**PROJECT DESIGN DOCUMENT FORM FOR
AFFORESTATION AND REFORESTATIONCDM PROJECT ACTIVITIES (F-CDM-AR-PDD)
Version 06.0**

PROJECT DESIGN DOCUMENT (PDD)

Title of the project activity	Mitigation of GHG: Rubber based agro-forestry system for sustainable development and poverty reduction in Pakkading, Bolikhamsay Province, Lao PDR.
Version number of the PDD	06
Completion date of the PDD	May 18, 2015
Project participant(s)	Lao Thai Hua Rubber Co. Ltd (Private entity)
Host Party(ies)	Lao PDR
Sectoral scope and selected methodology(ies)	Sectoral Scope 14, AR-ACM0003, A/R Large-scale Consolidated Methodology, Afforestation and reforestation of lands except wetlands Version 02.0
Estimated amount of annual average GHG removals by sinks	36,916 tCO_2-e

SECTION A. Description of project activity
A.1. Purpose and general description of project activity
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Purpose of the Project
The Rubber based agro-forestry system for sustainable development and poverty reduction CDM project aims at developing a pioneering forestry CDM project in Lao PDR by establishing 969.20 hectares of rubber plantations according to a pioneering social and economic formula that provides sustainable change to poor rural communities without adverse impact on land ownership issues. In fact the project promoter actively stimulates the progress of official efforts by the government of the Lao PDR to issue the farmers with formal land certificates, which will enable them to benefit in financial terms from their land ownership rights.

Rubber plantations is to be the one of potential targets of the country as an opportunity for rural development and poverty alleviation.This reforestation project will be established on degraded and abandoned grasslands by growing clones which are better adapted to the relatively long spells of dry weather that is found in Lao PDR, and which is different from the traditional rubber growing areas in Thailand and Malaysia.

The existing or historical land use scenario and the baseline land use scenario are same, hence only the baseline land use scenario is explained below. People had been practicing slash and burn in lands belonging to the project area for many years and the natural forests have seized to exist before 31st December 1989. Subsequently due to land degradation these lands were largely abandoned being too marginal for agricultural production. Since all of these lands were non-forest land as per 31st December 1989 according to the aerial photographs, this project is developed as a Reforestation CDM project under the Bonn Agreement and Marrakech Accords.

The proposed project will sequestrate approximately 1,107,495 tCO_2-e during its 30 year project period. Annual average GHG removals are estimated to be approximately 36,916 tCO_2-e. There are many significant environmental credits of natural rubber resource such as ability to lock carbon both in biomass and rubber, rubber plantations functioning as self-sustaining ecosystem (annual leaf fall, branches, fruits, twigs, root hairs), cultivation being less demanding on fertilizers and pesticides, promoting soil conservation (in view of 30 year replanting cycles), upkeep of soil, ground water, water infiltration, scope for biological diversity (integration of other species including food crops in the inter-rows according to guidelines to the farmers provided by the project promoter).

Rubber wood, after harvesting for replanting a new cycle will be carefully processed by the project promoter, and it will be going into wood based furniture which is held in inert form for a considerable period of time and the woody portion remaining in the soil decomposes in-situ etc., all in favour of natural resources.

This reforestation CDM project is implemented by Lao Thai Hua Rubber (LTR) Company Limited with the active participation of rural communities in the area who will lease their abandoned land to the project promoter and provide their labour for project implementation whilst the project promoter will provide the capital, technological expertise and marketing of the dried latex. This model is popularly referred to in Lao PDR as the 2 + 3 model. This model has never before been applied in the field of rubber plantations. The objective of this activity is to mitigate Green House Gases (GHG) and reduce poverty in relation to an environment that enables active participation of rural communities in an array of climate change mitigation activities, primarily by compensating for GHG emission through implementing a rubber based agro-forestry system with food crops and other related programmes, to support sustainable organic agriculture that would lead to substantial reduction in poverty among marginalized communities in Pakkading District, Bolikhamsay Province. Pakkading is a least developed area and have been identified as one of the 47 poorest districts in Lao PDR.

The project will provide over and above the carbon sequestration:

- Poverty alleviation and wealth creation in rural areas,
- Communities empowerment through active participation in all stages of the project, and
- Improvement of basic infrastructure for rural communities.

The project is implemented by Lao Thai Hua Rubber Co., Ltd. This is a joint venture company registered under laws and regulations of Lao PDR. The venture consists of the following three (3) companies.

1. Thai Hua Rubber Public Company Limited (THR) – 85.35 % shares
2. ChenShan Group (CSG) – 6.60 % shares
3. NCX Holding (NCXH) – 8.49 % shares

Project's contribution towards sustainable development

Environmental criteria:

Establishing rubber plantations on degraded and underutilized lands will sequestrate significant amount of GHGs compared to the baseline. This project is implemented by a project developer who is committed to environmental sustainability and social responsibility and who is confident that the extraordinary costs involved in pioneering this project will eventually be covered by the supplementary cash flow from sale of CERs.

Soil erosion has taken place over the years as indicated by the baseline scenario. Eroded topsoil tends to be washed away and ends in water bodies resulting in water pollution and loss of farmland nutrients. However under the project, soil erosion is checked, nutrition is retained on the land and therefore water pollution is minimized compared with the baseline scenario. The soil organic contents and mineral contents will be improved due to proper land management. Micro-organism will function and fertilize soil. Vegetation cover is expected to improve soil conditions and the farmers' intercropping with food crops as made possible by advice from the project developer will add to the farmers' food production and contribute to reduce plant diseases.

Social criteria:

The project involves low income families in the area who will get more opportunities to increase their income and thus be less prone to pursue unsustainable practices that might increase CO_2 emissions, harm the environment and deplete the soil limiting the farming potential and livelihood of future generations of farmers. The project promoter will also pay for land and other taxes and contribute to the village funds to strengthen infrastructure and the villagers' quality of life and thus motivate them to make committed efforts for the project to succeed.

The project creates direct employment at agreed wages of the farmers involved in the project and the project promoter is committed to provide all the training necessary. Previously many of the youth in these villages went to neighbouring districts and countries including Thailand and Vietnam to seek employment. As a result, in many cases only the children and older generation remained. This situation will change due to newly created employment from the project and the cash income from the project is likely to have a positive effect on their food crop farming as well. The project developer will promote a working family model where both men and women can actively participate in the project. There are sufficient opportunities where women can work in the project.

Improvements to the infrastructure in the area are being carried out by the project promoter to provide economic accessibility of the project area but also to facilitate farmers' access and strengthen the competitiveness of the farmers when it comes to taking their food crops to the market.

Economic criteria:

Labour requirement for the project will be fulfilled with local employment. Therefore the major portion of the budget on labour will be retained within the country and the local community. A significant portion of the investment capital including equipment and vehicles used will be spent within the country.

Farmers find rubber tree cultivation foreign to their geographical area and economically unattainable since they cannot afford the long term capital investment to grow rubber trees on their own without technical and financial support provided to help them sustain the first seven years with practically no revenue from the land, labour and inputs. LTR Co. Ltd is providing this support by actively engaging the communities in project activities from the start and ongoing. Commercial banks are unwilling to provide long term loans. The Agricultural Promotion Bank (APB) shares the short term perspective of the farming community in Lao PDR and generally does not expose itself to financing agricultural cycles that extend beyond one calendar year.

A.2. Location of project activity

A.2.1. Host Party(ies)

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Lao Peoples Democratic Republic (Lao PDR)

A.2.2. Region/State/Provinceetc.

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Bolikhamsay Province

A.2.3. City/Town/Community etc.

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Pakkading District - Huay Hai village
- Huay Phet village
- Nam Sang village
- Sonephansay village

The location of the project is part of depleted and underutilized land belonging to four villages. The area suitable for planting was assessed by Forest Mapping and Planning Division (FMP) of the Department of Forestry (DOF), Ministry of Agriculture and Forestry (MAF).

A.2.4. Physical/Geographical location

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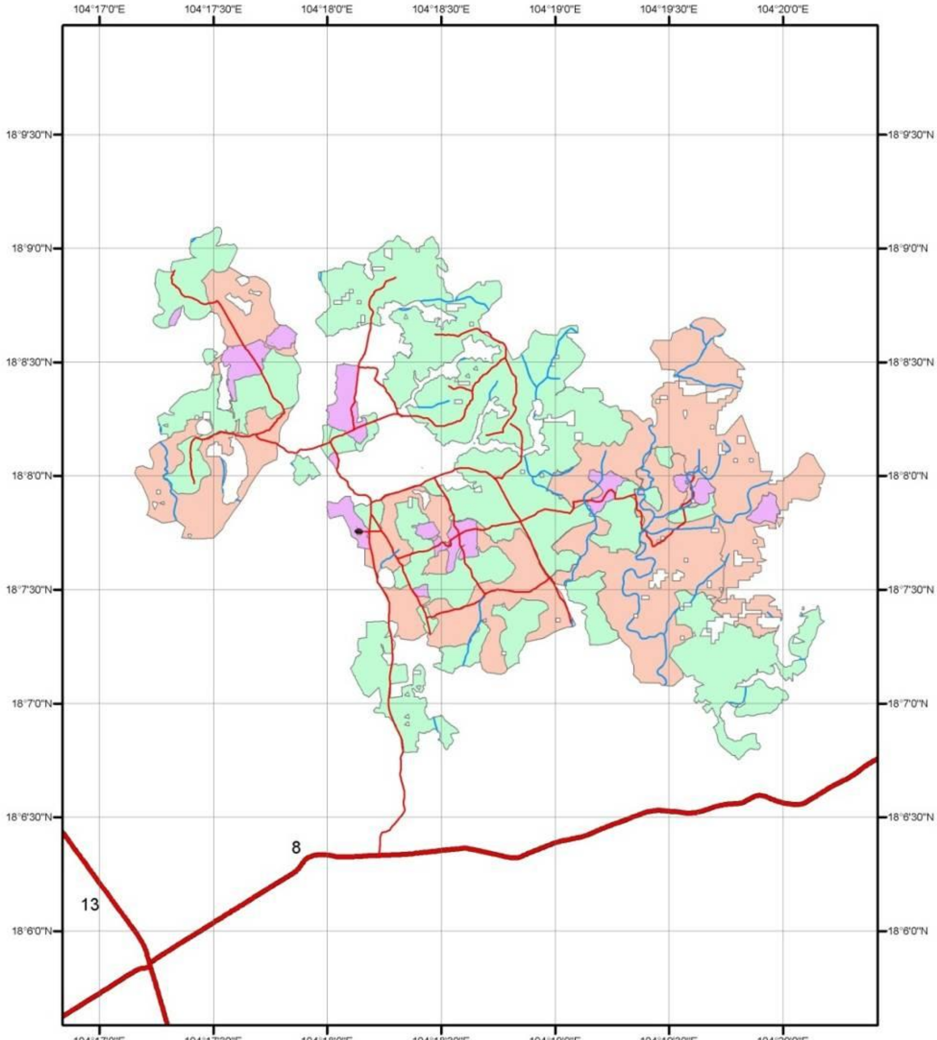
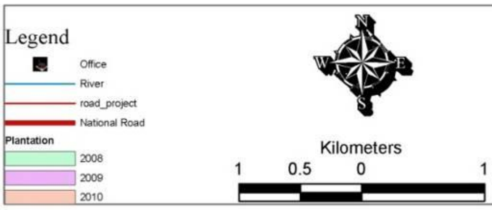
Figure A.1 Location of rubber plantation Area, Pakkading district, Bolikhamxay province, Lao PDR

Location of Pakkading Reforestration Project





POLYGON	HA
PROJECT AREA	969.2
YEAR 2008 TO BE PLANTED	507.2828
YEAR 2009 TO BE PLANTED	55.433
YEAR 2010 TO BE PLANTED	406.485
TOTAL	969.2

Drawing by Phonesavanh Chanthakhad

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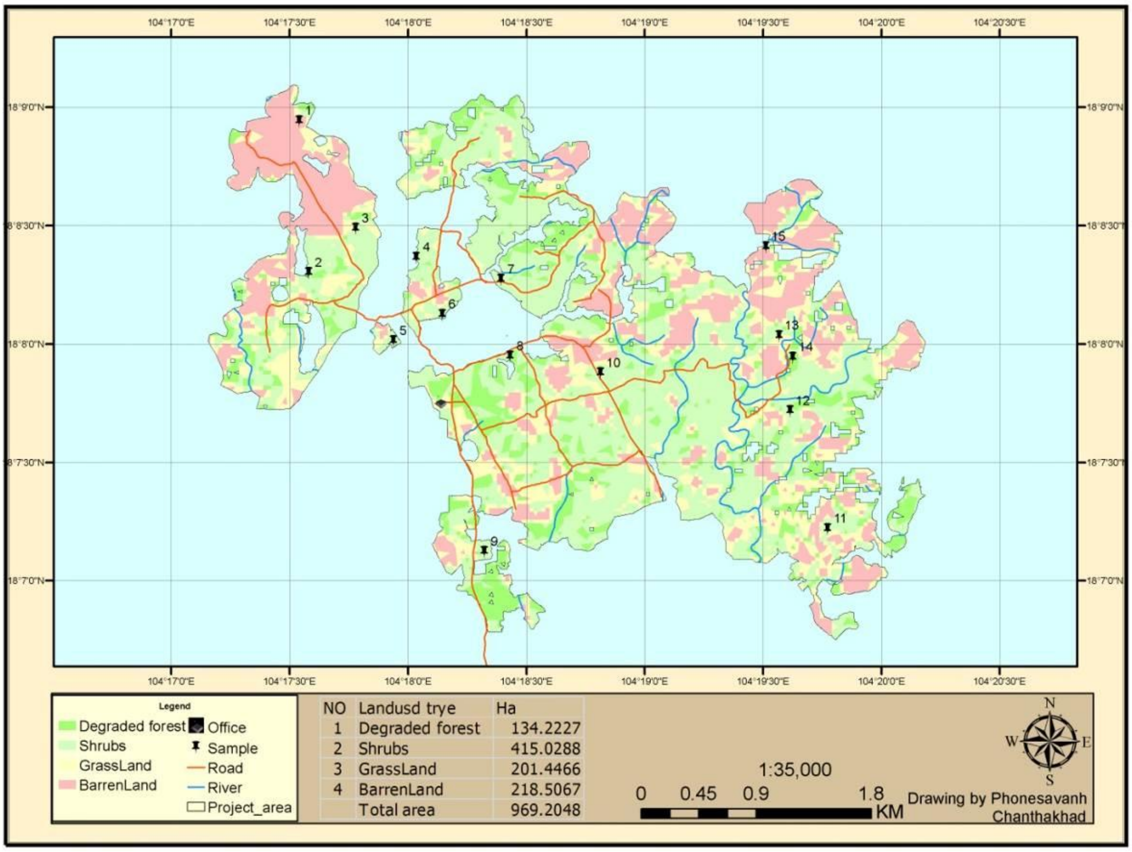
Figure A.2 Land use of rubber plantation area in Pakkading district, Bolikhamsay province, Lao PDR.

Land use map 2007 of Pakkading Reforestation Project



A.2.5. Geographical boundaries

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The project involves lands belonging to Nam Sang, Huay Hai, Huay Phet and Sonephansay villages. There have been 5 discrete parcels delineated for the unique identification.

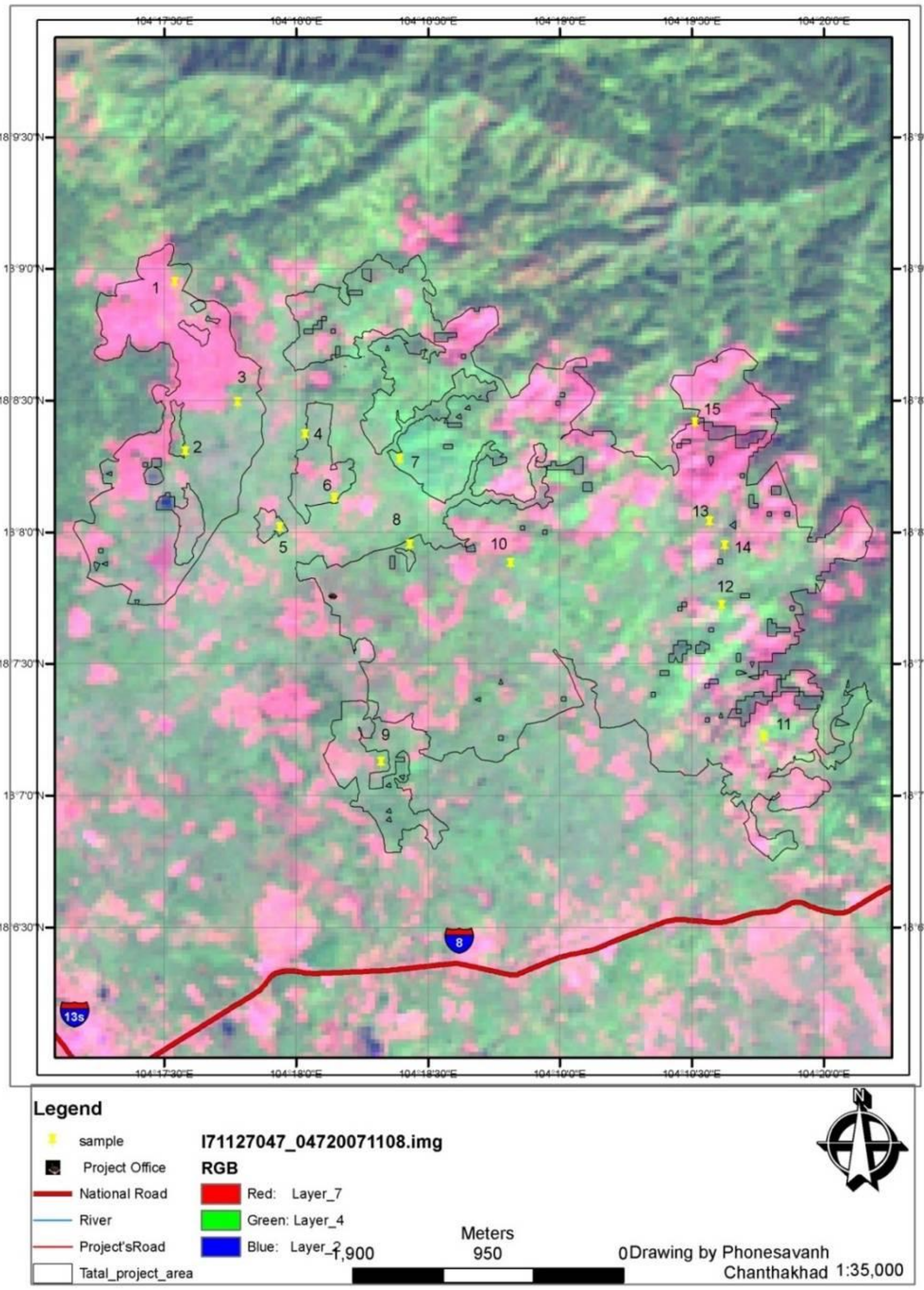
The size and coordinates of the project area was determined as follows:

The project developer contacted the village communities and informed them about the desired project activity. After several stakeholder meetings providing information on rubber planting and the project promoter's vision in respect of cooperation without transfer of title to the land, village families started joining the project. Only the few villagers with duly documented land titles joined initially. LTR helped the other villagers who did not have duly documented land titles to acquire them. Once these documents were acquired, boundaries of each single plot of land of each farmer were entered into a master data sheet. Then field verifications were done to get the GPS coordinates of these boundaries. Staff from LTR and local communities joined this process. These GPS coordinates were used by the GIS team at LTR Company to prepare GIS maps. The process initiated by the project promoter in the local farming communities resembled the pattern described by Hernando De Soto in his: "The Mystery of Capital – Why Capitalism Triumphs in the West and Fails Everywhere Else"

Only areas with potential for reforestation have been included. Others were excluded. Initially the project area was over 1000 ha but after including only reforestation areas, total project area is now 969.20 ha.

Figure A.3 Location of the project

Location of Pakkading Reforestation Project



A.3. Environmental conditions

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All the 5 parcels are located within the same District and belong to the neighbouring 4 villages. Environmental conditions in all 5 parcels are similar. Therefore the following information is common for all 5 parcels.

1. Climate

The area is in the Southeast Asia monsoon climate regime. During November-February, when the sun is to the south of the equator, the climate is under the influence of the cold continental high pressure region over China.

