}$ of 01/01/2017-30/06/2017 is calculated by 89,664*0.5=44,832 tCO_2

[2] The average annual $GHG_{NET|BSL}$ is calculated by 353,120/4.5=78,471 tCO_2/yr

4.2 Project Emissions

The net greenhouse gas emissions in the project scenario will be equal to emissions resulting from forest disturbance (both illegal logging and natural disturbances) minus carbon sequestration through ongoing forest growth.

$$\Delta C_{AB,t,PRJ} = \left(\sum_{i=1}^{M}\left(A_i * \frac{C_{AB,i,t2,PRJ} - C_{AB,i,t1,PRJ}}{T}\right)\right) * \frac{44}{12} \quad (9)$$

Therefore, based on the IPCC 2006 Inventory Guidelines, estimation of greenhouse gas emissions from biomass burning shall be calculated as:

$$\Delta C_{DIST_{FR},t|PRJ} = \sum_{i=1}^{M} A_{burn,i,t} * B_{i,t|PRJ} * COMF_i * G_{g,i} * 10^{-3}.GWP_{CH4} \quad (10)$$

As there is no fire occurred during the monitoring period, $\Delta C_{DIST-FR,t,PRJ}$ is equal to 0.

It is conservatively assumed that the natural disturbance is a stand-replacing disturbance, and that the biomass change as a result of the natural disturbance ($\Delta C_{DIST,t,PRJ}$) is emitted in the year of disturbance.

$$\Delta C_{DIST,t,PRJ} = \sum_{i=1}^{M}\left(A_{dist,i,t} * \sum_{j=1}^{J}\{C_{AB,j,i,BSL}\}\right) * \frac{44}{12} \quad (11)$$

As indicates by the relevant statement issued by the local authority, no natural disasters occurred during the monitoring period, $\Delta C_{DIST,t,PRJ}$ is equal to zero.

Illegal logging

A participatory rural appraisal (PRA) of the communities surrounding the project area must be completed to determine if there is the potential for illegal extraction of trees from the project area. If this assessment finds no potential pressure for these activities then illegal logging ($\Delta C_{DISTLI,i,t,PRJ}$) can be assumed to be zero and no monitoring is needed.

If the results of the PRA suggest that there is a potential for illegal logging activities, then limited field sampling must be undertaken.

Therefore, where the PRA or the limited sampling indicate no illegal logging occurring:

$\Delta C_{DIST\_IL,t,PRJ}$ =0

Where the PRA and the limited sampling indicate degradation is occurring, net carbon stock changes as a result of illegal logging shall be calculated as:

$$\Delta C_{DIST-IL,t,PRJ} = \sum_{i=1}^{M}(A_{DIST-IL,j} * \frac{C_{DIST-IL,i,t,PRJ}}{AP_i}) \quad (12)$$

Therefore, net greenhouse gas emissions in the project scenario in year t, is calculated as:

$$\Delta C_{NET,t,PRJ} = (\Delta C_{DIST-FR,t,PRJ} + \Delta C_{DIST,t,PRJ} + \Delta C_{DIST-IL,t,PRJ}) - \Delta C_{AB,t,PRJ} \quad (13)$$

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

$$GHG_{NET,PRJ} = \sum_{t=1}^{t^*} \Delta C_{NET,t,PRJ} \quad (14)$$

$\triangle C_{DIST-FR,t,PRJ}$, $\triangle C_{DIST,t,PRJ}$, $\triangle C_{DIST\_IL,I,t,PRJ}$ are zero during the monitoring period, on-going growth rate is measured by the project owner based on the sample data, the details are listed below:

Period	$\triangle C_{DIST-FR,t,PRJ}$ (tCO_2e)	$\triangle C_{DIST,t,PRJ}$ (tCO_2e)	$\triangle C_{DIST\_IL,I,t,PRJ}$ (tCO_2e)	[3]$\triangle C_{AB,t,PRJ}$ (tCO_2e)	$\triangle C_{NET,t,PRJ}$ (tCO_2e)
01/01/2013-31/12/2013	0	0	0	233,515	-233,515
01/01/2014-31/12/2014	0	0	0	233,515	-233,515
01/01/2015-31/12/2015	0	0	0	233,515	-233,515
01/01/2016-31/12/2016	0	0	0	233,515	-233,515
01/01/2017-30/06/2017	0	0	0	116,758[4]	-116,758
Total	**0**	**0**	**0**	**1,050,818**	**-1,050,818**
Average annual value	**0**	**0**	**0**	**233,515**	**-233,515**

[3] In fact, the total carbon stock change in project scenario from 01/01/2013 to 30/06/2017 is calculated based on the monitored growth during 2013 to 2017. In order to calculate the annual carbon stock change, the total carbon stock change is averaged by these 4.5 years. 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, 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.