1.1 Sunshine

Day length variation is reported to be from a minimum of 10.5 hours per day during December to January to a maximum 12.3 hours per day during June and July months. The bright sunshine per day varies from a minimum 3.65 hours per day to a maximum of 8.2 hours per day in May. The average number of bright sunshine – hours per day over a year is 6 hours per day.

1.2 Precipitation

For the area, the Southwest Monsoon begins in May, reaches its maximum strength in August and disappears about mid-October. The climate then cycles through a transition period to mid-November when the Northeast Monsoon appears. Rainfall becomes very infrequent and light, the air is cool and the humidity lower. The Northeast Monsoon lasts until the end of February when the hot and dry transition period begins.

The 13 years history (1990-2002) of average monthly rainfall at Paksan, Bolikhamxay Province follows the general pattern of the Southeast Asia monsoon. The mean annual rainfall is 3502 mm. The maximum rainfall was recorded in year 1995 as 4306.3 mm and the minimum rainfall was recorded in 1991 as 2315.6 mm.

Table A.1: Mean annual rainfall (mm) station KM 20 (1990 to 2002)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1990	2.5	51.6	91.8	154	417.0	934.0	750.8	570.5	353.1	59.4	48.5	0.5	3433.7
1991	2.5	_	84.2	12.9	202.7	370.4	729.8	589.4	258.3	38.0	_	27.4	2315.6
1992	30.4	26.6	18.9	14.4	282.5	503.0	618.7	559.0	567.8	42.7	0.2	20.1	2684.3
1993	1.7	23.5	139.6	163.5	416.9	865.7	862.1	665.7	504.3	45.1	_	_	3688.1
1994	_	71.6	160.8	56.3	285.5	1287.8	890.2	812.2	370.6	48.8	_	13.3	3997.1
1995	1.0	3.0	20.5	114.3	404.6	828.1	1165.3	1119.7	426.4	223.3	0.1	_	4306.3
1996	3.2	113.2	46.2	187.8	304.5	473.6	709.7	779.0	518.4	101.6	128.1	_	3365.3
1997	13.7	28.7	82.3	208.9	496.9	702.7	1143.5	627.6	633.3	34.6	_	0.4	3972.6
1998	0.1	57.0	77.0	82.0	247.7	757.1	1121.4	411.9	272.6	134.9	0.7	_	3162.4
1999	7.3	_	123.0	266.5	657.3	687.1	521.6	630.3	602.2	234.8	23.2	0.2	3753.5
2000	_	68.3	21.6	186.9	414.2	1063.1	657.1	645.6	731.3	64.4	7.0	_	3859.5
2001	0.9	_	102.0	209.6	506.8	715.9	718.3	646.2	388.2	127.1	0.2	0.7	3415.9
2002	1.0	2.1	24.9	179.2	378.8	847.6	798.9	808.9	466.9	55.0	_	16.7	3580.0

1.3 Temperature

Temperatures between years 1990-2002 are presented in Table A.2. The hottest year recorded was 1996 and the temperature recorded was 32.1 ^{o}C.

Table A.2: Temperature (°C & 1/10) Paksan Station, Bolikhamxay Province, Lao PDR

Year		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average
1990	Min	17.6	17.3	19.4	24.2	24.9	25.6	25.9	25.1	24.6	23.2	20.4	19.5	22.3
	Max	28.3	28.9	32.6	34.8	32.7	31.3	30.4	29.1	29.7	29.3	28.8	28.4	30.4
	Avg	20.4	23.6	27.1	24.8	28.1	27.6	28.8	27.9	27.1	24.5	22.6	21.3	25.3
1991	Min	17.0	17.4	20.9	23.6	24.8	25.1	25.6	24.8	24.1	22.4	20.3	18.6	22.1
	Max	27.9	28.6	32.4	34.5	31.4	31.0	30.7	29.4	29.3	29.0	28.6	28.1	30.1
	Avg	20.2	24.1	27.3	28.5	27.6	28.3	29.4	28.5	27.3	24.2	23.1	21.8	25.9
1992	Min	14.4	17.9	20.6	23.8	24.3	24.7	25.4	25.1	24.2	23.1	20.7	22.1	22.2
	Max	27.6	28.4	32.1	34.8	31.3	30.8	29.6	29.5	28.7	29.3	28.9	28.0	29.9
	Avg	21.2	24.6	27.4	28.3	27.8	27.4	28.1	27.3	26.7	24.1	23.6	22.3	25.7
1993	Min	16.7	17.8	21.1	24.4	24.6	24.9	25.1	24.7	24.4	21.2	19.4	16.8	21.8
	Max	27.0	30.8	33.2	34.2	30.1	29.4	30.1	28.8	29.7	30.4	29.8	27.8	30.1
	Avg	20.4	23.6	27.8	28.2	27.3	27.1	27.9	26.5	26.4	24.3	23.0	21.2	25.3
1994	Min	16.3	17.8	21.1	25.7	25.5	25.9	25.1	24.4	24.1	22.8	20.3	17.2	22.2
	Max	28.6	30.8	34.1	35.7	35.1	32.8	31.6	29.9	29.7	29.1	28.9	28.7	31.3
	Avg	21.3	23.6	25.4	27.8	28.6	27.6	27.1	26.8	26.2	25.0	23.4	22.1	25.4
1995	Min	16.7	17.5	22.5	25.2	25.3	26.1	25.8	25.4	24.6	22.8	19.6	16.0	22.3
	Max	29.2	31.3	34.3	35.5	34.4	31.4	29.7	29.5	29.1	28.7	27.3	26.5	30.6
	Avg	21.3	24.2	25.8	27.1	26.3	26.8	26.1	26.0	25.8	25.4	25.1	21.3	25.1
1996	Min	15.5	15.4	20.8	21.3	23.2	24.3	24.8	22.5	20.4	20.0	18.5	17.2	20.3
	Max	30.6	28.1	32.8	33.6	32.9	31.6	30.3	35.0	34.0	34.3	32.1	30.2	32.1
	Avg	22.1	21.3	25.4	29.6	28.4	27.9	27.5	28.1	27.3	36.9	35.1	21.9	27.6
1997	Min	16.8	18.3	21.1	22.6	24.5	24.9	24.5	25.1	22.1	20.7	20.1	18.5	21.6
	Max	26.8	29.4	32.4	31.6	31.8	31.6	28.9	30.2	30.1	31.8	30.9	29.9	30.5
	Avg	22.0	23.8	26.8	27.1	28.2	28.2	27.8	27.6	26.1	26.2	25.8	25.4	26.3
1998	Min	17.2	19.0	22.6	24.3	26.1	27.4	27.1	26.8	25.3	22.1	21.4	19.6	23.2
	Max	28.7	31.9	33.7	34.4	34.2	33.7	31.8	30.4	30.0	31.6	31.7	31.1	31.9
	Avg	23.7	25.4	28.2	29.4	30.2	29.3	28.6	28.1	27.5	27.1	26.4	24.3	27.4
1999	Min	16.6	18.2	21.2	23.7	23.4	24.4	24.7	23.9	23.9	22.8	20.5	14.5	21.5
	Max	29.5	31.4	31.4	32.1	30.4	30.7	31.1	30.4	31.1	31.4	29.9	25.7	30.4
	Avg	23.1	26.6	27.9	27.9	26.9	27.6	27.9	27.4	27.5	27.1	25.2	20.1	26.3
2000	Min	16.8	17.0	20.8	23.7	23.8	24.4	24.6	24.5	23.5	22.8	18.0	17.5	21.5
	Max	31.1	30.4	32.6	33.7	31.4	30.7	31.0	30.8	30.9	31.8	29.9	29.6	31.2

	Avg	24.0	23.7	26.7	28.7	27.6	37.6	31.8	27.6	27.4	27.3	23.9	23.5	27.5
2001	Min	15.5	18.8	21.6	24.8	23.9	24.2	25.0	24.7	24.1	22.9	17.7	17.2	21.7
	Max	30.5	30.6	31.4	36.5	35.6	31.0	29.8	31.2	31.7	32.5	29.2	29.2	31.6
	Avg	24.5	24.7	26.50	30.6	25.7	27.6	27.4	27.9	27.9	27.7	23.4	23.1	26.4
2002	Min	16.1	18.6	21.50	23.4	24.1	24.3	24.6	24.3	23.7	21.9	20.4	19.0	21.8
	Max	29.0	31.0	33.20	35.3	31.6	30.4	29.2	30.4	30.4	31.9	30.8	29.9	31.1
	Avg	22.5	24.8	27.30	29.3	27.8	27.3	27.2	23.7	27.0	26.9	25.6	24.4	26.2

1.4 Humidity

Relative humidity in the area is over 75% during the night and early morning, even reaching 85-90%. The relative humidity decreases during the day with a minimum in the afternoon at levels around 60% and sometimes even 40%. Very low humidity may occur in December, January or February. High relative humidity plays a role on trees internal pressure and is favourable to latex production and tree growth.

1.5 Surface winds

The winds are clockwise around the high and are from the Northeast over Southeast Asia. This is the Northeast Monsoon, characterized by cold dry air and infrequent and light rain. During May-August, the sun is to the north of the equator and heats the land mass beneath to a degree that causes an extensive low pressure region called the Inter-tropical Convergence Zone and the Monsoon tough.

1.6 Evaporation and evapo-transpiration

Warm winds from the Southwest carry moisture from the Andaman Sea and the Gulf of Thailand through the Lao PDR region where vertical convection causes the rainfall in large amounts during the height of the monsoon season. This is the Southwest Monsoon. The air is warm and humidity is high.

Evaporation is defined as the transfer of liquid water from the soil alone to the atmosphere. Evapotranspiration is the water-loss to the atmosphere through the combined surface of plants and soil. Variations in different factors of evapotranspiration generally cancel each other out and in Lao PDR the annual water loss to the atmosphere is about 1.485 mm.

1.7 Extreme events

There are no reported catastrophic climatic disasters such as heavy winds, droughts or frost.

2. Hydrology

2.1 Water erosion

Soil condition prior to the project activity was poor. Soil erosion is common in these soils due to lack of soil conservation techniques. However it is expected that erosion will be reduced due to the proposed project activity.

2.2 Flooding

There are no reported flooding in the area.

2.3 Water logging

The soil belonging to the project area does not have any water logging.

2.4 Presence of wetlands

The project area does not have any wetlands.

3. Soil

3.1 Topography

The country as a whole is classified as mountainous area. However, the project area is classified as lowland. The location of the project is between 18°06’50” to 18° 09’20” N Latitude and 104°16’ 20” to 104° 20’30” E Longitude. Elevation ranges from 141 m to 410 m MSL.

3.2 Soil types

There is a variation of soil types in the proposed project area. As soil quality begins to degrade under shifting cultivation of cleared land, the farmers have had to abandon land which was formerly cultivated after deforestation. Soil depth profile range from 20 cm in Nam Sang village to 120 cm in Huay Phet village but the humus layer is marginal at best as a result of erosion.

The disadvantages of these soil types are a low humus content and low cation exchange capacity, which makes temporary retaining nutrients in the topsoil quite difficult.

Most of the fertility was historically stored in the forest cover and, once the forest-cover is removed, these soils rapidly become very poor and therefore prone to surface-erosion. The soil of Huay Phet village is vulnerable and eroded near the Huay Phet stream. It was reported that the banks of the stream were lost year by year from 0.2 m to 1 m width because of lack of protection of trees cover.

4. Ecosystem

The vegetation type in this area is representative of tropical forest whereas the ecosystem of *Dipterocarpaceae*, have been subjected to heavy destruction due to construction of the roads and slash and burn by local villagers. This affected the characteristic of secondary habitats that have been cleared of natural forest cover. Most of these lands are grasslands and others covered with shrubs. Names of floral species found in the area are presented in Appendix 8: Baseline Information.

The source of the ecosystem information was the baseline study conducted by the team including Dr. Marc Morival (Prime Consultancy Co Ltd), Mr. Chanthaphone PHON-ASA (National University of Laos), Mr. Outhai Vongsa (Department of Forestry). Information about ecosystem “The vegetation type in this area is representative of tropical forest whereas the ecosystem of *Dipterocarpaceae,* have been subjected to heavy destruction due to construction of the roads and slash and burn by local villagers” was determined by the study done by baseline study team. Furthermore the Ministry of Agriculture and Forestry on Lao PDR have issued a letter stating the land belonging to the project activity is depleted and is underutilized.

There are no threatened or endangered species within the project boundary. Local communities in surrounding areas have been eating many of the species found in shrubs and bushes. Since the large trees have been cut down and lands are degrading, these lands are currently not habitats for any rare or endangered fauna.

A.4. Technologies and/or measures

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The existing or historical land use scenario and the baseline land use scenario are same, hence only the baseline land use scenario is explained below. People had been practicing slash and burn in lands belonging to the project area for many years and the natural forests have seized to exist before 31st

December 1989. Subsequently due to land degradation these lands were largely abandoned being too marginal for agricultural production. The Ministry of Agriculture and Forestry on Lao PDR have issued a letter stating the land belonging to the project activity is depleted and is underutilized.

The chosen species is *Hevea brasiliensis*, commonly known in English as rubber tree. Rubber trees, or at least some clones may well adapt to Laos' natural environment including the Lao climate which has protracted periods of dry season which is dissimilar to the climatic conditions of its native Amazonas and the areas of Malaysia, Thailand and Indonesia to which rubber plantation activities spread. They have been sporadically introduced in Lao PDR during the French's colonial era since 1930. The clone used for the reforestation project activity is RRIM 600. For transparency with respect to the requirements of the preamble of UNFCCC Decision 19/CP.9[1], the project shall not make use of genetically modified organisms.

Optimal climatic conditions for the Rubber planting are given below.

- A rainfall of 2000 mm or more, evenly distributed throughout the year with no severe dry season and with 125-150 annual rainy days. A maximum temperature of about 29-34 °C, minimum of about 20 °C and a monthly mean of 25-28 °C
- High atmospheric humidity of about 80 % with moderate wind, and Bright sunshine for about 2000 hours in a year, at the rate of six hours a day in all months

Annual rain fall in the area is usually higher than 3000 mm but the area is susceptible to facing a significant dry period from the month of November to March. Average temperature has no deviation compared to the optimal level unless there are several months reach temperature lesser than 20 ^{0}C. High atmospheric humidity and bright sunshine are typical in the regions which enhance the Rubber plant growth.

RRIM 600 is a suitable rubber clone for Southeast Asian region countries, particularly those areas which are prone to protracted dry seasons. This clone was introduced to Lao PDR in 1990 by a local company from Thailand (Para-rubber situation in Lao PDR, 2007). In 1994, this clone was introduced to the northern part of Laos and in 1996 it was planted in Vientiane Province, in all cases to gather information on the viability of commercial rubber production in Lao PDR. In the same year a pilot area of 4.0 ha was planted in Thaphabath District in Bolikhamsay Province. The project developers had studied the conditions of the project area and found that it had similarities to parts of North East Thailand, which climatically have a marginal importance for that country's rubber production. RRIM 600 has been the recommended species in the Northeast parts of Thailand by the Rubber Research Institute of Thailand. According to further studies by the developer, this clone was the best suitable to be planted in the project area. RRIM 600 obtains an even canopy, vigorous growth and high quality yield.

The proposed reforestation CDM project activity relies on sustainable production practices and plantation technology adopted by the project entity. The plantations are managed using sustainable management practices developed by LTR Co. Ltd.

The following features illustrate the technology employed by the project activity:

Nurseries:
Nurseries will be able to cover the demand for planting materials for the project. The existing nursery has a reservoir dam of 20,000 m^3 of water for irrigation and 5 ha of land available for the nurseries. A nursery area cannot be used every consecutive year, a two-year fallow period under *Pueraria* is practiced to regenerate the soil and to prevent root-diseases that may infect a new nursery.

[1] "Recognizing that host Parties evaluate, in accordance with their national laws, potential risks associated with the use of genetically modified organisms by afforestation and reforestation project activities and that Parties included in Annex I evaluate, in accordance with their national laws, the use of temporary certified emission reductions and/or long-term certified emission reductions generated from afforestation and reforestation project activities that make use of genetically modified organism

Planting material:
Stumps are more recommended than seedlings in bags. Stumps will be grafted only with clones RRIM600 recommended by the corresponding Research and Development Program under the ecological conditions of Lao PDR. The planting period traditionally starts mid-May and ends at the end of July, the most suitable time during June.

Land preparation:
The parcels will be delineated and prepared for the plantation. Weeds and bushes are to be cut down with a cutlass. Slashing is done using machinery. Then the debris is left onsite. The land must be ready in time to allow planting at the beginning of the rainy season.

Planting technique:
3 weeks prior to the planting, the farmer will have to dig a hole at each space with a hoe, shovel or palmist chisel. The surface soil will be separated and be used to backfill the hole. One month after the planting, the soil of each emplacement will be firmed again and a basin will be made around the stump (50 cm diameter). This basin will help collecting water from each rainfall.

The project proponent has given the opportunity to local villagers to use the space in between rubber to plant any cash crops depending on their choice for the first 3-4 years.

Planting density and spacing:
The plantation density will be 476 trees per hectare, for a spacing of 3m x 7m between the trees. This density and spacing will allow a proper density at maturity of more than 370 tapable trees per ha, while also ensuring a harmonious growth, a good development of the canopy and enabling inter-cropping

cultivations on the inter row during 3 to 4 years. The positioning of planting lines and individual trees will be executed by special teams working under the supervision of an extension agent.

Cover crop:
Stylo grass and *Leguminaceae* will be sown by spreading the seeds in the inter-row in order to prevent from risks of erosion, soil fertility and to limit the vegetation re-growth in the inter-row. The Stylo grass will be sown along the inter-row in about 10 kg per hectare and *Leguminaceae* seed will be depended on the species and design. The mixed-grass will comprise of Guinea 4 kg, Verano 1 kg, Stylo 2 kg, Centrosema 3 kg and Peurarai 2 kg per hectare.

Replacements:
Stumps are added for replacements at the time of the planting. Stumps will be placed in large size bags at the edge of the plantation, close to a water source and maintained by the planter (pruning, weeding, fertilizing). These bags will be used to replace dead stumps in the rainy season of the year following the initial planting. The advantage of this replacement technique is that the replacement stumps are just as old and have reached the same development/size as the stumps already planted.

Maintenance:
A mulching is performed around the stump during the dry season. Weeding around on the line and interline slashing are regularly performed to prevent weed from climbing on the rubber tree, adventitious plants to compete with the rubber tree and other plants to grow in the interline. As a weeding practice, the spaces between trees are ploughed up to a 20 cm depth annually. From the first year to the sixth year the number of annual passages and the intensity of weeding will be progressively reduced to simple strip-weeding with a cutlass, and removing the creepers. Boarders of the plantation will also be scheduled for clean up before the start of the dry season to mitigate the risk of fire outbreak.

Fertilization:
The project will use both synthetic NPK fertilizers ($N_{20}P_{10}K_{20}$+2MgO) and bio-fertilizers.

Pruning:
Pruning will be performed to obtain a well balanced canopy and large tapping panels. Side-shoots are cut up to 2.5 meters. This operation will have to be regularly carried out from the planting year to the 3rd year mainly after the dry season.

Disease control:
Only a good preparation of the soil can prevent root diseases (*Fomes lignosus*). The following procedure will have to be complied with. Checks are made in November by a supervision team, tree by tree and line by line, from the year 2 to the first opening. The treatment consists of isolating and uprooting the dead or contaminated trees and the spreading with Atemi of the neighboring trees at a dose of 50 g per tree per treatment. This treatment is repeated every six months during three years.

Tapping:
The tapping will normally start in year 7. The trees with a girth of more than 50 cm at 1 meter from the ground surface can be tapped and marked by a supervision team. They will be equipped with cups, spouts, cup collars and cup-hangers. The planter will be getting equipment for the tapping (knife and a sharpening stone). There should be 200 tapable trees in the year 7 and then 400 from year 8 and following years. The trees will be opened at 1.3 meter from the ground. A special team supervised by agents will execute the marking of the panels and tapping cut. The trees are tapped in a downward half-spiral every 4 or 5 days from age 7 to 30. The project will recommend the most appropriate tapping system afterward, according to LTR Co. Ltd experiments. The project management will train the tappers or farmers beforehand on the LTR Co. Ltd. The number of tapping days is estimated at 180-200 days per annum and the taper’s daily task at 600 trees.

Stimulation:
4 stimulations will be carried out per annum. The stimulating product will be based on Etephon at 2.5%. The product will be applied above the tapping cut.

Crop collection:
Cup lumps will be collected and stocked on tables sheltered from the sun and leaves. The current dry rubber content of cup lumps is 58%. These cup lumps will have to be free from leaves, sand, stones, polypropylene fibres and all other foreign bodies. Rubber will be collected at least once a month.

Planting schedules for proposed AR CDM project activity are presented below.
Table A.3: Activity plan for year 2008

No	Activity	Year 2008											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Village and district contacting	■	■										
2	Surveying		■	■									
3	Stumps + Equipment to site			■	■	■	■						
4	Land clearing						■	■	■				
5	Pole profile + dig hole						■	■	■				
6	Planting + Fertilization							■	■				
7	Replanting								■				
8	Clean grass around the tree I								■	■	■		
9	Clean grass around the tree II										■	■	
10	Pole remark of 100 ha (zoning)						■	■					
11	Pole remark 25ha, 8 ha						■	■	■				
12	Fence				■	■	■	■					
13	Fire protection & fence maintenance											■	■
14	Village and district contacting										■	■	
15	Surveying for the following year											■	■

Table A.4: Activity plan for year 2009

No	Activity	2009											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Import planting material & equipment			■	■	■	■						
2	Land clearing				■	■	■						
3	Pole profile + dig hole					■	■						
4	Planting + Fertilization						■	■	■				
5	Replanting							■	■				

6	Clean grass around the tree I							■	■				
7	Clean grass around the tree II									■	■		
8	Fire protection + Fence maintenance											■	■
9	Recount the number of plants											■	■
10	Village and district contacting										■	■	
11	Surveying for the following year												■

Table A.5: Activity plan for year 2010

No	Activity	2010											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Import planting material & equipment			■	■	■	■						
2	Land clearing				■	■	■						
3	Pole profile + dig hole					■	■						
4	Planting + Fertilization						■	■	■				
5	Replanting							■	■				
6	Clean grass around the tree I							■	■				
7	Clean grass around the tree II									■	■		
8	Fire protection + Fence maintenance											■	■
9	Recount the number of plants											■	■

Since the proposed AR-CDM project activity relies on the know-how and technology developed by the project participant in Lao PDR, it has not required transfer of technology from Annex 1 countries to Lao PDR or vice versa. However, the project may result in the transfer of the applied technology for non-Annex 1 countries as well as other plantation sectors within the country. It should also be noted that there are rubber plantations which have been established in the country and are applying less modern silvicultural techniques compared to other countries. The project participant will adopt technologies and use proper fertilizer applications in order to maintain a well managed rubber plantation producing results which will sustain the local community without the risk of destroying its environment. Considering above factors it can be mentioned that this will have a potential of implementing similar AR-CDM project activities.

Under applicability conditions, the land used for project can under the proposed AR-CDM project activity continue to provide at least the same amount of goods and services. Accordingly dead wood from the AR-CDM project activity will be allowed to be collected by local communities without compromising the growth of trees planted in the area. Also, the project proponent has instructed and will ensure that no fine litter (woody twigs less than 2mm diameter, bark and leaves) will be taken out from the project area. Only certain amount of dead wood will be allowed to be collected. This can be done through making the local communities aware. According to the present land-use maps and the development plans of LTR Company Limited, the lands within the project boundary are depleted, underutilized or abandoned lands which are below the forest threshold. There are no people living in this area. Therefore no displacement of people or activities occurs due to the project activity. The lands used for project activity have not been used for livestock. Villagers are not using this area for grazing. Since these lands are depleted, no development activities have been proposed and this project activity does not trigger activities outside the project boundary.

As mentioned in the letter issued by District Land Management Authority on 03.02.2010 the land was abandoned for 5 – 10 years. Therefore shift of livelihood was not occurred during the project.

A.5. Parties and project participants

Party involved (host) indicates a host Party	**Private and/or public entity(ies) project participants (as applicable)**	**Indicate if the Party involved wishes to be considered as a project participant (Yes/No)**
Party A Lao PDR	Lao Thai Hua Rubber Co. Ltd Private entity	No

A.6. Legal title to the land and rights to tCERs/lCERs issued for project activity

>>

The project includes land belonging to farmers of four villages namely Huay Hai, Huay Phet, Nam Sang and Sonephansay. There will be 402 families participating in the project. Land use of the four villages constituting the project area is presented in the following table.

Table A.6: Land use allocation for four villages

Land use/villages	Huay Hai (ha)	Huay Phet (ha)	Nam Sang (ha)	Sonephansay (ha)	Total (ha)
Village Area	2,500	3,400	3,800	Data N/A	9,700
Reserve Forest	1,007	1,831	2,040	Data N/A	4,878
Village Utilization Forest	370	403	504	Data N/A	1,277
Depleted and underutilized land	815	645	745	363	2568
Agricultural Production area	138	218	228	153	737
Rice field	140	268	258	30	696
House and Building area	30	35	25	8.4	98

Land owners with formal land certificate/ land title which are issued by the Government are eligible to join the project. The project proponent has committed to lease the land for a period of 30 years, which can be renewed for 20 years more. Project proponent will pay the land owner USD 8.00 per hectare per year as the land lease/rent. The company will pay the land lease upfront for a period of 5 years in the following 3 installments.

- 20% on the land identification, demarcation and signing of agreement,
- 40% after land preparation and,
- 40% after planting rubber trees depending on the actual planted area.

Thereafter the land lease will be paid annually by the company until the end of contract. In addition, the company will pay 5.30 USD (45,000 LAK) per hectare per year to the Government as the royalty/tax for land.

The land owner will provide labour for planting and maintenance depending on their personal capacity. The company will make payments according to the work done.

The rights to issued tCERs have been transferred to LTR Co. Ltd. Evidence collected from four chief of villages that the people from each village will join the project only after agreeing to transfer the rights to tCERs to LTR Co. Ltd.

A.7. Assessment of the eligibility of the land

>>

Latest version of "Procedures to demonstrate the eligibility of lands for afforestration and reforestation CDM project activities[2]" (Version 01) of the Annex 18, EB 35 was used in demonstrating the eligibility of lands for the AR-CDM project activity and the steps followed are presented in following paragraphs.

(a) Land at the moment the project starts does not contain forest:

Lao PDR country forest definition on forest was considered when assessing the land eligibility. In terms of the Lao PDR country definition for forest threshold limits, a forest with a minimum tree crown cover value of 20 %, a minimum land area value of 0.5 hectare, 5 m in height to the top of the canopy is considered as a forest[3].

The whole surrounding Pakkading District area including project site were exploited for timber since 1969 by cutting all sizeable big trunk of logs, near by the road and along the National Road Number 13 with easy conditions for transportation. Then from 1978, planning of building up the National Road Number 8 began and exploitation in this area was further continued, resulting in further deforestation. When the forested lands were cleared, people came and established villages such as Nam Sang, Huay Hai, Huay Phet and Sonephansay. Lands belonging to the project area were categorised as depleted and underutilized land (land allocation for all 4 villages are presented in Table A.6). Increasing population with migration from Huaphanh Province resulted in expansion of the agricultural area and the LFAP had to re-allocate land for transmigrants from Houaphanh Province to provide livelihoods.

According to the land classification of Lao PDR these are unfertile or seriously degraded land on shallow soil and rocky areas on which neither trees nor grasses can grow. Therefore it cannot be concluded that these lands will regain their original state if untouched. These lands have been degraded to the state that no natural regeneration is likely to occur. This is clearly defined in the "Forestry Strategy to the 2020 of the Lao PDR" published by Ministry of Agriculture and Forestry (July 2005**).**

As mentioned above, the area was heavily affected by slash and burn, and became increasingly degraded. Therefore these lands were not cultivated and left abandoned. Some of villagers left their home to neighbouring countries such as Thailand and Vietnam for better income.

In addition to the information mentioned above, a detailed survey on existing vegetation prior to the project start was conducted and is presented in Appendix 08 under baseline information. The results of the study revealed that the species on lands were below the forest thresholds. These species were not to reach the minimum crown cover and the minimum height of the forest definition mentioned above. The Ministry of Agriculture and Forestry on Lao PDR have issued a letter stating the land belonging to the project activity is depleted and is underutilized. This complies with stage one of the tool and thus it have been further proven that the lands are not under any management to reverse the degradation. As a result of being underutilized there is no possibility of being temporarily unstocked as a result of any human intervention.

[2] http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-10-v1.pdf

[3] http://cdm.unfccc.int/DNA/index.html

(b) The project activity is a reforestation or afforestation activity:

In terms of the Bonn Agreement and Marrakech Accords direct human induced conversion of land that has not been forested for a period of at least 50 years to forested land through planting, seeding and/or the human induced promotion of natural seed sources can be considered as an afforestation CDM project. Direct human induced conversion of non-forested land to forested land through planting, seeding or human induced promotion of natural seed sources on land that was forested but that has been converted to non-forested land prior to 31st December 1989 can be considered as a reforestation CDM project.

(a) Aerial photographs and satellite images

In order to prove the project as a reforestation activity, aerial photographs were used. These are aerial photographs of 1992 and 1982. The aerial photographs of 1992 in the scale 1:40,000 by Finmap Company of Finland and year 1982 were processed in the scale 1:30,000 by Russian company. An area of 1076.5 ha was interpreted as non forested area by GIS Division, Forestry Inventory & Planning Division of Department of Forestry.

Determination of project boundary, Interpretation of Aerial photographs, Preparation of digital land use maps and field re inspection are explained in the Letter issued by Forest inventory and planning Division on 01 September 2010.

(b) Land use maps

1:200,000 Land use map of the area prepared by Department of Maps, Lao PDR in 1985 were also assessed in identifying land use types in the area.

(c) Interviews with local communities

A series of meetings were held at all four villages in order to confirm the land use type by 31st December 1989. According to the results natural forests in these areas were cleared by the Royal Government of Lao for timber and also slash and burn were practiced. Therefore it is proved that lands within the project activity did not contain natural forest and the species that exist were below the forest threshold values.

A.8. Approach for addressing non-permanence

>>

The project aims at establishing rubber plantations while receiving CDM benefits to compensate extraordinary costs of introduction of rubber under unusual climatic, economic and social conditions as well as risks related thereto and contributing to addressing the global warming problem. Therefore, the project adopts a 30 year crediting period and uses the **tCER** approach to account for the net anthropogenic GHG removals by sinks. Since the plantations are established and managed, the proposed project activity is expected to bring long-term benefits to the climate.

Issuance of tCERs

There would be significant peaks of carbon stocks if there are any thinning operations involved as a part of forest management. However rubber plantations do not have any thinning operations involved. There will be no thinning in the proposed AR CDM project as well. Therefore there will be no drastic decrease in timber volumes in the project resulting in no coincidence of peaks in carbon stocks and time of verification. When the useful life of the rubber trees has ended the carbon will be preserved by wood processing into durable products primarily for the construction industry and replanting.

A.9. Public funding of project activity

>>

The project does not involve Official Development Assistance (ODA) or other source of public funding from Annex 1 countries.

SECTION B. Application of selected approved baseline and monitoring methodology
B.1. Reference of methodology
>>
A/R Large-scale Consolidated Methodology, Afforestation and reforestation of lands except wetlands (AR-ACM0003) Version 02.0

The methodology also refers to the latest approved versions of the following tools:

- A/R Methodological tool “Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities” (Version 01)
- A/R Methodological Tool “Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity” (Version 04.0.0)
- A/R Methodological Tool “Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities” (Version 03.0) - Change in carbon stocks in deadwood and litter has been excluded from calculation under the conservative approach under applicability condition. Hence this tool wasn’t used.
- Methodological tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities” (Version 04.1)
- A/R Methodological Tool “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity” (Version 02.0)
- A/R Methodological Tool “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities” (Version 01.1.0)

B.2. Applicability of methodology
>>
The selected methodology AR-ACM0003 Version 02.0 is applicable since the project meets the following conditions:

Condition 01
The land subject to the project activity does not fall in wetland category
Applicability
The lands belonging to the project activity were degraded lands where slash and burn had been practiced and left abandoned without any activity. This has been proven in Section A.7., assessment of the eligibility of land. Therefore, the land does not fall in wetland category.

Condition 02
Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when these lands are included within the project boundary:

(i) Land containing organic soils;
(ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in appendices 1 and 2 to referred methodology.

Applicability
The land subjected to the project activity does not contain organic soil and there were no land management practices carried out before the project. Therefore, this condition is not applicable.
A project activity applying this methodology shall also comply with the applicability conditions of the tools contained within the methodology and applied by the project activity.

The Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities” (Version 01) is applicable under the following conditions:

Condition 01
Forestation of the land within the proposed project boundary performed with or without being registered as the A/R CDM project activity shall not lead to violation of any applicable law even if the law is not enforced.

Applicability
All the laws and regulations and compliancy are described under section B.6 of the project design document. A/R CDM project activity described in the document is not lead to violation of any applicable law even if the law is not enforced.

Condition 02
This tool is not applicable to small - scale afforestation and reforestation project activities.
Applicability
The project is a large scale A/R CDM project activity. Therefore, this eligibility condition is not applicable.

A/R Methodological Tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0)

Condition 01
The tool is applicable to all occurrence of fire within the project boundary.
Applicability
Proper fire preventive measures have been applied by PP however in case there is an outbreak of fire, such fire will be reported and non-CO_2 GHG emissions shall be reported. Hence this tool is applicable.

Condition 02
Non-CO_2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥ 5% of the project area.
Applicability
Non-CO_2 GHG emissions resulting due to site preparation shall be accounted under the above condition 02 hence applicability criteria has been met. Borders of the plantation is scheduled for clean up before the start of the dry season to mitigate the risk of fire outbreak. Fire hazard will be monitored continuously.

A/R Methodological Tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity" (Version 02.0)

Condition 01
This tool is not applicable if the displacement of agricultural activities attributable to the A/R CDM project activity is expected to cause any drainage of wetlands or peatlands.
Applicability
The lands belonging to the project activity were degraded lands where slash and burn had been practiced and left abandoned without any activity. This has been proven in Section A.7., Assessment of the eligibility of land. Thus, the project activity does not lead to a shift of pre-project activity out-side the project boundary. The project proponent has given the opportunity to local villagers to use the space in between rubber to plant any cash crops depending on their choice for the first 3-4 years. Hence this applicability condition has met.

A/R Methodological Tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" (Version 01.1.0)

Condition 01

This tool is applicable when the areas of land, the baseline scenario, and the project activity meet the following conditions:

(a) The areas of land to which this tool is applied:

(i) Do not fall into wetland category; or

(ii) Do not contain organic soils as defined in "Annex A: glossary" of the IPCC GPG LULUCF 2003;

(iii) Are not subject to any of the land management practices and application of inputs as listed in the Tables 1 and 2;

(b) The A/R CDM project activity meets the following conditions:

(i) Litter remains on site and is not removed in the A/R CDM project activity; and

(ii) Soil disturbance attributable to the A/R CDM project activity, if any, is:

- In accordance with appropriate soil conservation practices, e.g. follows the land contours;
- Limited to soil disturbance for site preparation before planting and such disturbance is not repeated in less than twenty years.

Applicability

The project is implemented on degraded or degrading grasslands and has satisfied the following applicability conditions.

1. The baseline studies revealed that the areas do not include any organic soils or wetlands.
2. Rate of loss of carbon stocks in mineral soils due to erosion within the project area will not increase above the baseline rate since;

   (i) Heavy slash and burn was commonly practiced prior to the project activity.

   (ii) Soil disturbance from site preparation will not exceed 10% of the total project area

   (iii) Ploughing will follow the land contours.
3. Litter (including woody twigs, barks and leaves) shall remain on site.

Hence the soil organic carbon pool has been conservatively neglected.

B.3. Carbon pools and emission sources

Carbon pools	Selected?	Justification / Explanation
Above-ground	Yes	Major carbon pool subjected to the project activity
Below-ground	Yes	Major carbon pool subjected to the project activity
Dead wood	No	Conservative approach under applicability condition
Litter	No	Conservative approach under applicability condition
Soil organic carbon	Yes	Default approach

According to the A/R Methodological Tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities" (Version 01.1.0) SOC is incorporated with calculations.

There is minute amount of litter and dead wood on land in the baseline scenario and the carbon stock in them are expected to decrease further in the absence of the project. Considering all these factors and the conservative approach, the project participants have selected to account only for above-ground, below-ground carbon and soil organic carbon pools.

According to the AR Large-scale Consolidated methodology (AR-ACM 0003) Afforestation and reforestation of lands except wetlands Version 02.0 the project participants have selected the following emission sources to be included and excluded from the project activity.

Gases considered from emissions by sources other than resulting from changes in stocks in carbon pools

Sources	GHGs	Included?	Justification / Explanation
Burning of biomass	CO_2	Excluded	CO_2 emissions due to burning of biomass are accounted as a change in carbon stock.
	CH_4	Excluded	Lands are degraded and under-utilized and burning of existing biomass is not practiced in the proposed project.
	N_2O	Excluded	Lands are degraded and under-utilized and burning of existing biomass is not practiced in the proposed project.

B.4. Identification of strata
>>
Stratification was done as per Section 5.3 of the methodology. Baseline stratification was conducted the following method.
Information collected regarding the land use of the project area using land use maps, satellite images and discussions with local communities. Major land use types in the baseline scenario were identified and stratified using the information. Based on this stratification, detailed field surveys were done to strengthen the stratification process. This revealed that the existing vegetation on the degraded lands were below for forest threshold value of the country.

The land use of the area before 31st December 1989 was studied during the initial stage of the baseline survey. This was done to exclude all areas that consisted forests. The satellite images that were interpreted for Forest and Land cover assessed by FMP of DOF in 2005 were used. For further assessment of forest and land cover, the aerial photographs of 1992 and 1982 were assessed. The aerial photograph of 1992 (1:40,000) was taken by Finmap Company of Finland and the 1982 aerial photograph (1:30,000) were processed by Russian company. All forested lands were excluded from the project area. Landsat 4_5 TM satellite image of year 2007 was used in identifying land use types existed before the project started. This map was used along with the map of the project area provided by the project participant. The area was stratified according to the following major vegetation types.

1. Degraded Forest – 134.22 ha
2. Shrubs – 415.03 ha
3. Grasslands – 201.45 ha
4. Barren land – 218.51 ha

The definitions of forest types and land use types of the Forestry Strategy to the year 2020 of the Lao PDR (July 2005) published by the Ministry of Agriculture and Forestry was used in identifying baseline vegetation.

Stratification for actual GHG removals by the project were done in order to improve the accuracy and precision of biomass estimates. Accordingly, following steps were taken for *ex ante* stratification.

Step 1: Reconnaissance survey

Data on the ground surveys which were done by the survey team and forest management team were used to identify land use of the area.

Step 2: Criteria of stratification considered in the project activity

Main type of species used for reforestation is Rubber (*Hevea Brasiliensis*). Therefore type of species was not a criterion of *ex-ante* stratification.