[4] The project scenario emission reduction of 2017 is 233,515 as calculated in MR-ER sheet, the period of 01/01/2017-30/06/2017 is half year, so $GHG_{NET,PRJ,t}$ of 01/01/2017-30/06/2017 is calculated by 233,515*0.5=116,758 tCO_2

4.3 Leakage

4.3.1 Activity shifting leakage

The project does not consider the activity shifting leakage because:

According to Forest law of the People's Republic of China[5] Article 6 and Regulations of the People's Republic of China on forestry law[6] Article 28, forest cutting management quota system is implemented in China. The central government issued the maximum timber harvest to provinces and larger state-owned forest enterprises every five years. And the provincial forestry authority issued the timber harvest approval and restrictions to its subordinate based on its limit. Also, the China Forest Law also clearly stipulates the punishment for the illegal logging, which not only requires 5-10 times compensation of replanting, but also 2-10 times economic penalty.

Therefore, for the project activity, even if the project proponent has more than one forest parcels, the timber harvest limit is planned in advance by the forestry authority; they have no right to harvest more in other parcels outside the project activity.

So the activity shifting leakage is 0.

4.3.2 Market leakage

According to the VM0010 version 1.3, the leakage factor is defined as considering where in the country logging will be increased as a result of the decreased supply of the timber caused by the project. If the areas liable to be logged have a higher ratio of merchantable biomass to total biomass higher than the project area it is likely that the proportional leakage is higher and vice versa:

Therefore,

$LF_{ME} = 0$

If it can be demonstrated that no market-effects leakage will occur within national boundaries, that is if no new concessions are being assigned AND annual extracted volumes cannot be increased within existing national concessions AND illegal logging is absent (or de minimis) in the host country.

For the project,

- According to Forest law of the People's Republic of China Article 6/26/38 and Regulations of the People's Republic of China on forestry law Article 28/30/39, forest cutting management quota system has been implemented in China. The National Government issued the

5 http://www.law-lib.com/law/law_view.asp?id=95233

6 http://www.law-lib.com/law/law_view.asp?id=7

maximum timber harvest volume (quota) for provinces and the province government issued the quota to the projects in the geographic area. In addition, according to Implementation of Forest law of the People's Republic of China of the Inner Mongolia Autonomous Region Article 36, once the quota is issued in Inner Mongolia Autonomous Region, the maximum harvest volume for provincial or the projects has been fixed and could not be changed or shifted. Therefore, the Law not only just strictly restrict in the nationwide, but also the province-wide. Besides, Inner Mongolia Autonomous Region is the ecologically fragile area in China, forest cutting management quota system and no illegal logging is strictly enforced. In conclusion, the reduction in harvesting of the project in Inner Mongolia will not cause any increase of quota for any other authorized area.

- According to the 13th Five-year Forest Harvest Limit issued by State Council (Guohan [2016] No.32)[7] , the total harvest volume limit from 2016 to 2020 is 25,403.6*10^4 m^3 per year, the maximum timber harvest volume in Inner Mongolia Autonomous Region during the period from 2016 to 2020 is 588.4*10^4 m^3 per year, and the planned annual average harvest volume of the project is 18.17*10^4 m^3 during the period from 2016 to 2020, accounting 0.07% of the national harvest volume, 3.09% of the Inner Mongolia Autonomous Region harvest volume, which will not result in the significant national concession and illegal logging;

- According to available data of China Statistical Yearbook, the annual timber production in Inner Mongolia Autonomous Region from 2011 to 2015 is 2,179,000[8] m^3, 2,088,000[9] m^3, 1,862,000[10] m^3, 1,787,000[11] m^3, and 1,426,000[12] m^3 respectively. From 2011 to 2015 the timber production decreased by 34.56% sharply, with average annual decline rate 6.91%. Obviously, Inner Mongolia Autonomous Region doesn't balance for the reduction in harvesting within the project area from other area, which also demonstrates that the project hasn't caused market leakage in Inner Mongolia.