For the *ex-ante* calculation of the project biomass, it was decided to stratify the project area according to the project planting year. Year of planting and area of planting is as follows;

Table B.2: Area of planting

Year	Area (ha)
2008	507.28
2009	55.43
2010	406.49
Total	969.20

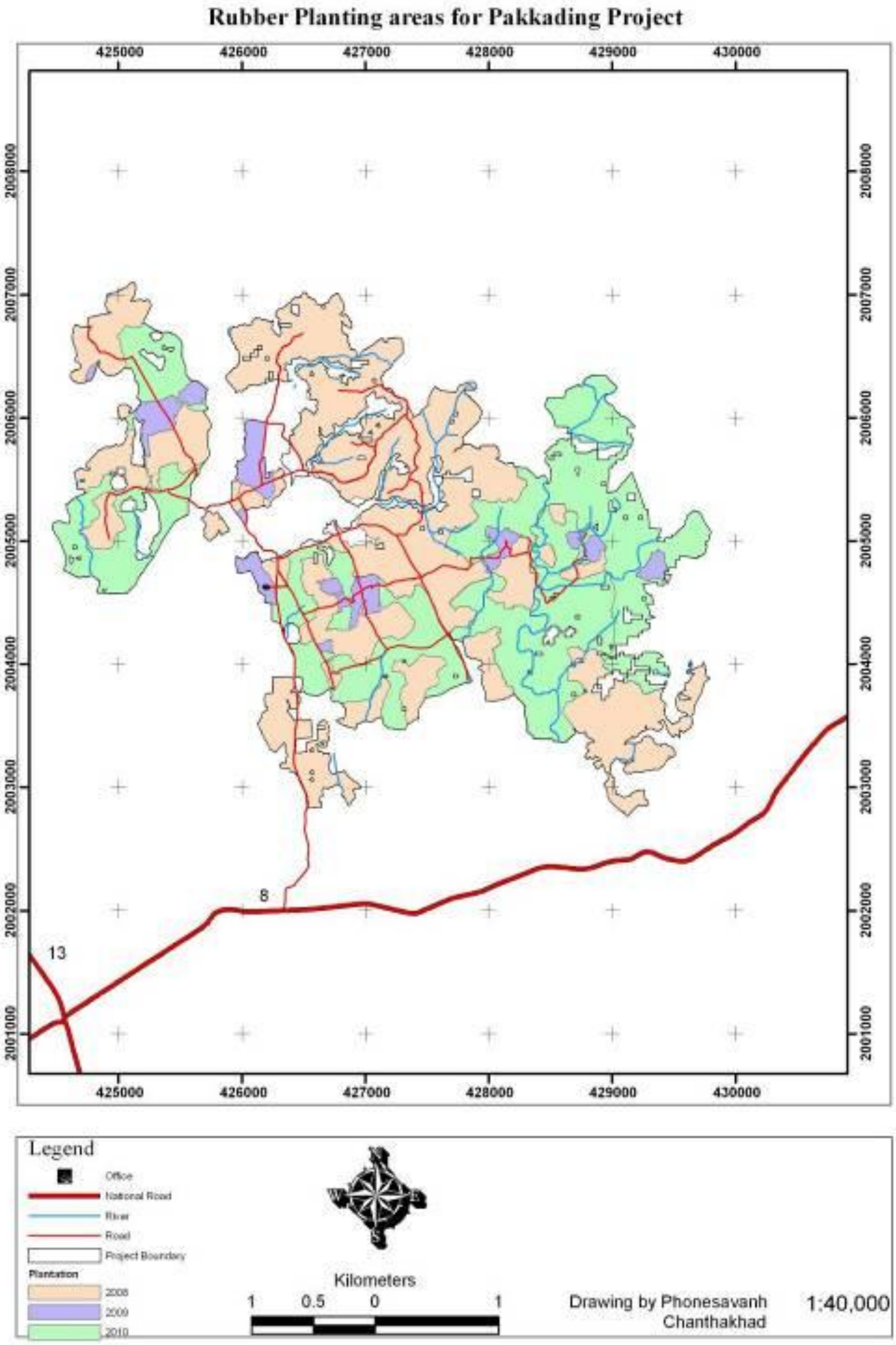
Step 3: Ex-ante stratification taking into account the stratification criteria and land use within the project boundary

Information about all stands within the project activity including date of planting is documented. Land Use maps with the limits of each stratum were prepared and will be available to the DOE for validation and verification.

Step 4: Ex-ante stratification map

Ex-ante stratification maps were prepared and are presented in Figure B.1

Figure B.1 Ex-stratification map of Pakkading project



B.5. Establishment and description of baseline scenario
>>
As stated in Section 5.2 of AR-ACM0003 the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01, Annex 19 of EB 35) was used. Description on the identified baseline is presented in Section B.6.

B.6. Demonstration of additionality
>>
This reforestation project activity under the AR CDM is additional since the actual net greenhouse gas removals by sinks are increased above the sum of the changes in carbon stocks in the carbon pools within the project boundary that would have occurred in the absence of the registered AR-CDM project activity, in accordance with paragraphs 18–22 of Modalities and Procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol (contained in the Annex to Decision 19/CP.9). The "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01, Annex 19 of EB 35) was used in assessment and demonstration of additionality.

Table B.3 Important events in project development

Date	Key event
26.12.2007	Board meeting decides to implement the project after considering CDM benefits.
January 2008	Village and District contacting
February 2008	Conducting survey
22.02.2008	Placing the order for planting material
01.06.2008	Land clearing (start of land clearing was considered as the project start date)
06.08.2008	Completing the baseline study
30.09.2008	Obtaining the non-objection letter from DNA, Lao PDR
October 2009	Public consultation on the project done by DNA, Lao PDR
25.01.2010	Consultation workshop on the project done by DNA, Lao PDR
11.02.2010	Field visit conducted by DNA, Lao PDR
18.05.2010	Host country approval letter issued by DNA, Lao PDR

STEP 0. Preliminary screening based on the starting date of the A/R project activity
The start date of the project is 1^{st} June 2008. Evidence of the project start date is with the project participant and will be available for DOE during validation.

STEP 1. Identification of alternative land use scenarios to the proposed A/R CDM project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed CDM project activity
The following two alternative land use scenarios have been identified to the proposed reforestation CDM project activity.
Alternative 1: Implementing the proposed project activity without registering as a AR-CDM project
Alternative 2: Continuation of the abandoned and degraded land use situation with no project activity.

Sub-step 1b. Consistency of credible alternative land use scenarios with enforced mandatory applicable laws and regulations

The following laws and regulations were used to demonstrate above alternatives in Sub-step 1a are in compliance with mandatory applicable legal and regulatory requirements of the country. All these laws and regulations were implemented prior to adoption of Modalities and Procedures for CDM (11^{th} November 2001).

1. Decree on the Implementation of the Environmental Protection Law No.102/Prime Minister, Vientiane, Date 04/06/2001
2. Decree on the Implementation and progressing of Water Resources and Environment Administration, dated 23/05/1999
3. Decree 169/Prime Minister (1993) on Management of forestry and land forestry.
4. Decree 169/Prime Minister (1993) on Land allocation for planting and protection.

The following table presents the plausible alternatives that are in compliance with mandatory legislations of Lao PDR.

Table B.4. Plausible alternatives that are in compliance with mandatory legislations of Lao PDR

Number	Alternative	In compliance with national laws and regulations (Yes/No)
1	Implementing the proposed project activity without registering as a AR-CDM project	Yes
2	Continuation of the abandoned and degraded land use situation with no project activity.	Yes

Outcome of Sub-step 1b: The following are the plausible alternative land uses to the proposed AR-CDM project activity which are in compliance with all applicable legal and regulatory requirements of Lao PDR.
Alternative 1: Implementing the proposed project activity without registering as a AR-CDM project
Alternative 2: Continuation of the abandoned and degraded land use situation with no project activity.

STEP 2. Barrier analysis

Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios

The Board of Directors of LTR Co. Limited have approved this project activity in spite of its failing to comply with its generally applied IRR benchmark as applied by the UN at 12.75% for this kind of investments in Lao PDR. This is due to the extraordinary costs incurred as a consequence of its character as a pilot project, which is based on a social and legal model, which does not disturb the established pattern of land ownership etc. The Pakkading project has addressed issues, which have caused the Government of Lao PDR to reconsider continued development of plantations in general based on conventional concessions. The Board of Directors decided to go ahead with project implementation based on an innovative and socially just model which is in full compliance with the new strategy of the Government of Lao PDR. In this manner Pakkading serves as a pilot investment project which incurs extraordinary costs in social and legal project design. The Board of Directors has accepted these extraordinary costs trusting in successful registration as an AR-CDM project.

The proposed project activity faces following barriers that prevent the implementation of the proposed project activity. Continuation of the abandoned and degraded land use with no project activity does not face any of the following barriers.

(a) Investment barrier
Lack of access to credit: In Lao PDR, obtaining long term financing for the Pakkading project has proven impossible. This may be because of the high perceived risks and the long term nature of plantation projects. In respect of investments in Lao PDR systematic and keen efforts to mobilize bank loans did not produce the desired results, neither from Thai nor from Lao banks (letters from TMB Bank public company limited, Agricultural Promotion bank and BCEL bank provided as proof).

In Laos the only bank to provide financing for forestry sector is the Agriculture Promotion bank (APB) while other Lao commercial banks have ceased lending for the forestry sector (Source – Forestry Strategy to 2020) and even APB refused to fund the proposed project leaving the developers in a very difficult situation with lack of access to credit.

One may speculate to which extent perceived risk played a role, for the Thai banks it might have been the political risk exposure and for the Lao banks it might have been systematic risk of funding an investment venture based on a new and untried legal formula for cooperation with the rural community. Consequently, the project is facing a real investment barrier.

(b) Technological barriers

Rubber plantations need an ample supply of good quality planting materials to be successful. Pakkading District, being a remote area and with majority of local communities living below the poverty line, are short of access to good quality planting material. In fact inadequate tree-growing technologies have been identified of the issues for improvement of tree plantation development by the Forest Strategy to the year 2020 (MAF, July 2005). According to this report 146,000 ha of plantations including rubber which accounts for a very small part of the total as shown in table B.8, have been established predominantly in the Central Region. However, only 66% have survived (with approximately 70% seedling survival rate). Main reasons for this failure are inadequate technology and lack of proper maintenance. The report further identified that the productivity of plantations which have reached the production stage is lower than anticipated.

There is no Rubber Research Institute where people can get information in Lao PDR. Even though the project developer is supposed to provide the technological know-how under the 2+3 scheme, without a relevant institute in the country, planting rubber in this remote area face barriers and incurs extraordinary costs on the part of the investor. The report Para-rubber situation of Lao PDR (2007) also identified limited technical knowledge on rubber as a problem in Lao PDR.

From the point of view of the local communities who provide land and labour under the 2+3 scheme, they lack the skills for plantation management as well as for preventing planted trees from being subject to fire, pest and disease attack. Sustainable agricultural practices were not common in these communities. In fact they were used to slash and burn. The project developer is not bringing foreign labour which could have been cost effective but socially undesirable under the circumstance where local communities lack the proper technology to maintain the plantations hence alternative 1 faces with technological barriers.

(c) Barriers related to local tradition

Discussions with the local communities have proven they have scant knowledge in technical know-how, laws and regulations, present market conditions and practices relating to rubber planting and management. They also lack knowledge on environmentally friendly agricultural activities although agriculture is their main source of income. Slash and burn practice is common among them. Rubber planting has not been a traditional activity among them. The entire Bolikhamsay Province has reported to have 1026 ha of rubber scattered over the province (Para-rubber Situation in Lao PDR, 2007), however, it appears that the statistics apart from general deficiencies of official data in Lao PDR mainly cover smallholders' rubber, which is highly likely not to reach the point of actual latex production. Therefore alternative 1 faces barriers related to local tradition.

The following paragraphs are provided to sustain the above barrier: Rubber Planting in Laos: Local Approaches to New Challenge (2010) reports that the rubber projects are more than just another livelihood option for the villagers. Rather, its implementation requires significant changes concerning the entire livelihood of farmers. It is not only a question of a shift from subsistence farming to commercial farming, but it involves long term capital investments, which are beyond the means of local farmers. Even in Thailand traditional smallholder rubber farming is sustained largely by a government run financial mechanism for funding the replanting of rubber trees. Therefore alternative 1: Implementing the proposed project activity without registering as an AR-CDM project faced with this barrier.

(d) Barriers due to local ecological conditions
The lands included in the project activity have been identified and classified as depleted and underutilized by the Ministry of Agriculture and Forestry according to their own assessment. Therefore unless proper silvicultural practices are applied, such lands cannot be replanted with rubber.

The competition with herbaceous/shrub vegetation is very high in the first few years for any plantation. This could not be overcome unless farmers were able to spend a considerable amount of time doing manual weeding. Due to land degradation and low harvest from slash and burn, the villagers had stopped slash and burn practice 5-10 years ago.

Further baseline information is given in Appendix 8. Based on this information there was a barrier to overcome due to local ecological conditions. Main problem was the harsh microclimate which is generally not conducive to agricultural activities. Vegetation cover was shown the features of early stages of succession after being abandoned by local people. Therefore, local ecological conditions were not favourable for tree planting. The study team from WREA also observed the situation of degraded condition of the land. Hence alternative 1 has barriers due to local ecological conditions.

Outcome of Step 2a: Barriers preventing the alternative 1 - Implementing the proposed project activity without registering as an AR-CDM project identified in Step 1b.

Sub-step 2b: Elimination of land use scenarios that are prevented by the identified barriers.
All the alternative land use scenarios that were prevented by the identified barriers were excluded from further evaluation.
The following matrix presents each alternative and barriers which prevent them.

Table B.5 Alternatives and which alternative is prevented by a barrier

	Investment barrier	**Technological barriers**	**Barriers related to local tradition**	**Barriers due to local ecological conditions**
Alternative 1				
Alternative 2				

Alternative 1: Implementing the proposed project activity without registering as a AR-CDM project
Alternative 2: Continuation of the abandoned and degraded land use situation with no project activity

Outcome of Sub-step 2b: The land use types that are not prevented by any barriers are as follows.
Alternative 2: Continuation of the abandoned and degraded land use situation with no project activity.

Sub-step 2c. Determination of baseline scenario
The following decision tree was applied to the outcome of sub-step 2b.

Is forestation without being registered as an A/R CDM project activity included in the list of land use scenarios that are not prevented by any barrier?

→ If yes, then:

Does the list contain only one land use scenario?

→ If yes, then the proposed A/R CDM project activity is not additional.

→ If no, then continue with Step 3: Investment analysis.

→ If no, then:

Does the list contain only one land use scenario?

→ If yes, then the remaining land use is the baseline scenario. Continue with Step 4: Common practice test

→ If no, then through qualitative analysis, assess the removals by sinks for each scenario and select one of the following options:

<u>Option 1</u>: Baseline scenario is the land use scenario that allows for the highest baseline GHG removals by sinks. Continue with Step 4: Common practice test, .

<u>Option 2</u>: Continue with Step 3: Investment analysis.

Since implementing the project without being registered as an AR-CDM project activity and the list of sub-step 2b contain only one land use scenario, the remaining land use is the baseline scenario.
Therefore the baseline scenario is: **Degraded and abandoned land use**.
Although the decision tree allows PP to directly continue with Step 4: Common practice test, PP selected Step 3: Investment analysis to further strengthen the additionality test.

STEP 03: Investment Analysis

The Board of Directors of the project promoter approved this project in spite of its falling short of the UN recognized IRR benchmark for plantation projects in Lao PDR trusting in successful CDM registration and considering its benefits to the global community. For the development of the Investment Analysis, the project promoter chose to follow the "Guidelines on the assessment of investment analysis – version 05 (EB 62, Annex 05)" and will apply the guidance in the steps below:

Sub-step 3a. Determine appropriate analysis method

According to the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities – Version 01 (EB35, Annex 19)" the project promoter chose to apply Option III (Benchmark analysis). Option I (simple cost analysis) was considered not applicable since the project activity generates other economic benefits than the CDM related income.

Sub-step 3b. – Option III. Apply benchmark analysis

<u>Identification of the financial indicator:</u> The Internal Rate of Return (IRR) was considered the most appropriate financial indicator to conduct the benchmark analysis.

<u>Identification of a benchmark:</u> UN benchmark for the afforestation/reforestation sector in Lao PDR of 12.75% was used in the calculation.

Sub-step 3c. Calculation and comparison of financial indicators (only applicable to options II and III):

Guidance 6 from the tool "Guidelines on the assessment of investment analysis – version 05" establish that "Input values used in all investment analysis should be valid and applicable at the time of the investment decision taken by the project participant". Therefore, in accordance with this guidance, the project promoter chose to conduct the investment analysis based on the investment decision scenario.

Parameter	Value
Project area	969.20 ha
Land lease price per ha	8 US$ per year
Plantation period	30 years
Average Rubber Trees Planted (Trees per ha)	476
Labor cost (% of revenue)	30%

CER price	3.5 US$

The project promoter made basic assumptions as follows:

1. The Productivity would – after the first couple of years of tapping – reach an average of 1,500 kg dry latex per ha per year. The production figures achieved by others, according to the most recent data shown in table B.8 tend to be around 1,400 kg dry latex per ha per year.
2. The selling price has been estimated at USD 4.00 per kg, which was based on optimistic market sentiments. Recently the prices have dropped to a level at which some producers stop tapping.

<u>Results and comparison of the IRR and benchmark rate:</u>
According to the basic assumptions the estimated IRR for Pakkading has been calculated at 11.79%, which is well below the UN benchmark for this sector in Lao PDR of 12.75%, calculated over the entire project life cycle of 30 years.
A calculation of the project IRR inclusive of CDM income at the price fixed in the ERPA concluded the calculated IRR is 12.30%, still below the UN benchmark.

Since option III Benchmark analysis was used, the following decision tree was applied:

Is forestation without being registered as an A/R CDM project activity included in the list of land use scenarios that are not prevented by any barrier? NO

➔ *If no, then:*

Has at least one of them land use scenarios that are not prevented by any barrier the financial indicator that meets the benchmark? NO

➔ *If no, then the baseline scenario is the continuation of the pre-project land use.*

Although it wasn’t mandatory to continue with Sub-step 3d. Sensitivity analysis, PP chose to further continue to strengthen the additionality test.

Sub-step 3d. Sensitivity analysis (for Option II and III)

A sensitivity analysis on market prices result in an estimated IRR of 7.49% at 20% lower prices for dry latex, i.e. USD 3.20 per kg and an estimated IRR of 15.04% at 20% higher prices for dry latex, i.e. USD 4.80 per kg. The yield assumptions are maintained at 1,500 kg dry latex per ha per year.

Another sensitivity analysis calculated on the impact of variations of project yield result in an estimated IRR of 7.49% at 20% lower yield, i.e. 1,200 kg dry latex per ha per year and an estimated IRR of 15,04 at 20% higher yield, i.e. 1,800 kg dry latex per ha per year. The price assumptions are maintained at USD 4.00 per kg dry latex.

A scenario involving at the same time lower prices and lower yields will send the IRR lower than 7.49%. It should not be forgotten that the 2 + 3 project formula involves contractual obligations to pay members of the local community in price situations when a plantation company operating on the basis of a conventional concession might benefit from the option of stopping the tapping for shorter or longer periods of time as a means of stopping or reducing its losses.

The sensitivity analysis indicates that the investment analysis provided a valid argument in favor of the proposed project activity since it consistently supports the conclusion that the project activity without carbon revenue is unlikely to be economically attractive. However the alternative scenario 2 (Continuation of the abandoned and degraded land use situation with no project activity) faces no significant barrier of any time and the main land use trend in the area (baseline scenario).

	Latex price USD 3.2 per kg (20% less)	Latex price USD 4.8 per kg (20% high)	Yield 1200 kg dry latex per ha per year (20% less)	Yield 1800 kg dry latex per ha per year (20% high)
Estimated IRR	7.49%	15.04%	7.49%	15.04%

The following decision tree was applied:

Is forestation without being registered as an A/R CDM project activity included in the list of land use scenarios that are not prevented by any barrier? YES

➔ *If yes, then:*

Is the sensitivity analysis conclusive? YES
Then the selection of baseline scenario is valid. Proceed to Step 4. Common practice test.

Outcome of step 3: The selected baseline scenario: Continuation of the abandoned and degraded land use situation with no project activity being the valid baseline scenario.

STEP 4: Common practice analysis

The geographical region considered for the following comparison of the proposed AR CDM project and other project activities was Lao PDR. There are presently no registered AR CDM project activities in Lao PDR. Rubber plantations in Lao PDR have yet to develop – if indeed deemed feasible by government and investors - and also have to overcome many issues that hinder the development of the forestry sector. Among various barriers exists the Forestry Strategy to the year 2020 of the Lao PDR (July 2005) by the Ministry of Agriculture and Forestry have identified the following:

1. Low tree plantation profitability
    a. Inadequate tree growing technology - Achieving satisfactory tree growth due to lack of proper technology is an issue
    b. Low prices for the product (rubber milk (latex), timber etc.,)
2. Legal & regulatory framework
   Lack of proper land titles among local communities is discouraging project developers to conduct forestation activities on degraded lands belonging to local communities.
3. Funding and incentives – lack of proper and secure funding for this type of reforestation activities due to perceived risks such as market constraints.

The Para-rubber Situation in Lao PDR (2007) also has analyzed the present situation of rubber plantation in the country (pp.21). The report states the following facts as limitations for extension of rubber planting in Lao PDR;

- Less knowledge of using rubber clones,
- No formal government organization to be responsible for quality of planting materials, rubber planting techniques etc.,
- Shortage of know-how to extend the sector: presently the only people trained for rubber industry is trained by some commercial investors. The Government has no specific training program for all levels.
- Lack of financing opportunities for rubber growers/ limited numbers of private investors due to the long immature period,
- Conflicts between local communities and people migrated from outside areas,
- Less knowledge on rubber maintenance and processing,

There is an increase of income among the local communities that participate in the Pakkading project. Average monthly income per farmer participant for this project is 64.58 USD (549,000 LAK) for maintenance and 52.94 USD – 70.58 USD (450,000 – 600,000 LAK) (if work 15 - 20 days as receives 3.52 USD (30,000 LAK) per working day in field). Therefore, average monthly income of a participant is in between 117.52 – 135.17 USD (999,000 – 1,149,000 LAK), USD: LAK = 1:8,500, in 2008). Frequency of weeding is higher during the rainy season, with participants receiving about USD 435.29 (3,700,000 LAK), USD: LAK = 1:8,500, in 2006) for weeding 25 hectares (Reference: Information collected during the baseline study and stakeholder meetings – submitted to DOE during validation).

Compared to the data available on the currently limited rubber activities in Lao PDR participants in other rubber projects would get 35.29 USD to 58.82 USD (300,000 - 500,000 LAK), USD: LAK = 1:8,500, in 2008) per month for weeding in the dry season.(Reference: Land, Rubber and People: Rapid Agrarian Changes and Responses in Southern Laos (January, 2009))

LTR Co. Ltd is paying the land owner USD 8.00 per hectare per year as the land lease/rent for land which during recent years had no alternative value as it was abandoned. The project proponent has agreed to pay the land lease upfront for a period of 5 years in the following 3 instalments.

a. 20% on the land identification, demarcation and signing of agreement,
b. 40% after land preparation and,
c. 40% after planting rubber trees depending on the actual planted area. This will be calculated using GPS.

Thereafter the land lease will be paid annually until the end of contract. In addition, the company is paying USD 5.30 (45,000 LAK) per hectare per year to the Government as the royalty/tax for land, which would otherwise have to be paid by the farmers themselves.

At the end of the project cycle, rubber trees will be harvested for timber. The gross profit sharing will be 10% to the land owner and 90% to the company from sale of rubber wood. It should be mentioned that rubber wood has to be treated immediately after harvesting if it is to have any commercial value. The individual farmers would not be able to do that by themselves. An independent monitoring report will be submitted to the verifiers during the verification process. Two independent teams are assigned to evaluate above criteria. Two university lecturers from the National University of Laos (Department of Forestry) will be leading and five students will be assigned for each team. 50% of total families will be selected randomly for the survey. In addition to that there will be open meetings held at each village to make a flat form to express their ideas openly.

The following table B.6 presents the areas planted with rubber in Laos PDR. The decision regarding the proposed AR CDM project was made in 2007 and by that time the country at best had only rubber statistics up to 2004. Laos being a least developed country didn’t have reliable statistics at the time the investment decision was made and the project developer had to rely on data with poor quality by the time the investment decision was made. By 2004 only 6,887 ha of rubber was in Lao PDR which is less than 0.03% of total land area of the country. It should be noted that much of the area claimed to have been planted with rubber relate to smallholder activities involving a few trees, and which typically do not even reach the point of production. Therefore, it is important to compare Table B.6 with Table B.8 which shows the estimated area of rubber in actual production.

According to the Chief of Planning Section, Agriculture and Forestry Division of Bolikhamxay province dated 05/12/2011, 45% of the total area under rubber in Bolikhamxay province did not survive due to technical and financial problems. Similar percentage of areas throughout Lao PDR was abandoned at later stages due to financial and technological constraints. Therefore it is clear that although some planting of rubber took place throughout the country, the continuation of such rubber activities till economic fruition is often not possible.

Table B. 6 Rubber planted areas in Lao PDR (Source – Rubber Research, 2011. Agriculture and Forestry Centre, National Agriculture and Forestry Research Institute, Ministry of Agriculture and Forestry, Lao PDR)

Province	Planted Area (ha)			
	2003	2004	2005	2006
Phongsali	0	0	0	0
Loung Namtha	472	4,244	4,590	4,590
Bokeo	120	701	701	701
Sainyabuli	-	-	14	66
Oudomxai	3	880	1,567	1,567
Louangphabang	-	400	518	529
Houaphan	0	0	0	0
Northern	**595**	**6,225**	**7,390**	**7,453**
Vientiane Capital	130	130	130	130
Xiangkhoang	0	0	0	0
Vientiane Province	0	0	0	100
Bolikhamxai	4	107	1,026	1,026
Khammouan	103	347	347	347
Savannakhet	0	4	243	243
Central Region	**237**	**588**	**1,746**	**1,846**
Salavan	0	0	0	0
Champasak	74	74	2,227	2,747
Sekong	0	0	0	0
Attapu	0	0	0	0

Southern	**74**	**74**	**2227**	**2747**
Total	**906**	**6,887**	**11,363**	**12,046**

Rubber as a plantation activity was introduced in the 1930s by the colonial authorities. However these plantations established in Bacieng District, Champasak Province were not successful. Thereafter no successful attempts were made to establish rubber until 1990s where 80 hectare in Thakhek District and 23 hectares in Hathyao District were planted as experimental plots. By 1996 another 342 hectares were extended to northern parts of the country. Yet according to the Economic Valuation of Ecosystem Services and Poverty Alleviation (November, 2012) report prepared by the National Economic Research Institute, Lao PDR rubber wasn't developed as a plantation activity nor it had received any attention by the Lao community until the end of 1990s.

It is important to look at the main land use policies that are used in forestry and agricultural projects. They are the 2+3 policy and large-scale land concessions. In 2012 the Lao government started to review the effectiveness of these policies to ensure that both project developers and local communities benefit from the forestry and agricultural plantations.

The 2+3 policy was used for agricultural projects (mainly sugarcane and corn) and not for forestry projects. Forestry projects in Lao PDR used large-scale land concessions due to its profitability and control by the project developers over the plantation. However these large-scale land concessions were not helping the local communities and no proper monitoring over the plantations existed. The proposed AR CDM project in Pakkading District with its aim of ensuring sustainable development was planned to be implemented using the 2+3 policy thus being the first rubber plantation to be implemented under such a scheme.

The following table B.7 presents the main differences between other forestation activities and proposed AR CDM project activity.

Table B.7: Main differences between other forestation activities and proposed AR CDM project activity

Other forestation activities	Proposed AR CDM project activity
Forestation activities are conducted on all categories of land which results in conversion of already forested lands	Forestation carried out on degraded and abandoned lands
Forestation activities conducted on all types of land (State, private, lands belonging to local communities) under large-scale land concessions provided by the Government.	Forestation conducted under 2+3 model on lands belonging to local communities
Large areas of land belonging to the forestation activity overlaps with public and private lands (forest, production land etc) because there is not any assessment prior approving the land concession.	Only lands without forest vegetation as of December 31st 1989 are being forested thus not causing any removal of existing vegetation
Benefits include forest wood and non-wood products, ecosystem services (water, recreation, air). Situations where new plantations are established on forested lands, the benefits will diminish due to the transformation.	Benefits include latex, wood and non-wood products, ecosystem services (water, recreation, air) plus additional benefits obtained via sale of carbon emission reductions. Due to transformation of abandoned land the ecosystem benefits are more credible.
Lack of participation from Government and associations to monitor how the contract is	Project developers are committed to ensure quality assurance and quality maintenance in all

compiled between local communities and project developers and lack of monitoring the forestation activities or control over the activities	silvicultural activities and periodic monitoring exists in the interest of achieving the best possible results.

By analyzing the situation of similar rubber planting activities in Lao PDR, it is clear that the proposed AR CDM project in Pakkading District is not similar to other rubber planting activities in Lao PDR. This project has unique characteristics and also faces barriers mentioned in the Barrier Analysis. Due to the conditions in Pakkading in terms of depleted and underutilized land condition, lack of local experience in rubber plantation activities, particularly in forms which are economically, socially and politically sustainable, the project proponent committed itself to this investment trusting in a supplementary cash flow from CDM registration. This has proven even more vital than originally believed as the lack of experience in rubber plantation investments has proven to have repercussions also in the financial sector, not only in Lao PDR but also in Thailand where the project proponent is a well known name.

Traditional plantation models based on concessions which involve transfer of ownership have proven socially, politically and environmentally unsustainable. Therefore the project proponent has realized that a sustainable model that minimizes the political risk of the investment needs a strong element of corporate social responsibility and has to respect traditional rights of land ownership. This has caused the project proponent to engage in pioneering activities in social and legal terms resulting in extraordinary costs of this pioneer project.

Following table B.8 presents the expected/estimated area of tapping and rubber yield for Lao PDR in 2010. According to the results the area in actual production was only 906 ha. These results prove that growing rubber was not a common practice even in 2010 and constitutes a new species in reforestation.

Table B.8 Estimated rubber tapping area and yield in Lao PDR in 2010 (Source – Rubber Research, 2011. Agriculture and Forestry Centre, National Agriculture and Forestry Research Institute, Ministry of Agriculture and Forestry, Lao PDR)

Province	Area rubber tapping (ha)	Rubber Yield (tonne)
Loung Namtha	472	675
Bokeo	120	172
Oudomxai	3	4
Northern	**595**	**851**
Vientiane Capital	130	186
Bolikhamxai	4	6
Khammouan	103	147
Central Region	**237**	**339**
Champasak	74	106
Southern	**74**	**106**

Total	**906**	**1,296**

The above mentioned data support the notion that this project is the first of its kind not only in the district but also in the country. Hence the proposed AR CDM project activity is additional. Furthermore, the project developer is trying to remove the financial barrier by registering this project as an AR-CDM project as follows:

i) Since the additional revenue from the sale of tCERs can meet some of the investment cost, the investment barrier can be alleviated but not entirely removed as risks will prevail.

ii) Being an AR-CDM project, the developer expects more technical support from government, non-government and universities to cope with some of the technical barriers

iii) The perceived market risk due to high cost of the rubber plantation investment can be reduced through the additional revenue from the sale of tCERs.

The Board of Directors of the project promoter was persuaded to approve this project based on the above. Without the supplementary CDM revenue the company would not be able to justify the project as it would not meet the UN IRR benchmark of 12.75% in the plantation sector in Lao PDR (Guidelines on the assessment of Investment Analysis (Version 05) EB 62 Annex 5). In addition, the project promoter has the ambition to develop this project activity as a pilot project to prove the physical viability of rubber plantations in Lao PDR and to demonstrate that such projects can be implemented without transfer of ownership from farmers to plantation companies, which would render the first ones landless labourers. On the contrary, this project aims to prove that rural development can be accomplished in partnership between local farmers and external partners, who provide capital and expertise. In this context it is important that this rubber project will been registered as an AR-CDM project.

B.7. GHG removals by sinks
B.7.1. Explanation of methodology

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According to the selected methodology AR-ACM0003 (Version 02.0), first step towards the estimation of GHG removals by sinks is the estimation of Baseline net GHG removals by sinks (Section 5.4 of the methodology). Thereafter actual nett GHG removals by sinks are estimated using BEF method since this method is the most appropriated given the availability of data. Calculation methods and formulae are presented as follows:

As per AR-ACM0003, the baseline net GHG removals by sinks are the summation of following changes in Carbon stocks.

$$\Delta C_{BSL,t} = \Delta C_{TREE\_BSL,t} + \Delta C_{SHRUB\_BSL,t} + \Delta C_{DW\_BSL,t} + \Delta C_{LI\_BSL,t} \qquad \text{Equation (1)}$$

Where

$\Delta C_{BSL,t}$ = Baseline net GHG removals by sinks in year *t*; t CO_2-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 CO_2-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 CO_2-e

$\Delta C_{DW\_BSL,t}$ = Change in carbon stock in baseline dead wood biomass within the project boundary, in year *t*, Not included in the carbon pool under the conservative approach under applicability condition.

$\Delta C_{LI\_BSL,t}$ = Change in carbon stock in baseline litter biomass within the project boundary, in year *t*, Not included in the carbon pool under the conservative approach under applicability condition

As explained in Appendix 8, Landsat 4_5 TM satellite image of year 2007 was used in identifying land use types existed before the project started. This map was used along with the map of the project area provided by the project participant. The area was stratified according to the following major vegetation types.

1. Barren land (lands with heavily degraded condition) – 218.51 ha
2. Grasslands – 201.45 ha
3. Lands with shrubs on degraded soil – 415.03 ha
4. Degraded forests – 134.22 ha

In accordance with the approved methodology AR-ACM0003 baseline stratification can be done according to the major vegetation types. Therefore above major vegetation types were considered for baseline net GHG removals by sinks.

There were 419.96 ha of land comprising of bare land and grass. These lands were not able to withstand shrubs or any growing tree due to degraded condition. The reasons are mainly due to increased slash and burn during the past. Soil erosion was a common observation on these lands. Therefore as per AR CDM tool “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Version 04.1), the carbon stock and change in carbon stock was estimated as zero for the 419.96 ha.

Under conservative approach change in carbon stock of deadwood and litter are assumed zero. The crown cover of remaining trees under the degraded forest section was estimated as 4%. Using the following equations, the baseline net GHG removals were calculated.

$$\Delta C_{TREE\_BSL} = \sum_{i=1}^{M} \Delta C_{TREE\_BSL,i}$$

$$\Delta C_{TREE\_BSL,i} = \frac{44}{12} \times CF_{TREE} \times \Delta b_{FOREST} \times (1 + R_{TREE}) \times CC_{TREE\_BSL,i} \times A_i$$

Where:

ΔC_{TREE_BSL} = Mean annual change in carbon stock in trees in the baseline; t CO_2e yr^{-1}

ΔC_{TREE_BSL} = Mean annual change in carbon stock in trees in the baseline, in baseline stratum *i;* t CO_2e yr^{-1}

CF_{TREE} = Carbon fraction of tree biomass: t C (t. d.m.)$^{-1}$

Δb_{FOREST} = Default mean annual increment of above-ground biomass in forest in the region; t d.m. $ha^{-1}yr^{-1}$

R_{TREE} = Root-shoot ratio for the trees in the baseline; dimensionless

$CC_{TREE\_BSL,i}$ = Crown cover of trees in the baseline, in baseline stratum *i,* at the start of the project activity

A_i = Area of baseline stratum *i*, delineated on the basis of tree crown cover at the start of the AR CDM project activity; ha

Change in carbon stock in shrubs was estimated as follows;

$$\Delta C_{SHRUB,t} = \frac{C_{SHRUB,t_2} - C_{SHRUB,t_1}}{T} \times 1\ year$$

$$C_{SHRUB,t} = \frac{44}{12} \times CF_s \times (1 + R_s) \times \sum_i A_{SHRUB,i} \times b_{SHRUB,i}$$

$$b_{SHRUB,i} = BDR_{SF} \times b_{FOREST} \times CC_{SHRUB,i}$$

Where;

$\Delta C_{SHRUB,t}$	= Change in carbon stock in shrubs within project boundary in year t between times t_1 and t_2; t CO_2e
$C_{SHRUB,t2}$	= Carbon stock in shrubs within project boundary at time t2*;* t CO_2e
$C_{SHRUB,t1}$	= Carbon stock in shrubs within project boundary at time t1*;* t CO_2e
T	= Time elapsed between two successive estimations; yr
$C_{SHRUB,t}$	= Carbon stock in shrubs within project at given point of time in year t; t CO_2e
CF_S	= Carbon fraction of shrub biomass: t C (t. d.m.)$^{-1}$
R_S	= Root-shoot ratio for the shrubs in the baseline; dimensionless
$b_{SHRUB,i}$	= Shrub biomass per ha in shrub biomass estimation stratum i; t d.m. ha^{-1}
$A_{iSHRUB,i}$	= Area of shrub biomass estimation stratum *i;* ha
BDR_{SF}	= Ratio of shrub biomass per ha in land having a shrub crown cover of 1.0 & the default above-ground biomass content per ha in forest in the region/country; dimensionless
b_{FOREST}	= Default above-ground biomass content in forest in region/ country; t d.m. ha^{-1}
$CC_{SHRUB,i}$	= Crown cover of shrubs in shrub biomass estimation stratum i at the time of estimation, expressed as a fraction

Steady state under Baseline conditions:

Since the baseline net GHG removals by sinks are greater than zero, it will be estimated using above equations until a steady state is reached. Under steady state

$$\Delta C_{BSL} = 0$$

The proposed project has selected a default period of 20 years since the project commenced as the time taken to reach a steady state.

Table B.9. Annual estimation of baseline net anthropogenic GHG removals by sinks

Year	**Annual estimation of baseline net GHG removals by sinks; t CO_2-e**
2008	1603
2009	1603
2010	1603
2011	1603
2012	1603

2013	1603
2014	1603
2015	1603
2016	1603
2017	1603
2018	1603
2019	1603
2020	1603
2021	1603
2022	1603
2023	1603
2024	1603
2025	1603
2026	1603
2027	1603
2028	0.00
2029	0.00
2030	0.00
2031	0.00
2032	0.00
2033	0.00
2034	0.00
2035	0.00
2036	0.00
2037	0.00
Total estimated baseline net GHG removals by sinks; t CO_2-e	32060
Total number of crediting years	30
Annual average over the crediting period of estimated baseline net GHG removals by sinks; t CO_2-e	1069

IPCC values were used in equation 3.2.5 because of the unavailability of local data. PP used following values from the referred tables as mentioned in the table. The values signed for tropical and subtropical, Moist with Short Dry Season and values for broad leaf trees were used b as the most appreciated vales for this project (Rubber trees in the tropics, moist with short dry seasons).

Data variable	Data unit	Value applied	Data source
Default average annual increment of above-ground biomass in forest in the region/country where the A/R CDM project is located (ΔB_{FOREST})	td.m./ha/year	3.0	Table 3A.1.5 of IPCC GPG-LULUCF 2003
Root-shoot ratio appropriate for biomass increment (R_{TREE_BSL})	td.m./t/d.m.	0.83	Table 3A.1.8 of IPCC GPG-LULUCF 2003
Carbon fraction of tree biomass in the baseline (CF_{TREE_BSL})	t C t^{-1} d.m.	0.47	Methodological tool: Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities (Version 04.1)

Actual net GHG removals by sinks were calculated as follows:

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$$ Equation (2)

Where

$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$GHG_{E,t}$	=	Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year *t*, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

The verifiable changes in the carbon stock in above-ground and below-ground biomass (since only these were selected as carbon pools) within the project boundary were estimated using the following equations.