- Regulations of the People's Republic of China on forestry law Article 38 and Article 39 clearly stipulates the punishment for the illegal logging. According to the volume and quantity of illegal logging, punishment includes not only 5-10 times compensation of replanting, but also 2-10 times economic penalty.

Therefore, for the project, no new concessions are being assigned and annual extracted volumes cannot be increased within existing national concessions AND illegal logging is absent in the country. According to the section 8.3.2 of methodology VM0010, " *LF_{ME}=0,if it can be demonstrated that no market-effects leakage will occur within national boundaries, that is if no new concessions are being assigned AND annual extracted volumes cannot be increased within existing national concessions AND illegal logging is absent (or de minimis) in the host country*". Therefore, LF_{ME}=0, according to VM0010 version 1.3 Equation (40)

$GHG_{LK|LtPF,t*} = LF_{ME} * GHG_{NET|BSL,t*}$,there is no market leakage.

[7] http://www.gov.cn/zhengce/content/2016-02/16/content_5041486.htm
[8] <China Statistical Yearbook 2012>
[9] <China Statistical Yearbook 2013>
[10] <China Statistical Yearbook 2014>
[11] <China Statistical Yearbook 2015>
[12] <China Statistical Yearbook 2016>

4.4 Net GHG Emission Reductions and Removals

According to the equation (28) in VCS-PD, the Net Project Greenhouse Gas Emission Reductions are calculated as:

$$GHG_{CREDITS,LTPF,t*} = GHG_{NET,BSL,t*} - GHG_{NET,PRJ,t*} - GHG_{LK,,LtPF,t*} \quad (15)$$

$GHG_{NET|BSL}$ 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 2013-2017. Detailed calculation could be seen in the excel version of emission calculation.

Table 7 Summary of total net GHG emission reductions for 01/01/2013-30/06/2017

Period	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
01/01/2013-31/12/2013	17,449	-233,515	0	250,964
01/01/2014-31/12/2014	149,647	-233,515	0	383,162
01/01/2015-31/12/2015	30,686	-233,515	0	264,201
01/01/2016-31/12/2016	110,506	-233,515	0	344,021
01/01/2017-30/06/2017	44,832	-116,758	0	161,590
Total	**353,120**	**-1,050,818**	**0**	**1,403,938**
Average annual value	**78,471**	**-233,515**	**0**	**311,986**

4.4.1 Adjustment for uncertainty

Estimated greenhouse gas emissions and emission reductions from IFM activities have uncertainties associated with parameters and coefficients including estimates of area, carbon stocks, regrowth and expansion factors. It is assumed that the uncertainties associated with input data are available, either as default uncertainty values given in most recent IPCC guidelines, or as statistical estimates based on sampling.

Uncertainty at all times is defined at the 95% confidence interval where the estimated variance exceeds +/- 15 percent from the mean. Procedures including stratification and the allocation of sufficient measurement plots will help ensure that low uncertainty results and ultimately full crediting can result.

Uncertainties arising from the measurement and monitoring of carbon pools and greenhouse gases shall always be quantified. Errors in each pool shall be weighted by the size of the pool so that projects may reasonably target a lower precision level in pools that only form a small proportion of the total stock.

For both the baseline and the with-project case the total uncertainty is equal to the square root of the sum of the squares of each component uncertainty and is calculated at the time of reporting through propagating the error in the baseline stocks and the error in the project stocks. Therefore, total uncertainty for the project is calculated as:

$$U_{Totall|LtPF} = \sqrt{U^2_{|PRJ} + U^2_{|BSL}} \quad (16)$$

If $U_{total|LtPF} \leq 0.15$ then no deduction will result for uncertainty.

If $U_{total|LtPF} > 0.15$ then the amount of greenhouse gas emission credits associated with IFM activities will be deducted as follows:

$$Credits_{total|LtPF} = GHG_{credits|LtPF} \cdot (1 - U_{total|LtPF}) \quad (17)$$

For the baseline scenario:

As ex-ante calculated in the VCS-PD, the U_{BSL} is 1.43% for the baseline scenario.