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t}$$ Equation (3)

Where

$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	=	Change in carbon stock in tree biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{SHRUB\_PROJ,t}$	=	Change in carbon stock in shrub biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	=	Change in carbon stock in dead wood in project in year *t*, Not included in the carbon pool under the conservative approach under applicability condition
$\Delta C_{LI\_PROJ,t}$	=	Change in carbon stock in litter in project in year *t*, Not included in the carbon pool under the conservative approach under applicability condition
$\Delta SOC_{AL,t}$	=	Change in carbon stock in SOC in project, in year *t*, in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; t CO_2-e

Leakage emissions was estimated as follows:

$$LK_t = LK_{AGRIC,t}$$ Equation (4)

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 in the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity"; t CO_2-e

The net anthropogenic GHG removals by sinks shall be calculated as follows:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$ Equation (5)

Where:

$\Delta C_{AR-CDM,t}$	=	Net anthropogenic GHG removals by sinks, in year t; t CO_2-e
$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year t; t CO_2-e
$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks, in year t; t CO_2-e
LK_t	=	GHG emissions due to leakage, in year t; t CO_2-e

The tCERs and lCERs for a verification period T = $t_2 - t_1$, (where t_1 and t_2 are the years of the start and the end, respectively, of the verification period) shall be calculated as follows:

$$tCER_{t_2} = \sum_{1}^{t_2} \Delta C_{AR-CDM,t}$$ Equation (6)

$$lCER_{t_2} = \sum_{t_1+1}^{t_2} \Delta C_{AR-CDM,t}$$ Equation (7)

Where:

$tCER_{t_2}$	=	Number of units of temporary Certified Emission Reductions issuable in year t_2
$lCER_{t_2}$	=	Number of units of long-term Certified Emission Reductions issuable in year t_2
$\Delta C_{AR-CDM,t}$	=	Net anthropogenic GHG removals by sinks, in year t; t CO_2-e
t_1, t_2	=	The years of the start and the end, respectively, of the verification period

B.7.2. Data and parameters fixed ex ante

Data / Parameter	BEF_2
Unit	Dimensionless
Description	Biomass expansion factor for conversion of stem biomass to above-ground tree biomass for rubber
Source of data	IPCC GPG-LULUCF, 2003 Table 3A.1.10
Value(s) applied	1,2
Choice of data or Measurement methods and procedures	IPCC default values allow using 2 for tree species in the tropical climatic zone if the diameter at breast height (dbh) is more than 10 cm. The dbh for rubber trees is less than 10 cm until the 3rd year and therefore have used BEF_2 = 1 for calculations up to the 3rd year. BEF_2 = 2 was used as per IPCC guidelines for 4th year onwards.
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	
Data / Parameter	BDR_{SF}
Unit	Dimensionless
Description	Ratio of biomass per hectare in land having a shrub crown cover of 1.0 (i.e. 100%) and the default above-ground biomass content in forest in the region/country where the A/R CDM project is located
Source of data	A default value of 0.10 should be used unless transparent and verifiable information can be provided to justify a different value
Value(s) applied	0.1
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	
Data / Parameter	B_{FOREST}
Unit	t d.m. ha^{-1}
Description	Default above-ground biomass content in forest in the region/country where the A/R CDM project is located
Source of data	IPCC GPG-LULUCF, 2003 Table 3A.1.4
Value(s) applied	31
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	
Data / Parameter	ΔB_{FOREST}
Unit	t d.m. $ha^{-1} year^{-1}$
Description	Default average annual increment in above-ground biomass in forest in the region/country where the A/R CDM project is located
Source of data	IPCC GPG-LULUCF, 2003 Table 3A.1.5
Value(s) applied	3

Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	
Data / Parameter	D_j
Unit	t d.m. m^{-3}
Description	Density (overbark) of tree stem for rubber
Source of data	IPCC GPG-LULUCF, 2003 Table 3A.1.9-2
Value(s) applied	0.53
Choice of data or Measurement methods and procedures	Default value
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	
Data / Parameter	R_J
Unit	Dimensionless
Description	Root-shoot ratio for tree species *j*
Source of data	IPCC GPG-LULUCF, 2003 Table 4A.4
Value(s) applied	0.43, 0.26
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	
Data / Parameter	R_S
Unit	Dimensionless
Description	Root-shoot ratio for shrubs
Source of data	Table 4.4 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied	0.4
Choice of data or Measurement methods and procedures	-
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data and parameters measured:

Data / Parameter	$A_{PLOT,i}$
Unit	Ha
Description	Area of sample p in stratum i
Source of data	Field measurement
Value(s) applied	1

Choice of data or Measurement methods and 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, are applied
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	Sample plot location is registered with a GPS and marked on the project map.
Data / Parameter	$A_{SHRUB,i,t}$
Unit	ha
Description	Area of shrub biomass stratum i at a given point of time in year t
Source of data	Field measurement
Value(s) applied	415.03
Choice of data or Measurement methods and procedures	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In the absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	
Data / Parameter	$CC_{SHRUB,i,t}$
Unit	Dimensionless
Description	Crown cover of shrubs in shrub biomass stratum i at a given point of time in year t
Source of data	
Value(s) applied	0.5
Choice of data or Measurement methods and procedures	When land is subjected to periodic slash-and-burn practices in the baseline, an average shrub crown cover equal to default value of 0.5 is used unless transparent and verifiable information can be provided to justify a different value
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	
Data / Parameter	$CC_{TREE\_BSL,i,t}$
Unit	Dimensionless
Description	Crown cover of trees in the baseline, in baseline stratum i, expressed as a fraction (e.g. 10% crown cover implies $CC_{TREE\_BSL,i,t}$ = 0.10)
Source of data	
Value(s) applied	0.04
Choice of data or Measurement methods and procedures	Considering that the biomass in trees in the baseline is smaller compared to the biomass in trees in the project, a simplified method of measurement may be used for estimating tree crown cover. Ocular estimation of tree crown cover may be carried out or any other method such as the line transect method or the relascope method may be applied
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	
Data / Parameter	$V_{TREE,j,p,i,t}$
Unit	m^3
Description	Stem volume of trees of species j in sample plot p of stratum i at a

	point of time in year t calculated using a volume table or volume equation
Source of data	Field measurements of tree parameters (such as DBH, H, etc.) measured in sample plot p of stratum i at a given point of time in year t
Value(s) applied	
Choice of data or Measurement methods and procedures	A volume table or volume equation is a table or an equation that predicts tree stem volume on the basis of one or more measurements of a tree.
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	
Data / Parameter	$x1_{p,i,t}$, $x2_{p,i,t}$, $x3_{p,i,t}$
Unit	Unit of parameter such as length (cm)
Description	Often tree parameters such as tree height and diameter at breast height of the tree, but other tree parameters could be used (e.g. basal diameter, root-collar diameter, basal area, etc.) that are applicable for the model or data source used
Source of data	Field measurements in sample plots. For ex ante estimations, values should be estimated using a growth curve, a growth model, or a yield table that gives the expected tree dimensions as a function of tree age
Value(s) applied	
Choice of data or Measurement methods and procedures	
Purpose of data	
Additional comment	
Data / Parameter	T
Unit	Year
Description	Time period elapsed between two successive estimations of carbon stock in trees and shrubs
Source of data	Recorded time
Value(s) applied	
Choice of data or Measurement methods and procedures	N/A
Purpose of data	
Additional comment	
Data / Parameter	Volume table or equation
Unit	m^3
Description	Volume table or volume equation is a table or an equation that predicts tree stem volume on the basis of one or more measurements of a tree (e.g. DBH and/or tree height)

Source of data	For ex ante estimation table or equation applicable to a tree species is selected from the following sources (the most preferred source being listed first): (a) Existing data applicable to local situation (e.g. represented by similar ecological conditions); (i) National data (e.g. from national forest inventory or national GHG inventory); (ii) Data from neighbouring countries with similar conditions; (iii) Globally applicable data. For ex post estimation, the volume table or equation used must be demonstrated to be appropriate for the purpose of estimation of tree biomass by applying the tool "Demonstrating appropriateness of volume equations for estimation of aboveground tree biomass in A/R CDM project activities"
Value(s) applied	
Choice of data **or** **Measurement methods and procedures**	
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

B.7.3. Ex ante calculation of net anthropogenic GHG removals by sinks
>>
Actual net GHG removals by sinks

As per 'Guidance on accounting GHG emissions in A/R CDM project activities' Part I and II (Extract of the report of the EB 42 meeting of the Executive Board, paragraph 35 and Extract of the report of the EB 44 meeting of the Executive Board, paragraph 37) GHG emissions 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.

Actual net GHG removals by sinks were calculated using the following equations from AR-ACM0003. A conservative approach was used in making estimates for values. Therefore;

$$\Delta C_{ACTUAL,t} = \Delta C_{P,t} - GHG_{E,t}$$

Where

$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year t; t CO_2-e
$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year t; t CO_2-e
$GHG_{E,t}$	=	Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t, as estimated in the tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity"; t CO_2-e

The verifiable changes in the carbon stock in above-ground and below-ground biomass (since only these were selected as carbon pools) within the project boundary were estimated using the following equations.

$$\Delta C_{P,t} = \Delta C_{TREE\_PROJ,t} + \Delta C_{SHRUB\_PROJ,t} + \Delta C_{DW\_PROJ,t} + \Delta C_{LI\_PROJ,t} + \Delta SOC_{AL,t}$$

Where

$\Delta C_{P,t}$	=	Change in the carbon stocks in project, occurring in the selected carbon pools, in year *t*; t CO_2-e
$\Delta C_{TREE\_PROJ,t}$	=	Change in carbon stock in tree biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{SHRUB\_PROJ,t}$	=	Change in carbon stock in shrub biomass in project in year *t*, as estimated in the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities"; t CO_2-e
$\Delta C_{DW\_PROJ,t}$	=	Change in carbon stock in dead wood in project in year *t*, Not included in the carbon pool under the conservative approach under applicability condition
$\Delta C_{LI\_PROJ,t}$	=	Change in carbon stock in litter in project in year *t*, Not included in the carbon pool under the conservative approach under applicability condition
$\Delta SOC_{AL,t}$	=	Change in carbon stock in SOC in project, in year *t*, in areas of land meeting the applicability conditions of the tool "Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities", as estimated in the same tool; t CO_2-e

Evidence collected both by the project participants and village chief from all villages have been collected. These documents prove that the land belonging to the project activity has had slash and burn practice and continuous fire prior to the project start date. Further it has been proven that the baseline scenario was not a fire-adopted ecosystem. The above documents further states that the valuable timber of these lands has been cut both by the Government and local communities prior to 31st December 1989. Further the project participant have provided documents stating that there have been illegal timber felling of the lands belonging to the project within the last 10 years.

Latest version of the tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities" (Version 04.1) was used.

Calculating the change in carbon stock in tree biomass in project in each year:

Biomass of trees of species j in sample plot p was estimated as:

$$B_{TREE,j,p,i,t} = V_{TREE,j,p,i,t} \times D_j \times BEF_{2,j} \times (1 + R_j)$$

Where:

$B_{TREE,j,p,i,t}$ = Biomass of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*; t dry matter (d.m.)

$V_{TREE,j,p,i,t}$ = Stem volume of trees of species *j* in sample plot *p* of stratum *i* at a point of time in year *t*, estimated by using the tree dimension(s) as entry data into a volume table or volume equation; m^3
D_j = Density (overbark) of tree species *j*; t d.m. m-3
$BEF_{2,j}$ = Biomass expansion factor for conversion of stem biomass to above-ground tree biomass, for tree species *j*; dimensionless
R_j = Root-shoot ratio for tree species *j*; dimensionless
j = 1, 2, 3, … tree species in plot *p*
p = 1, 2, 3, … sample plots in stratum *i*

The tree biomass in sample plot p of stratum i was estimated as follows:

$$B_{TREE,p,i,t} = \sum_j B_{TREE,j,p,i,t}$$

Where:
$B_{TREE,p,i,t}$ = Tree biomass in sample plot *p* in stratum *i* at a given point of time in year *t*; t d.m.
$B_{TREE,j,p,i,t}$ = Biomass of trees of species *j* in sample plot *p* of stratum *i* at a given point of time in year *t*; t d.m.
j = 1, 2, 3, … species in plot *p*
p = 1, 2, 3, … sample plots in stratum *i*
i = 1, 2, 3, … strata used for tree biomass estimation within the project boundary
t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

Since rubber is the only species, $B_{TREE,j,p,i,t} = B_{TREE,p,i,t}$. Tree biomass per hectare in plot *p* in stratum *i* was estimated as follows:

$$b_{TREE,p,i,t} = \frac{B_{TREE,p,i,t}}{A_{PLOT,i}}$$

Where:
$b_{TREE,p,i,t}$ = Tree biomass per hectare in sample plot *p* in stratum *i* at a given point of time in year *t*; t d.m. ha^{-1}
$B_{TREE,p,i,t}$ = Tree biomass in sample plot *p* in stratum *i* at a given point of time in year *t*; t d.m.
$A_{PLOT,,i}$ = Area of sample plot *p* in stratum *i*; ha
p = 1, 2, 3, … sample plots in stratum *i*
i = 1, 2, 3, … tree biomass estimation strata within the project boundary
t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

Mean tree biomass per hectare in stratum *i* and the variance of tree biomass per hectare in the stratum was estimated as follows:

$$b_{TREE,i,t} = \frac{\sum_{p=1}^{n_i} b_{TREE,p,i,t}}{n_i}$$

Where:
$b_{TREE,i,t}$ = Mean tree biomass per hectare in stratum *i* at a given point of time in year *t*; t d.m. ha^{-1}
$b_{TREE,p,i,t}$ = Tree biomass per hectare in sample plot *p* in stratum *i* at a given point of time in year *t*; t d.m. ha^{-1}
p = 1, 2, 3, … sample plots in stratum *i*

i = 1, 2, 3, … tree biomass estimation strata within the project boundary
t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

Mean tree biomass per hectare within the project boundary and its variance was estimated as follows:

$$b_{TREE,t} = \sum_{i=1}^{M} w_i \times b_{TREE,i,t}$$

Where:
$b_{TREE,t}$ = Mean tree biomass per hectare within the project boundary at a given point of time in year *t*; t d.m. ha^{-1}
w_i= Ratio of the area of stratum *i* to the sum of areas of biomass estimation strata; dimensionless
$b_{TREE,i,t}$ = Mean tree biomass per hectare in stratum *i* at a given point of time in year *t*; t d.m. ha^{-1}
M = Number of tree biomass estimation strata within the project boundary
p = 1, 2, 3, … sample plots in stratum *i*
i = 1, 2, 3, … tree biomass estimation strata within the project boundary
t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

For the ex-ante calculations stratums were chosen according to the area of planting. Table B.10 presents each stratum and the area of each stratum.

Table B.10 Area planted in each year

Stratum number	Area of stratum *i* (ha)
i = 1	A_1 = 507.28
i = 2	A_2 = 55.43
i = 3	A_3 = 406.49

Table B.11: Mean tree biomass per hectare in stratum i_1

Year	Year	Stem volume of trees of species j in sample plot p of stratum i_3 at a point of time in year t; m^3	Biomass Expansion Factor for species *j*	Basic Wood density of species *j* (t d.m./m^3)	Root to shoot ratio of species *j* (t d.m./t d.m.)	Biomass of trees of species j in sample plot p of stratum i_1 at a point of time in year t; t dry matter (d.m.)	Tree biomass in sample plot p in stratum i_1 at a given point of time in year t; t d.m.	Area of sample plot p in stratum i_1	Tree biomass per hectare in sample plot p in stratum i_1 at a given point of time in year t; t d.m. ha^{-1}	Number of sample plots in stratum i_1	Mean tree biomass per hectare in stratum i_1 at a given point of time in year t; t d.m. ha^{-1}
	t	$V_{TREE,j,p,i,t}$	$BEF_{2,j}$	D_j	R_j	$B_{TREE,j,p,i,t}$	$B_{TREE,p,i,t}$	$A_{plot,i}$	$b_{TREE,p,i,t}$	n_i	$b_{TREE,i,t}$
2008	1	0.19	1	0.53	0.43	0.14	0.14	1	0.14	1	0.14
2009	2	1.82	1	0.53	0.43	1.38	1.38	1	1.38	1	1.38
2010	3	9.08	1	0.53	0.43	6.88	6.88	1	6.88	1	6.88
2011	4	27.84	2	0.53	0.43	42.20	42.20	1	42.20	1	42.20
2012	5	30.28	2	0.53	0.43	45.89	45.89	1	45.89	1	45.89

2013	6	71.08	2	0.53	0.26	94.93	94.93	1	94.93	1	94.93
2014	7	96.40	2	0.53	0.26	128.75	128.75	1	128.75	1	128.75
2015	8	117.54	2	0.53	0.26	156.99	156.99	1	156.99	1	156.99
2016	9	139.67	2	0.53	0.26	186.54	186.54	1	186.54	1	186.54
2017	10	156.79	2	0.53	0.26	209.41	209.41	1	209.41	1	209.41
2018	11	174.01	2	0.53	0.26	232.41	232.41	1	232.41	1	232.41
2019	12	185.42	2	0.53	0.26	247.65	247.65	1	247.65	1	247.65
2020	13	203.22	2	0.53	0.26	271.43	271.43	1	271.43	1	271.43
2021	14	221.86	2	0.53	0.26	296.32	296.32	1	296.32	1	296.32
2022	15	233.24	2	0.53	0.26	311.52	311.52	1	311.52	1	311.52
2023	16	245.22	2	0.53	0.26	327.51	327.51	1	327.51	1	327.51
2024	17	257.26	2	0.53	0.26	343.60	343.60	1	343.60	1	343.60
2025	18	262.06	2	0.53	0.26	350.00	350.00	1	350.00	1	350.00
2026	19	274.12	2	0.53	0.26	366.12	366.12	1	366.12	1	366.12
2027	20	282.34	2	0.53	0.26	377.09	377.09	1	377.09	1	377.09
2028	21	292.54	2	0.53	0.26	390.72	390.72	1	390.72	1	390.72
2029	22	304.12	2	0.53	0.26	406.18	406.18	1	406.18	1	406.18
2030	23	317.59	2	0.53	0.26	424.18	424.18	1	424.18	1	424.18
2031	24	333.52	2	0.53	0.26	445.45	445.45	1	445.45	1	445.45
2032	25	352.50	2	0.53	0.26	470.80	470.80	1	470.80	1	470.80
2033	26	375.19	2	0.53	0.26	501.10	501.10	1	501.10	1	501.10
2034	27	404.42	2	0.53	0.26	540.15	540.15	1	540.15	1	540.15
2035	28	435.84	2	0.53	0.26	582.11	582.11	1	582.11	1	582.11
2036	29	474.52	2	0.53	0.26	633.77	633.77	1	633.77	1	633.77
2037	30	520.46	2	0.53	0.26	695.12	695.12	1	695.12	1	695.12

Table B.12: Mean tree biomass per hectare in stratum i_2

Year	Year	Stem volume of trees of species j in sample plot p of stratum i_3 at a point of time in year t; m^3	Biomass Expansion Factor for species *j*	Basic Wood density of species *j* (t d.m./ m^3)	Root to shoot ratio of species *j* (t d.m./t d.m.)	Biomass of trees of species j in sample plot p of stratum i_2 at a point of time in year t; t dry matter (d.m.)	Tree biomass in sample plot p in stratum i_2 at a given point of time in year t; t d.m.	Area of sample plot p in stratum i_2	Tree biomass per hectare in sample plot p in stratum i_2 at a given point of time in year t; t d.m. ha^{-1}	Number of sample plots in stratum i_2	Mean tree biomass per hectare in stratum i_2 at a given point of time in year t; t d.m. ha^{-1}
	t	$V_{TREE,j,p,i,t}$	$BEF_{2,j}$	D_j	R_j	$B_{TREE,j,p,i,t}$	$B_{TREE,p,i,t}$	$A_{plot,i}$	$b_{TREE,p,i,t}$	n_i	$b_{TREE,i,t}$
2008	1	0.00	1	0.53	0.43	0.00	0.00	1	0.00	1	0.00
2009	2	0.19	1	0.53	0.43	0.14	0.14	1	0.14	1	0.14
2010	3	1.82	1	0.53	0.43	1.38	1.38	1	1.38	1	1.38
2011	4	9.08	2	0.53	0.43	13.77	13.77	1	13.77	1	13.77

2012	5	27.84	2	0.53	0.43	42.20	42.20	1	42.20	1	42.20
2013	6	30.28	2	0.53	0.43	45.89	45.89	1	45.89	1	45.89
2014	7	71.08	2	0.53	0.26	94.93	94.93	1	94.93	1	94.93
2015	8	96.40	2	0.53	0.26	128.75	128.75	1	128.75	1	128.75
2016	9	117.54	2	0.53	0.26	156.99	156.99	1	156.99	1	156.99
2017	10	139.67	2	0.53	0.26	186.54	186.54	1	186.54	1	186.54
2018	11	156.79	2	0.53	0.26	209.41	209.41	1	209.41	1	209.41
2019	12	174.01	2	0.53	0.26	232.41	232.41	1	232.41	1	232.41
2020	13	185.42	2	0.53	0.26	247.65	247.65	1	247.65	1	247.65
2021	14	203.22	2	0.53	0.26	271.43	271.43	1	271.43	1	271.43
2022	15	221.86	2	0.53	0.26	296.32	296.32	1	296.32	1	296.32
2023	16	233.24	2	0.53	0.26	311.52	311.52	1	311.52	1	311.52
2024	17	245.22	2	0.53	0.26	327.51	327.51	1	327.51	1	327.51
2025	18	257.26	2	0.53	0.26	343.60	343.60	1	343.60	1	343.60
2026	19	262.06	2	0.53	0.26	350.00	350.00	1	350.00	1	350.00
2027	20	274.12	2	0.53	0.26	366.12	366.12	1	366.12	1	366.12
2028	21	282.34	2	0.53	0.26	377.09	377.09	1	377.09	1	377.09
2029	22	292.54	2	0.53	0.26	390.72	390.72	1	390.72	1	390.72
2030	23	304.12	2	0.53	0.26	406.18	406.18	1	406.18	1	406.18
2031	24	317.59	2	0.53	0.26	424.18	424.18	1	424.18	1	424.18
2032	25	333.52	2	0.53	0.26	445.45	445.45	1	445.45	1	445.45
2033	26	352.50	2	0.53	0.26	470.80	470.80	1	470.80	1	470.80
2034	27	375.19	2	0.53	0.26	501.10	501.10	1	501.10	1	501.10
2035	28	404.42	2	0.53	0.26	540.15	540.15	1	540.15	1	540.15
2036	29	435.84	2	0.53	0.26	582.11	582.11	1	582.11	1	582.11
2037	30	474.52	2	0.53	0.26	633.77	633.77	1	633.77	1	633.77