For the project scenario:

According to *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories*[13], the uncertainty in the baseline scenario is associated with parameters and coefficients including estimates of area, carbon stocks, and expansion factors, the calculation process follows the two rules below:

Rule A: Where uncertainties are to be combined by addition, the standard deviation of the sum will be the square root of the sum of the squares of the standard deviations of the quantities that are added with the standard deviations all expressed in absolute terms (this rule is exact for uncorrelated variables).

Using this interpretation, a simple equation can be derived for the uncertainty of the sum, that when expressed in percentage terms becomes:

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Where:

U_{total} is the percentage uncertainty in the sum of the quantities (half the 95% confidence interval divided by the total (i.e. mean) and expressed as a percentage);

[13] IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories, Chapter 6, Quantifying Uncertainties in Practice.

E_i and U_i are the uncertain quantities and the percentage uncertainties associated with them, respectively

Rule B: Where uncertain quantities are to be combined by multiplication, the same rule applies except that the standard deviations must all be expressed as fractions of the appropriate mean values (this rule is approximate for all random variables).

A simple equation can also be derived for the uncertainty of the product, expressed in percentage terms:

$$U_{total} = \sqrt{U_1^2 + U_2^2 + \ldots + U_n^2} \quad (19)$$

Where:

U_{total} is the percentage uncertainty in the product of the quantities (half the 95% confidence interval divided by the total and expressed as a percentage);

U_i is the percentage uncertainties associated with each of the quantities.

The uncertainty of each stratum is calculated by dividing the 95% confidence interval by the mean value of the uncertainty quantities. The corresponding standard deviation is calculated over the measured plot values of the uncertainty quantities. The 95% confidence interval is calculated based on the standard deviation and the t-value for n-1 degree of freedom of plots per stratum.

As the uncertainty in the baseline scenario is associated with parameters and coefficients including estimates of area, carbon stocks, regrowth and expansion factors, the calculation of the 4 parameters and coefficients are shown below:

1) Uncertainty of Area:

In the baseline and project scenario, the area of every stratum are quoted from the field survey inventory data and legal right of harvest, so no data are from measurement and monitoring. Therefore, it is deemed as 0 in the period of validation. It will be monitored in the period of verification..

2) Uncertainty of expansion factors:

The Sample size, Sample mean and Standard error of expansion factors are quoted from Forestry Part of China's greenhouse gas emissions list divided as tree species, and the uncertainty of expansion factors are calculated as below:

For Birch:

Uncertainty of BCEF-Birch		5.95%	
Uncertainty of BEF-Birch	5.89%	Uncertainty of D-Birch	0.84%
BEF		D	
Sample size	55	Sample size	62
Sample mean (BEF)	1.180	Sample mean (D)	0.541
Standard deviation	0.257	Standard deviation	0.018
Average error	0.035	Average error	0.002
Confidence level	0.950	Confidence level	0.950
Degree of freedom	54	Degree of freedom	61
Two-sided Student's t-value	2.005	Two-sided Student's t-value	2.000
Allowable error	0.069	Allowable error	0.005
Lower confidence limit	1.111	Lower confidence limit	0.536
Upper confidence limit	1.249	Upper confidence limit	0.546
Confidence interval	0.069	Confidence interval	0.005

For Larch:

Uncertainty of BCEF-Larch		5.76%	
Uncertainty of BEF-Larch	3.16%	Uncertainty of D-Larch	4.81%
BEF		D	
Sample size	321	Sample size	13
Sample mean (BEF)	1.416	Sample mean (D)	0.490
Standard deviation	0.408	Standard deviation	0.039
Average error	0.023	Average error	0.011
Confidence level	0.950	Confidence level	0.950
Degree of freedom	320	Degree of freedom	12
Two-sided Student's t-value	1.967	Two-sided Student's t-value	2.179
Allowable error	0.045	Allowable error	0.024
Lower confidence limit	1.371	Lower confidence limit	0.466
Upper confidence limit	1.461	Upper confidence limit	0.514
Confidence interval	0.045	Confidence interval	0.024

3) Uncertainty of carbon stock:

The calculation of uncertainty of carbon stock is based on the uncertainty of volume in every stratum multiply by the uncertainty of expansion factors using formula (21) in the VCS-PD:

For year 2013:

Uncertainty of carbon stock-Birch	6.14%	Uncertainty of carbon stock-Larch	5.80%
Uncertainty of volumn-Birch	1.51%	Uncertainty of volumn-Larch	0.74%
carbon stock-Birch	1048198.84	carbon stock-Larch	2541564.38
Area(ha)	14377.00	Area(ha)	28790.00
Sample size	1058	Sample size	2433
Sample mean (m3/ha)	189.28	Sample mean (m3/ha)	254.47
Standard deviation	47.53	Standard deviation	47.09
Average error	1.46	Average error	0.95
Confidence level	0.95	Confidence level	0.95
Degree of freedom	1057	Degree of freedom	2432
Two-sided Student's t-value	1.96	Two-sided Student's t-value	1.96
Allowable error	2.87	Allowable error	1.87
Lower confidence limit	186.41	Lower confidence limit	252.59
Upper confidence limit	192.14	Upper confidence limit	256.34
Confidence interval	2.87	Confidence interval	1.87

For year 2017:

Uncertainty of carbon stock-Birch	7.56%	Uncertainty of carbon stock-Larch	4.73%
Uncertainty of volumn-Birch	4.74%	Uncertainty of volumn-Larch	3.52%
carbon stock-Birch	79.26	carbon stock-Larch	153.45
Area(ha)	1.68	Area(ha)	3.32
Sample size	42	Sample size	83
Sample mean (m3/ha)	122.48	Sample mean (m3/ha)	133.23
Standard deviation	18.62	Standard deviation	21.48
Average error	2.87	Average error	2.36
Confidence level	0.95	Confidence level	0.95
Degree of freedom	41	Degree of freedom	82
Two-sided Student's t-value	2.02	Two-sided Student's t-value	1.99
Allowable error	5.80	Allowable error	4.69
Lower confidence limit	116.67	Lower confidence limit	128.54
Upper confidence limit	128.28	Upper confidence limit	137.92
Confidence interval	5.80	Confidence interval	4.69

The baseline emission uncertainty has been listed in the PD is 1.43%, the detailed calculation is listed as follows:

Based on the calculation of the parameters and coefficients above, the calculation of U_{PRJ} is shown below

Baseline Emission Uncertainty:

Stratum	Parameter	A_{rea}(Ha)	$V_{EX,j,i\|BSL}$ (m3/ha)	BEF	D(tdm/m3)	$BCEF_R$ (tdm/m3)	CFj(tc/tdm)	$C_{HB,j,i\|BSL}$ (tC /ha)	$C_{EX,j,i\|BSL}$ (tC ha^{-1})	$\Delta C_{DW,i,p\|BSL}$
		a	b	c	d	e=c*d	f	g=b*e*f	h=b*d*f	i=g-h
								$U_g=\sqrt{U_b^2+U_e^2}$	$U_h=\sqrt{U_b^2+U_d^2}$	$U_i=\frac{\sqrt{(E_g*U_g)^2+(E_h*U_h)^2}}{(E_g+E_h)}$
Birch	E	14377.00	133.50	1.424	0.541	0.770	0.5	51.42	36.11	15.31
	U	0	1.51%	5.89%	0.84%	5.95%		6.14%	1.73%	3.68%
Larch	E	28790.00	156.85	1.416	0.490	0.694	0.5	54.41	38.43	15.99
	U	0	0.74%	3.16%	4.81%	5.76%		5.80%	4.87%	3.95%

Stratum	Parameter	WW_k	SLF_k	$C_{wp,0\|BSL}$ (tc/ha)	$C_{WP,i\|BSL}$(tc/ha)	OF_k	$\Delta C_{WP,100\|BSL}$ (tc/ha)	Ai,p(ha)	$\Delta C_{NET\|BSL(1)}$(tC)
		j	k	l=h*(j+k)	m=h-l	n	o=m*n	p	q=(i/10+l+o/20)*p
				$U_l=U_h$	$U_m=\frac{\sqrt{(E_h*U_h)^2+(E_l*U_l)^2}}{(E_h+E_l)}$		$U_o=U_m$	$U_p=0$	$U_m=\frac{\sqrt{(E_i*U_i)^2+(E_l*U_l)^2+(E_o*U_o)^2}}{(E_i+E_l+E_o)}$
Birch	E	24%	0.12	13.00	23.11	0.62	14.33	2906.13	44312.71
	U			1.73%	1.36%		1.36%		1.49%
Larch	E	24%	0.12	13.83	24.59	0.62	15.25	5685.11	92072.33
	U			4.87%	3.80%		3.80%		2.42%

Stratum	Parameter	$\Delta C_{NET\|BSL(2-10)}$(tC)	$\Delta C_{NET\|BSL(11-20)}$(tC)	regrowth rate (m3/ha/yr)	$\Delta C_{NET\|BSL,t^*}$(tC)	ΔCNET, i,P|BSL
		r=(i/10+o/20)*p	s=o/20*p	t	v=e*f*p*t	w=q+r+s-v
		$U_r=\frac{\sqrt{(E_i*U_i)^2+(E_o*U_o)^2}}{(E_i+E_o)}$	$U_s=U_o$	U_t=10%	$U_v=\sqrt{U_e^2+U_t^2}$	$U_w=\frac{\sqrt{(E_q*U_q)^2+(E_r*U_r)^2+(E_s*U_s)^2+(E_v*U_v)^2}}{(E_q+E_r+E_s+E_v)}$
Birch	E	6531.89	2082.14	1.56	1746.29	51180.45
	U	2.01%	1.36%	10.00%	11.64%	1.29%
Larch	E	13422.85	4334.46	2.54	5009.59	104820.05
	U	2.75%	3.80%	10.00%	11.54%	2.03%
					U_{BSL}	1.43%

Project Emission Uncertainty:

Stratum	Parameter	A_{rea}(Ha)	$V_{AB,i,2013}$ (m^3 ha^{-1})	BEF	D(tdm/m^3)	$BCEF_R$ (tdm/m^3)	CFj (tc/tdm)	$V_{AB,i,2017}$ (m^3 ha^{-1})	$\Delta V_{AB,t\|PRJ}$(m^3 ha^{-1})	$\Delta C_{AB,t\|PRJ}$(tCO_2)
		a	b	c	d	e=c*d	f	g	h=g-b	i=h*a*e*f*44/12
									$U_h=\frac{\sqrt{(E_b*U_b)^2+(E_g*U_g)^2}}{(E_b+E_g)}$	$U_i=\sqrt{U_h^2+U_e^2}$
	E	14377.00	105.28	1.424	0.541	0.770	0.5	122.48	17.20	349238.13
Birch	U	0.00	1.51%	5.89%	0.84%	5.95%		4.74%	2.64%	6.51%
	E	28790.00	114.07	1.416	0.490	0.694	0.5	133.23	19.16	701777.41
Larch	U	0.00	0.74%	3.16%	4.81%	5.76%		3.52%	1.93%	6.07%
									U|PRJ	4.59%

Total uncertainty

Total uncertainty for LtPF project is calculated according to the equation (29) in VCS-PD:

$$U_{Totall|LtPF} = \sqrt{U^2_{|BSL} + U^2_{|PRJ}} = \sqrt{1.43\%^2 + 4.59^2} = 4.81\% = 0.0481$$

As $U_{total} \leq$ 错误!未找到引用源。0.15, then no deduction will result for 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 Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination version 3.3, the amount of VCUs 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 (31) in VCS-PD:

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Based on the analysis in section 2.1, the overall risk rating of 22 is converted to a percentage as 22%. This percentage is multiplied by the net change in the project's carbon stock. Therefore, the amount of verified carbon units of this crediting period is:

Year	$GHG_{NET,BSL}$ (tCO_2e)	$GHG_{NET,PRJ}$ (tCO_2e)	GHG_{LK} (tCO_2e)	$Credits_{total,LtPF}$ (tCO_2e)	Risk Score	$VCU_{NET,IFM}$ (tCO_2e)
01/01/2013-31/12/2013	17,449	-233,515	0	250,964	22	195,751
01/01/2014-31/12/2014	149,647	-233,515	0	383,162	22	298,866
01/01/2015-31/12/2015	30,686	-233,515	0	264,201	22	206,076
01/01/2016-31/12/2016	110,506	-233,515	0	344,021	22	268,336
01/01/2017-30/06/2017	44,832	-116,758	0	161,590	22	126,040
Total	**353,120**	**-1,050,818**	**0**	**1,403,938**		**1,095,069**
Average annual value	**78,471**	**-233,515**	**0**	**311,986**		**243,348**