Table B.13: Mean tree biomass per hectare in stratum i_3

Year	Year	Stem volume of trees of species j in sample plot p of stratum i_3 at a point of time in year t; m^3	Biomass Expansion Factor for species *j*	Basic Wood density of species *j* (t d.m./m^3)	Root to shoot ratio of species *j* (t d.m. /t d.m.)	Biomass of trees of species j in sample plot p of stratum i_3 at a point of time in year t; t dry matter (d.m.)	Tree biomass in sample plot p in stratum i_3 at a given point of time in year t; t d.m.	Area of sample plot p in stratum i_3	Tree biomass per hectare in sample plot p in stratum i_3 at a given point of time in year t; t d.m. ha^{-1}	Number of sample plots in stratum i_3	Mean tree biomass per hectare in stratum i_3 at a given point of time in year t; t d.m. ha^{-1}
	t	$V_{TREE,j,p,i,t}$	$BEF_{2,j}$	D_j	R_j	$B_{TREE,j,p,i,t}$	$B_{TREE,p,i,t}$	$A_{plot,i}$	$b_{TREE,p,i,t}$	n_i	$b_{TREE,i,t}$
2008	1	0.00	1	0.53	0.43	0.00	0.00	1	0.00	1	0.00

2009	2	0.00	1	0.53	0.43	0.00	0.00	1	0.00	1	0.00
2010	3	0.19	1	0.53	0.43	0.14	0.14	1	0.14	1	0.14
2011	4	1.82	2	0.53	0.43	2.76	2.76	1	2.76	1	2.76
2012	5	9.08	2	0.53	0.43	13.77	13.77	1	13.77	1	13.77
2013	6	27.84	2	0.53	0.43	42.20	42.20	1	42.20	1	42.20
2014	7	30.28	2	0.53	0.43	45.89	45.89	1	45.89	1	45.89
2015	8	71.08	2	0.53	0.26	94.93	94.93	1	94.93	1	94.93
2016	9	96.40	2	0.53	0.26	128.75	128.75	1	128.75	1	128.75
2017	10	117.54	2	0.53	0.26	156.99	156.99	1	156.99	1	156.99
2018	11	139.67	2	0.53	0.26	186.54	186.54	1	186.54	1	186.54
2019	12	156.79	2	0.53	0.26	209.41	209.41	1	209.41	1	209.41
2020	13	174.01	2	0.53	0.26	232.41	232.41	1	232.41	1	232.41
2021	14	185.42	2	0.53	0.26	247.65	247.65	1	247.65	1	247.65
2022	15	203.22	2	0.53	0.26	271.43	271.43	1	271.43	1	271.43
2023	16	221.86	2	0.53	0.26	296.32	296.32	1	296.32	1	296.32
2024	17	233.24	2	0.53	0.26	311.52	311.52	1	311.52	1	311.52
2025	18	245.22	2	0.53	0.26	327.51	327.51	1	327.51	1	327.51
2026	19	257.26	2	0.53	0.26	343.60	343.60	1	343.60	1	343.60
2027	20	262.06	2	0.53	0.26	350.00	350.00	1	350.00	1	350.00
2028	21	274.12	2	0.53	0.26	366.12	366.12	1	366.12	1	366.12
2029	22	282.34	2	0.53	0.26	377.09	377.09	1	377.09	1	377.09
2030	23	292.54	2	0.53	0.26	390.72	390.72	1	390.72	1	390.72
2031	24	304.12	2	0.53	0.26	406.18	406.18	1	406.18	1	406.18
2032	25	317.59	2	0.53	0.26	424.18	424.18	1	424.18	1	424.18
2033	26	333.52	2	0.53	0.26	445.45	445.45	1	445.45	1	445.45
2034	27	352.50	2	0.53	0.26	470.80	470.80	1	470.80	1	470.80
2035	28	375.19	2	0.53	0.26	501.10	501.10	1	501.10	1	501.10
2036	29	404.42	2	0.53	0.26	540.15	540.15	1	540.15	1	540.15
2037	30	435.84	2	0.53	0.26	582.11	582.11	1	582.11	1	582.11

According to AR-ACM 0003 the stem volume of Rubber tree was based on available data and research studies both from the project participant and regional institutes. A detailed estimation of volume of rubber tree is presented in Appendix.

Total tree biomass within the project boundary at a given point of time in year *t* was estimated as follows:

$$B_{TREE,t} = A \times b_{TREE,t}$$

Where:
$B_{TREE,t}$ = Total tree biomass within the project boundary at a given point of time in year *t*; t d.m.
A = Sum of areas of the biomass estimation strata within the project boundary; ha
$b_{TREE,t}$ = Mean tree biomass per hectare within the project boundary at a given point of time in year *t*; t d.m. ha^{-1}
t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

Carbon stock in tree biomass within the project boundary at a given point of time in year *t* was estimated as follows:

$$C_{TREE,t} = \frac{44}{12} \times B_{TREE,t} \times CF_{TREE}$$

Where:

$C_{TREE,t}$ = Carbon stock in tree biomass within the project boundary at a given point of time in year *t*; t CO_{2-e}

$B_{TREE,t}$ = Total tree biomass within the project boundary at a given point of time in year *t*; t d.m.

CF_{TREE} = Carbon fraction of tree biomass; t C t d.m.$^{-1}$

t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

Change in carbon stock in trees is calculated assuming that the rate of change of tree biomass over a period of time is calculated assuming a linear growth. Therefore, the rate of change in carbon stock in tree biomass over a period of time was calculated as follows:

$$\Delta C_{TREE,t} = \frac{C_{TREE,t_2} - C_{TREE,t_1}}{T} \times 1\ year$$

Where:

$\Delta C_{TREE,t}$ = Change in carbon stock in trees within the project boundary in year *t*;t CO_{2-e}

$C_{TREE,t2}$ = Carbon stock in tree biomass within the project boundary at a point of time in year t_2; t CO_{2-e}

$C_{TREE,t1}$ = Carbon stock in tree biomass within the project boundary at a point of time in year t_1; t CO_{2-e}

T = Time elapsed between two successive estimations ($T=t_2 - t_1$); yr

Table B.14. Change in carbon stock in tree biomass within the project boundary

Year	Year	Mean tree biomass per hectare within the project boundary at a given point of time in year t; t d.m. ha^{-1}	Sum of areas of the biomass estimation strata within the project boundary; ha	Total tree biomass within the project boundary at a given point of time in year t; t d.m.	Carbon fraction of tree biomass; t C t d.m^{-1}	Carbon stock in tree biomass within the project boundary at a given point of time in year t; t CO_2-e	Change in carbon stock in tree biomass within the project boundary in year t; t CO_2-e	Change in carbon stock in tree biomass in project in year t; t CO_2-e
	t	$b_{TREE,t}$	A	$B_{TREE,t}$	CF_{TREE}	$C_{TREE,t}$	$\Delta C_{TREE,t}$	$\Delta C_{TREE\_PROJ,t}$
2008	1	0.07	507.28	37.55	0.47	64.72	64.72	64.72
2009	2	0.73	562.71	411.23	0.47	708.68	643.97	643.97
2010	3	3.74	969.2	3625.44	0.47	6247.85	5539.16	5539.16
2011	4	24.03	969.2	23293.47	0.47	40142.41	33894.56	33894.56
2012	5	32.21	969.2	31215.92	0.47	53795.43	13653.02	13653.02
2013	6	70.01	969.2	67856.16	0.47	116938.77	63143.34	63143.34
2014	7	92.06	969.2	89227.65	0.47	153768.99	36830.21	36830.21
2015	8	129.35	969.2	125361.84	0.47	216040.24	62271.25	62271.25
2016	9	160.61	969.2	155663.17	0.47	268259.54	52219.30	52219.30
2017	10	186.12	969.2	180383.43	0.47	310860.77	42601.23	42601.23
2018	11	211.86	969.2	205331.61	0.47	353854.81	42994.04	42994.04
2019	12	230.74	969.2	223635.31	0.47	385398.18	31543.37	31543.37
2020	13	253.70	969.2	245888.82	0.47	423748.40	38350.22	38350.22

2021	14	274.48	969.2	266029.44	0.47	458457.41	34709.01	34709.01
2022	15	293.83	969.2	284784.52	0.47	490778.66	32321.25	32321.25
2023	16	313.51	969.2	303858.41	0.47	523649.32	32870.67	32870.67
2024	17	329.23	969.2	319085.97	0.47	549891.49	26242.17	26242.17
2025	18	340.20	969.2	329726.07	0.47	568227.92	18336.43	18336.43
2026	19	355.75	969.2	344795.59	0.47	594197.73	25969.81	25969.81
2027	20	365.10	969.2	353855.67	0.47	609811.27	15613.54	15613.54
2028	21	379.62	969.2	367928.07	0.47	634062.70	24251.43	24251.43
2029	22	393.09	969.2	380986.97	0.47	656567.55	22504.85	22504.85
2030	23	409.11	969.2	396513.68	0.47	683325.24	26757.70	26757.70
2031	24	427.76	969.2	414588.04	0.47	714473.39	31148.15	31148.15
2032	25	449.80	969.2	435941.32	0.47	751272.20	36798.81	36798.81
2033	26	476.03	969.2	461364.47	0.47	795084.77	43812.57	43812.57
2034	27	508.83	969.2	493156.29	0.47	849872.67	54787.90	54787.90
2035	28	545.74	969.2	528926.62	0.47	911516.87	61644.20	61644.20
2036	29	591.55	969.2	573330.77	0.47	988040.03	76523.16	76523.16
2037	30	644.22	969.2	624376.12	0.47	1076008.18	87968.15	87968.15

Calculating the change in carbon stock in shrub biomass in project in each year:

Change in carbon stock in shrub biomass within the project boundary in year t ($t_1 < t < t_2$) was calculated as follows:

$$\Delta C_{SHRUB,t} = dC_{SHRUB,(t_1,t_2)} \times 1\ year \text{ for } t_1 \le t \le t_2$$

Where:
$\Delta C_{SHRUB\_BSL,t}$ = Change in carbon stock in shrub biomass within the project boundary in year t; t CO_{2-e}
$dC_{SHRUB,(t1,t2)}$ = Rate of change in carbon stock in shrub biomass within the project boundary during the period between a point of time in year t_1 and a point of time in year t_2; t CO_{2-e} yr^{-1}
t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

The rate of change of shrub biomass over a period of time is estimated as follows:

$$dC_{SHRUB,(t_1,t_2)} = \frac{C_{SHRUB,t_2} - C_{SHRUB,t_1}}{T}$$

$dC_{SHRUB,(t1,t2)}$ = Rate of change in carbon stock in shrub biomass within the project boundary during the period between a point of time in year t_1 and a point of time in year $t2$; t CO_{2-e} yr^{-1}
$C_{SHRUB,t2}$ = Carbon stock in shrub biomass within the project boundary at a point of time in year t_2; t CO_{2-e}
$C_{SHRUB,t1}$ = Carbon stock in shrub biomass within the project boundary at a point of time in year t_1; t CO_{2-e}
T = Time elapsed between two successive estimations ($T=t_2 - t_1$); yr
t 1, 2, 3, … years counted from the start of the A/R CDM project activity

Shrub biomass per hectare ($B_{SHRUB,i,t}$) was estimated as follows:
(a) For those areas where the shrub crown cover is less than 5 per cent, the shrub biomass per hectare is considered negligible and hence accounted as zero;
(b) For those areas where the shrub crown cover is 5 per cent or more, shrub biomass per hectare is estimated as follows:

$$B_{SHRUB,i,t} = BDR_{SF} \times B_{FOREST} \times CC_{SHRUB,i,t}$$

$B_{SHRUB,i,t}$ = Shrub biomass per hectare in shrub biomass stratum *i*, at a given point of time in year *t*; t d.m. ha^{-1}
BDR_{SF} = Ratio of shrub biomass per hectare in land having a shrub crown cover of 1.0 and default above-ground biomass content per hectare in forest in the region/country where the A/R CDM project is located; dimensionless
B_{FOREST} = Default above-ground biomass content in forest in the region/country where the A/R CDM project is located; t d.m. ha^{-1}
$CC_{SHRUB,i,t}$ = Crown cover of shrubs in shrub biomass stratum *i* at a given point of time in year *t* expressed as a fraction (e.g. 10% crown cover implies $_{SHRUB\,i\,t}CC_{,\,,}$ = 0.10); dimensionless
t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

Carbon stock in shrub biomass within the project boundary at a given point of time in year *t* was calculated as:

$$C_{SHRUB,t} = \frac{44}{12} \times CF_S \times (1 + R_S) \times \sum_i A_{SHRUB,i,t} \times B_{SHRUB,i,t}$$

Where:
$C_{SHRUB,t}$ = Carbon stock in shrub biomass within the project boundary at a given point of time in year *t*; t $CO_{2\text{-}e}$
CF_S = Carbon fraction of shrub biomass; t C $(t.d.m.)^{-1}$ IPCC default value of 0.47 t C $(t.d.m.)^{-1}$ is used
R_S = Root-shoot ratio for shrubs; dimensionless
$A_{SHRUB,i,t}$ = Area of shrub biomass stratum *i* at a given point of time in year *t*; ha
$B_{SHRUB,i,t}$ = Shrub biomass per hectare in shrub biomass stratum *i* at a given point of time in year *t*; t d.m. ha^{-1}
i = 1, 2, 3, … shrub biomass strata delineated on the basis of shrub crown cover
t = 1, 2, 3, … years counted from the start of the A/R CDM project activity

For t = 1,2,3….30 the area of shrub biomass ($A_{SHRUB,i,t}$) = 0.

Therefore for t = 1,2,3….30 $\Delta C_{SHRUB,t} = 0$

Calculating the change in carbon stock in SOC (soil organic carbon) in project in each year:

The initial SOC stock at the start of the project was estimated as follows:

$$SOC_{INITIAL,i} = SOC_{REF,i} * f_{LU,i} * f_{MG,i} * f_{IN,i}$$

Where:
$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the areas of land; t C ha^{-1}
$SOC_{REF,i}$ = Reference SOC stock corresponding to the reference condition in native lands by climate region and soil type applicable to stratum *i* of the areas of land; t C ha^{-1}
$f_{LU,i}$ = Relative stock change factor for baseline land-use in stratum *i* of the areas of land; dimensionless
$f_{MG,i}$ = Relative stock change factor for baseline management regime in stratum *i* of the areas of land; dimensionless
$f_{IN,I}$ = Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum *i* of the areas of land; dimensionless
i 1, 2, 3, . strata of areas of land; dimensionless

Loss of SOC caused by soil disturbance attributable the A/R CDM project activity was estimated as follows:

$$SOC_{LOSS,i} = SOC_{INITIAL,i} * 0.1$$

Where:
$SOC_{LOSS,i}$ = Loss of SOC caused by soil disturbance attributable the A/R CDM project activity, in stratum *i* of the areas of land; t C ha^{-1}
0.1 = The approximate proportion of SOC lost within the first five years from the year of site preparation
i 1, 2, 3, . strata of areas of land; dimensionless

The rate of change in SOC stock in project scenario until the steady-state SOC content is reached was estimated as follows:

$$dSOC_{t,i} = 0 \quad \text{for } t < t_{PREP,i}$$

$$dSOC_{t,i} = -\frac{SOC_{LOSS,i}}{1\ year} \quad \text{for } t = t_{PREP,i}$$

$$dSOC_{t,i} = \frac{SOC_{REF,i} - (SOC_{INITIAL,i} - SOC_{LOSS,i})}{20\ years} \quad \text{for } t_{PREP,i} < t \leq t_{PREP,i} + 20$$

Where:
$dSOC_{t,i}$ = The rate of change in SOC stock in stratum *i* of the areas of land, in year *t*; t C ha^{-1} yr^{-1}
$t_{PREP,i}$ = The year in which first soil disturbance takes place in stratum *i* of the areas of land
$SOC_{LOSS,i}$ = Loss of SOC caused by soil disturbance attributable the A/R CDM project activity, in stratum *i* of the areas of land; t C ha^{-1}
$SOC_{REF,i}$ = Reference SOC stock corresponding to the reference condition in native lands by climate region and soil type applicable to stratum *i* of the areas of land; t C ha^{-1}
$SOC_{INITIAL,i}$ = SOC stock at the beginning of the A/R CDM project activity in stratum *i* of the areas of land; t C ha^{-1}
i = 1, 2, 3, . strata of areas of land; dimensionless
t = 1, 2, 3, . years elapsed since the start of the A/R CDM project activity

If $dSOC_{t,i} > 0.8$ t C ha^{-1} yr^{-1} then $dSOC_{t,i} = 0.8$ t C ha^{-1} yr^{-1}

The change in SOC stock for all the strata of the areas of land, in year *t*, was calculated as:

$$\Delta SOC_{AL,t} = \frac{44}{12} * \sum_i A_i * dSOC_{t,i} * 1 year$$

Where:
$\Delta SOC_{AL,t}$ = Change in SOC stock in areas of land meeting the applicability conditions of this tool, in year *t*; t CO_2-e
A_i The area of stratum *i* of the areas of land; ha
$dSOC_{t,i}$ = The rate of change in SOC stocks in stratum *i* of the areas of land; t C ha^{-1} yr^{-1}
i = 1, 2, 3, . strata of areas of land; dimensionless

Table B.15: Changes in carbon stock in soil organic matter

Year	Year	The rate of change in SOC stock in stratum i of the areas of land, in year t; t C ha^{-1} yr^{-1}	The rate of change in SOC stock in stratum i of the areas of land, in year t; t C ha^{-1} yr^{-1}	The rate of change in SOC stock in stratum i of the areas of land, in year t; t C ha^{-1} yr^{-1}	The area of stratum i=1 of the areas of land; ha	The area of stratum i=2 of the areas of land; ha	The area of stratum i=3 of the areas of land; ha	Change in carbon stock in SOC in project, in year t; t CO_2-e
	t	$dSOC_{t,1}$	$dSOC_{t,2}$	$dSOC_{t,3}$	A_1	A_2	A_3	$\Delta SOC_{AL,t}$
2008	1	0.80	0.00	0.00	507.28	0	0	1488.02
2009	2	0.80	0.80	0.00	507.28	55.43	0	1650.62
2010	3	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2011	4	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2012	5	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2013	6	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2014	7	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2015	8	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2016	9	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2017	10	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2018	11	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2019	12	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2020	13	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2021	14	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2022	15	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2023	16	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2024	17	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2025	18	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2026	19	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2027	20	0.80	0.80	0.80	507.28	55.43	406.49	2842.99
2028	21	0.21	0.80	0.80	507.28	55.43	406.49	1739.24
2029	22	0.21	0.21	0.80	507.28	55.43	406.49	1618.63
2030	23	0.21	0.21	0.21	507.28	55.43	406.49	734.18
2031	24	0.21	0.21	0.21	507.28	55.43	406.49	734.18
2032	25	0.21	0.21	0.21	507.28	55.43	406.49	734.18
2033	26	0.21	0.21	0.21	507.28	55.43	406.49	734.18
2034	27	0.21	0.21	0.21	507.28	55.43	406.49	734.18
2035	28	0.21	0.21	0.21	507.28	55.43	406.49	734.18
2036	29	0.21	0.21	0.21	507.28	55.43	406.49	734.18
2037	30	0.21	0.21	0.21	507.28	55.43	406.49	734.18

Leakage:

According to the methodology AR-ACM0003: Afforestation and reforestation of lands except wetlands (Version 02.0) leakage shall be calculated as follows:

$$LK_t = LK_{AGRIC,t}$$ Equation (8)

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 in the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity"; t CO_2-e

Leakage due to the displacement of agricultural activities in year *t*, shall be estimated using the tool "Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity (Version 02.0)". However under the village land allocation program lands within the project area were not agricultural land or pastoral land. The villagers have separate lands for grazing activities and also the historical evidence shows that these lands were not used for grazing. Grazing is not a common practice within the project boundary hence there will be no displacement of grazing activities within the project area.

The District Land Management Authority has confirmed that the land used for the project is specifically under Depleted and Underutilized category (dated 07.05.2008). Also the developer has agreed with land owners to implement the project as an agro-forestry system where villagers can use the land for their agricultural activities if they want. Therefore by this, the developer has ensured that there will be no leakages or local communities will have to clear forests from other areas for their activities.

The local communities may collect a limited amount of fuel from the project sites. Dead wood and some living branch biomass from the AR-CDM project activity can continue to be collected by local farmers as fuelwood without compromising the growth of rubber trees established under the project. Thus, as a result of the project activities, local farmers will not have to collect additional fuelwood on lands outside the project boundary.

Therefore leakage from the project activity is zero.

Non-CO_2 GHG emissions resulting from burning of biomass

Emission of non-CO_2 GHGs resulting from burning of biomass and forest fires within the project boundary is determined using the A/R Methodological Tool "Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity" (Version 04.0.0). Emission resulting from use of fire in site preparation is the only aspect of emission of non-CO_2 GHGs resulting from burning of biomass and forest fires within the project boundary.

$$GHG_{E,t} = GHG_{SPF,t} + GHG_{FMF,t} + GHG_{FF,t}$$

Where;

$GHG_{E,t}$	= Emission of non-CO_2 GHGs resulting from burning of biomass and forest fires within the project boundary in year t; tCO_2-e
$GHG_{SPF,t}$	= Emission of non-CO_2 GHGs resulting from use of fire in site preparation in year t; tCO_2-e

$GHG_{FMF,t}$ = Emission of non-CO_2 GHGs resulting from use of fire to clear the land of harvest residue prior to replanting of the land or other forest management in year t; tCO_2-e
$GHG_{FF,t}$ = Emission of non-CO_2 GHGs resulting from fire in year t; tCO_2-e
t = 1,2,3………years counted from the start of the AR CDM project activity

Emission resulting from use of fire in site preparation
According to the tool, For all areas of land where: (i) Slash-and-burn is a common practice in the baseline, and (ii) Fire has been used in the area at least once during the period of ten years preceding the start of the A/R CDM project activity ($GHG_{spf,t}$) = 0. Slash and burn is a common practice in the baseline. The Letter issued by District Land Management Authority on 03.02.2010 has been submitted to DOE. It mentions that these lands are identified as degraded and underutilized. The lands were heavily slashed and burned by the local people for many years. Subsequently due to these lands were abandoned for 5 to 10 years. Therefore, Emission of non CO_2 GHGs resulting from use of fire in site preparation within the project boundary is zero.

$GHG_{SPF,t} = 0$

Non-CO_2 emissions resulting from use of fire to clear the land of harvest residue prior to replanting of the land
The proposed project involved reforestation of depleted and under-utilized land and therefore cannot be considered as a replanting activity. Furthermore since there is no use of fire to clear the land of harvest residue prior to replanting, $GHG_{FMF,t} = 0$

Non-CO_2 emissions resulting from forest fires
Emission of GHGs resulting from the burning of aboveground project tree biomass in fire that is not site preparation or burning of harvest residue (defined from this point forward as forest fire) shall be calculated using the aboveground biomass in trees and dead wood of relevant strata in last verification.

$$GHG_{FF,t} = GHG_{FF\_TREE,t} + GHG_{FF\_DOM,t}$$

Where;
$GHG_{FF,t}$ = Emission of non-CO_2 GHGs resulting from forest fire, in year t; t CO_2-e
$GHG_{FF\_TREE,t}$ = Emission of non-CO_2 GHGs resulting from the loss of above-ground biomass of trees due to forest fire, in year t; t CO_2-e
$GHG_{FF\_DOM,t}$ = Emission of non-CO_2 GHGs resulting from the loss of dead organic matter due to forest fire, in year t; t CO_2-e

Emission of non-CO_2 GHGs resulting from the loss of dead organic matter due to fire is calculated using the dead organic matter stock at the last verification. However since PP has selected not to account for dead organic matter pool, the dead organic matter stock shall be considered zero and non-CO_2 GHG emissions from fire are not accounted.

Therefore ex-ante Emission of non-CO_2 GHGs resulting from burning of biomass and forest fires = zero

The net anthropogenic GHG removals by sinks shall be calculated as follows:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t \qquad \text{Equation (9)}$$

Where

$\Delta C_{AR-CDM,t}$	=	Net anthropogenic GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{ACTUAL,t}$	=	Actual net GHG removals by sinks, in year *t*; t CO_2-e
$\Delta C_{BSL,t}$	=	Baseline net GHG removals by sinks, in year *t*; t CO_2-e
LK_t	=	GHG emissions due to leakage, in year *t*; t CO_2-e

The tCERs and lCERs for a verification period T = $t_2 - t_1$, (where t_1 and t_2 are the years of the start and the end, respectively, of the verification period) shall be calculated as follows:

$$tCER_{t_2} = \sum_{1}^{t_2} \Delta C_{AR-CDM,t}$$ Equation (10)

$$lCER_{t_2} = \sum_{t_1+1}^{t_2} \Delta C_{AR-CDM,t}$$ Equation (11)

Where:

$tCER_{t_2}$	=	Number of units of temporary Certified Emission Reductions issuable in year t_2
$lCER_{t_2}$	=	Number of units of long-term Certified Emission Reductions issuable in year t_2
$\Delta C_{AR-CDM,t}$	=	Net anthropogenic GHG removals by sinks, in year *t*; t CO_2-e
t_1, t_2	=	The years of the start and the end, respectively, of the verification period

If $lCER_{t2} < 0$ then $lCER_{t2}$ represents the number of *lCERs* that shall be replaced because of a reversal of net anthropogenic greenhouse gas removals by sinks since the previous certification.

B.7.4. Summary of ex ante estimates of GHG removals by sinks

Year	Baseline net GHG removals by sinks (tCO_2e)	Actual net GHG removals by sinks (tCO_2e)	Leakage (tCO_2e)	Net anthropogenic GHG removals by sinks (tCO_2e)	Cumulative net anthropogenic GHG removals by sinks (tCO_2e)
2008	1603	1553	0	-50	-50
2009	1603	2295	0	692	642
2010	1603	8382	0	6779	7421
2011	1603	36738	0	35135	42556
2012	1603	16496	0	14893	57449
2013	1603	65986	0	64383	121832
2014	1603	39673	0	38070	159903
2015	1603	65114	0	63511	223414
2016	1603	55062	0	53459	276873
2017	1603	45444	0	43841	320715
2018	1603	45837	0	44234	364949
2019	1603	34386	0	32784	397732
2020	1603	41193	0	39590	437323
2021	1603	37552	0	35949	473272
2022	1603	35164	0	33561	506833
2023	1603	35714	0	34111	540944
2024	1603	29085	0	27482	568426
2025	1603	21179	0	19577	588003
2026	1603	28813	0	27210	615213
2027	1603	18457	0	16854	632067
2028	0	25991	0	25991	658057
2029	0	24123	0	24123	682181
2030	0	27492	0	27492	709673
2031	0	31882	0	31882	741555
2032	0	37533	0	37533	779088
2033	0	44547	0	44547	823635
2034	0	55522	0	55522	879157
2035	0	62378	0	62378	941535
2036	0	77257	0	77257	1018792
2037	0	88702	0	88702	1107495
Total	32057	1139552	0	1107495	
Total number of crediting years	30				
Annual average over the crediting period	1069	37985	0	36916	

B.8. Monitoring plan

B.8.1. Data and parameters to be monitored be monitored

Monitoring will be organized according to Section 06 of AR-ACM0003. All the data that are mentioned in this section will be collected and archived electronically and kept for 2 years after the end of last crediting period.

Project Boundary

Keeping records of the project boundary is one of the most important activities during monitoring. The geographic coordinates of the project boundary and all stratifications within the project have been established and will be recorded. Field surveys using GPS, satellite images and land use maps have been used in this activity.

This activity will be done throughout the project period to ensure there are no errors in the definition of the project boundary. The project participant has a GIS expert who will be coordinating this section. There will be two staff members working with him in recording proper boundaries.

Data / Parameter	$A_{PLOT,i}$ (1.1.1.01)
Unit	ha
Description	Area of a sample plot in stratum *i*
Source of data	Field measurement
Value(s) applied	$A_{PLOT,1} = A_{PLOT,2} = A_{PLOT,3} = 1$
Measurement methods and procedures	Standard operating procedures (SOPs) prescribed under national forest inventory are applied.
Monitoring frequency	At every verification
QA/QC procedures	Quality control/quality assurance (QA/QC) procedures developed by PP using the prescribed national forest inventory are applied
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	$A_{SHRUB,i}$ (1.1.1.02)
Unit	ha
Description	Area of shrub in stratum *i*
Source of data	Field measurement
Value(s) applied	415.03
Measurement methods and procedures	Quality control/quality assurance (QA/QC) procedures developed by PP using the prescribed national forest inventory are applied
Monitoring frequency	At every verification
QA/QC procedures	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied
Purpose of data	Calculation of baseline net GHG removals by sinks;
Additional comment	

Data / Parameter	A_i (1.1.1.03)
Unit	ha
Description	Area of stratum i
Source of data	Field measurement
Value(s) applied	A_1 = 507.28, A_2 = 55.43, A_3 = 406.49
Measurement methods and procedures	Standard operating procedures (SOPs) prescribed under national forest inventory are applied.
Monitoring frequency	At every verification
QA/QC procedures	Quality control/quality assurance (QA/QC) procedures developed by PP using the prescribed national forest inventory are applied
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	$CC_{SHRUB,i}$ (1.1.1.04)
Unit	Dimensionless
Description	Crown cover of shrubs in shrub biomass stratum i
Source of data	Field measurement
Value(s) applied	0.5
Measurement methods and procedures	Considering that the biomass in shrubs is smaller than the biomass in trees, a simplified method of measurement may be used for estimating shrub crown cover. Ocular estimation of crown cover may be carried out or any other method such as the line transect method or the relascope method may be applied
Monitoring frequency	At every verification
QA/QC procedures	Quality control/quality assurance (QA/QC) procedures developed by PP using the prescribed national forest inventory are applied
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	When land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the shrub crown cover oscillates between a minimum and maximum values in the baseline, an average shrub crown cover equal to 0.5 is used unless transparent and verifiable information can be provided to justify a different value

Data / Parameter	$CC_{TREE\_BSL,i}$ (1.1.1.05)
Unit	Dimensionless
Description	Crown cover of trees in the baseline stratum i
Source of data	Field measurement
Value(s) applied	0.04
Measurement methods and procedures	Considering that the biomass in trees in the baseline is smaller compared to the biomass in trees in the project, a simplified method of measurement may be used for estimating tree crown cover. Ocular estimation of tree crown cover may be carried out or any other method such as the line transect method or the relascope method may be applied
Monitoring frequency	Measured only once (at the beginning of the project)
QA/QC procedures	Quality control/quality assurance (QA/QC) procedures developed by PP using the prescribed national forest inventory are applied
Purpose of data	Calculation of baseline net GHG removals by sinks
Additional comment	When land is subjected to periodic cycles (e.g. slash-and-burn, or clearing-regrowing cycles) so that the tree crown cover oscillates between a minimum and maximum values in the baseline, the value of this parameter should be set equal to half the maximum tree crown cover that would be achieved under the cycle

Data / Parameter	DBH (1.1.1.06)
Unit	cm
Description	Diameter breast height of tree
Source of data	Field measurement
Value(s) applied	
Measurement methods and procedures	Standard measurement in forest inventory. Measured in all trees within the plots with a diameter tape
Monitoring frequency	5 years
QA/QC procedures	Will be measured 100% in sample plots and verified in 10% of them
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	H (1.1.1.07)
Unit	m
Description	Height of tree
Source of data	Field measurement
Value(s) applied	
Measurement methods and procedures	Field measurement in sample plots. For *ex ante* estimations, mean *H* values have been estimated for rubber tree using growth models and yield tables.
Monitoring frequency	5 years
QA/QC procedures	Will be measured 100% in sample plots and verified in 10% of them
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	N (1.1.1.08)
Unit	Dimensionless
Description	Number of trees in sample tree plot
Source of data	Field measurement
Value(s) applied	
Measurement methods and procedures	Counted in plot measurement
Monitoring frequency	5 years
QA/QC procedures	Will be measured 100% in sample plots and verified in 10% of them
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	$V_{TREE,j,p,i,t}$ (1.1.1.09)
Unit	m^3 $tree^{-1}$
Description	Stem volume of tree (*ex-post*)
Source of data	Field measurements of tree parameters (such as DBH, H, etc.) measured in sample plot p of stratum i at a given point of time in year t
Value(s) applied	
Measurement methods and procedures	Calculated using allometric equations using diameter at breast height (*DBH)* and tree height (*H)* measured in plots
Monitoring frequency	5 years
QA/QC procedures	
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	

Data / Parameter	PL_i (1.1.1.10)
Unit	Dimensionless
Description	Plot number belonging to each land owner
Source of data	
Value(s) applied	
Measurement methods and procedures	Measured and record the coordinates using a GPS each time a land owner join the project
Monitoring frequency	5 years
QA/QC procedures	
Purpose of data	Calculation of actual net GHG removals by sinks
Additional comment	Each plot of every farmer who joins the project will be recorded and monitored.

Data / Parameter	Boundary (1.1.1.11)
Unit	Numeric
Description	Boundary of Planting area
Source of data	
Value(s) applied	
Measurement methods and procedures	Measured using GPS
Monitoring frequency	Start of the project and once in every 5 years
QA/QC procedures	
Purpose of data	
Additional comment	The project boundary will be monitored at the start of the project, during validation and once in every 5 years. Any changes will be recorded and will notify the DOE.

B.8.2. Sampling plan and stratification
>>
The stratification of the project was done by year of planting. Such stratification was selected to increase the measuring precision without increasing unnecessary costs. *Ex ante* stratification map have been prepared by the GIS personal of the project participant and is presented in the PDD (Figure B.1).

For *ex ante* stratification the strata are as follows:
Strata 1: 2008 planting
Strata 2: 2009 planting
Strata 3: 2010 planting

Further changes in *ex ante* stratificiation due to implementation of the planting activities and/or management shall be reported and revised strata will be identified. Any anthropogenic or natural impacts that impact such stratification shall be reported.

- *Ex post* stratification

Ex post stratification will be studied and evaluated during each monitoring exercise. The reasons will be:

- Unexpected disturbances that may occur during the crediting period (e.g. rain, fire, winds, pest attacks) that would affect differently to each stratum.
- Forest management activities (weeding, planting, replanting etc.,) that may affect the existing stratification.

Such changes within the project will be recorded and reported to the DOE during verification. The project will adopt the following sampling framework.

- Sampling framework

The number of samples and sample size was determined using “Calculation of the number of sample plots for measurements within A/R CDM project activities (Version 02.1.0)”.

Initial estimate of number of plots is done with targeted precision level for biomass estimation within each stratum at +/- 10% of the mean at a 90% confidence level. The number of required plots (n) was calculated using the following equation:

$$n = \frac{N * t_{VAL}^{2} * \left(\sum_{i} w_i * s_i \right)^2}{N * E^2 + t_{VAL}^{2} * \sum_{i} w_i * s_i^{2}}$$

Where;

n	Number of sample plots required for estimation of biomass stocks within the project boundary; dimensionless
N	Total number of possible sample plots within the project boundary (i.e. the sampling space or population); dimensionless
t_{VAL}	Two-sided Student's t-value, at infinite degrees of freedom with 90% confidence level; dimensionless
w_i	Relative weight of the area of stratum *i* (i.e. the area of stratum *i* divided by project area); dimensionless
si	Estimated standard deviation of biomass stock in stratum *i*; t d.m. (or t d.m. ha^{-1})
E	Acceptable margin of error 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 si
i	1,2,3,….. Biomass stock estimation strata within the project boundary

Total number of sample plots is 49.

The number of plots allocated to each stratum was calculated as follows;

$$n_i = n * \frac{w_i * s_i}{\sum_{i} w_i * s_i}$$

Where;

ni	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 stratum *i* divided by project area); dimensionless
si	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

Results are presented below:

Strata	Area (ha)	N	t_{VAL}	Relative weight of the area of stratum *i* (w_i)	Estimated standard deviation of biomass stock in stratum *i*; (t d.m. ha^{-1}) s_i	E (10%)	Number of sample plots
i = 1	507.28	24230	1.65	0.52	292.28	63.70	28
i = 2	55.43	24230	1.65	0.06	266.48	63.70	3

i = 3	406.49	24230	1.65	0.42	244.76	63.70	19

Sampling plot area: Circular plots of 0.1 ha (1000m^2) with radius of 17.84 m for all three strata will be laid out in order to make sure a minimum of 30 trees per plot. With the selected plot size a minimum of 30 trees per plot can be expected even at the end of project area (30 years).

B.8.3. Other elements of monitoring plan

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The QC and QA procedures under the project aim at implementing standard and methodical procedures for monitoring and collection of precise field measurements. Quality control (QC) and quality assurance (QA) procedures that will be applied to monitor actual GHG removals by sinks include (1) Collecting reliable field measurements and Precise field monitoring (2) Verifying methods used to collect field data using independent expert opinion; (3) Verifying data entry and analysis techniques using independent expert opinion ; and (4) Data maintenance and archiving.

(1) Collecting reliable field measurements and Precise field monitoring

A team consisting of members representing the entire project area was formed. This team involved in field monitoring will be carefully trained in data collection and analysis. Each team member has been assigned in duties related to monitoring actual GHG removal. Data collection will be conducted by a well trained team. Those responsible for the measurement work are trained in all aspects of the field data collection and data analyses. It is good practice to develop Standard Operating Procedures (SOPs) for each step of the field measurements, which will be adhered to at all times. These SOPs describe in detail all steps that should be taken in the field measurements and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent fashion.

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

(2) Verifying the methods used to collect field data

The data collected by the team will be verified by taking random checks from stands, including their re-measurement by a senior member of the monitoring team. In case of errors, they are corrected and recorded for each stratum.

(3) Verifying data entry and analysis techniques

Reliable carbon estimates will require proper entry of data into the data analysis spreadsheets. Possible errors in this process will be minimized by cross checking these entries of both field data and laboratory data. In order to ensure more precise output, internal tests will be incorporated into the spreadsheets to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data will be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot will not be used in the analysis.
Quantifying data is an important procedure and will be done accordingly.

(4) Data maintenance and achieving

Because of the relatively long-term nature of these project activities, data archiving (maintenance and storage) will be an important component of the work. Data archiving will take several forms and copies (electronic and paper) of all field data, data analyses, and models; estimates of the changes in carbon stocks and corresponding calculations and models used; any GIS products; and copies of the measuring and monitoring reports will be stored in a dedicated and safe place, preferably offsite. These monitored data will be achieved for 2 years following the end of the crediting period as well.

Sampling Design

- **Type of plots**

In order to monitor the project through time, permanent-sampling plots will be established and maintained. These will be managed in an identical way to the rest of the project, and will permit the most cost and labor effective form of forest monitoring.

- **Number of Plots**

Number of plots will be calculated using accepted formulae. Total number of sample plots is 49.

- **Location of sampling plots**

In order to avoid bias with regard to plot locations, permanent sample plots will be been located systematically with a random start. The geographical position (GPS coordinate), location, stratum and sub-stratum series number of each plot is recorded and archived. It is to be ensured that the sampling plots are distributed randomly.

- **Monitoring frequency**

Plantation establishment will be conducted from 2008 to 2010. Permanent plots will be monitored every five years to assess actual above and below ground biomass accumulation.

- **Measuring and estimating carbon stock changes over time**

Carbon stock changes in above- and below-ground biomass on each plot are estimated using Biomass Expansion Factors (BEF) method using IPCC data.

- **Stratification and sample size**

49 circular plots of 0.1 ha (1000m^2) with radius of 17.84 m will be established systematically with a random start for each strata based on the year of planting. Stratification for *ex ante* estimation of the actual net GHG removals by sinks was done according to the year of planting. Stratification for sampling will be the same as above. These plots will be monitored and the information will be collected and recorded.

- **Monitoring frequency**

First monitoring will be conducted in 2012 with subsequent monitoring interval of 5 years, i.e., in 2017, 2022, 2027, 2032 and 2037 respectively.

- **Measuring and estimating carbon stock changes over time**

Carbon stock changes over time will be measured according to the procedures above.

- **Monitoring GHG emissions by sources as the results of the A/R CDM project activity**

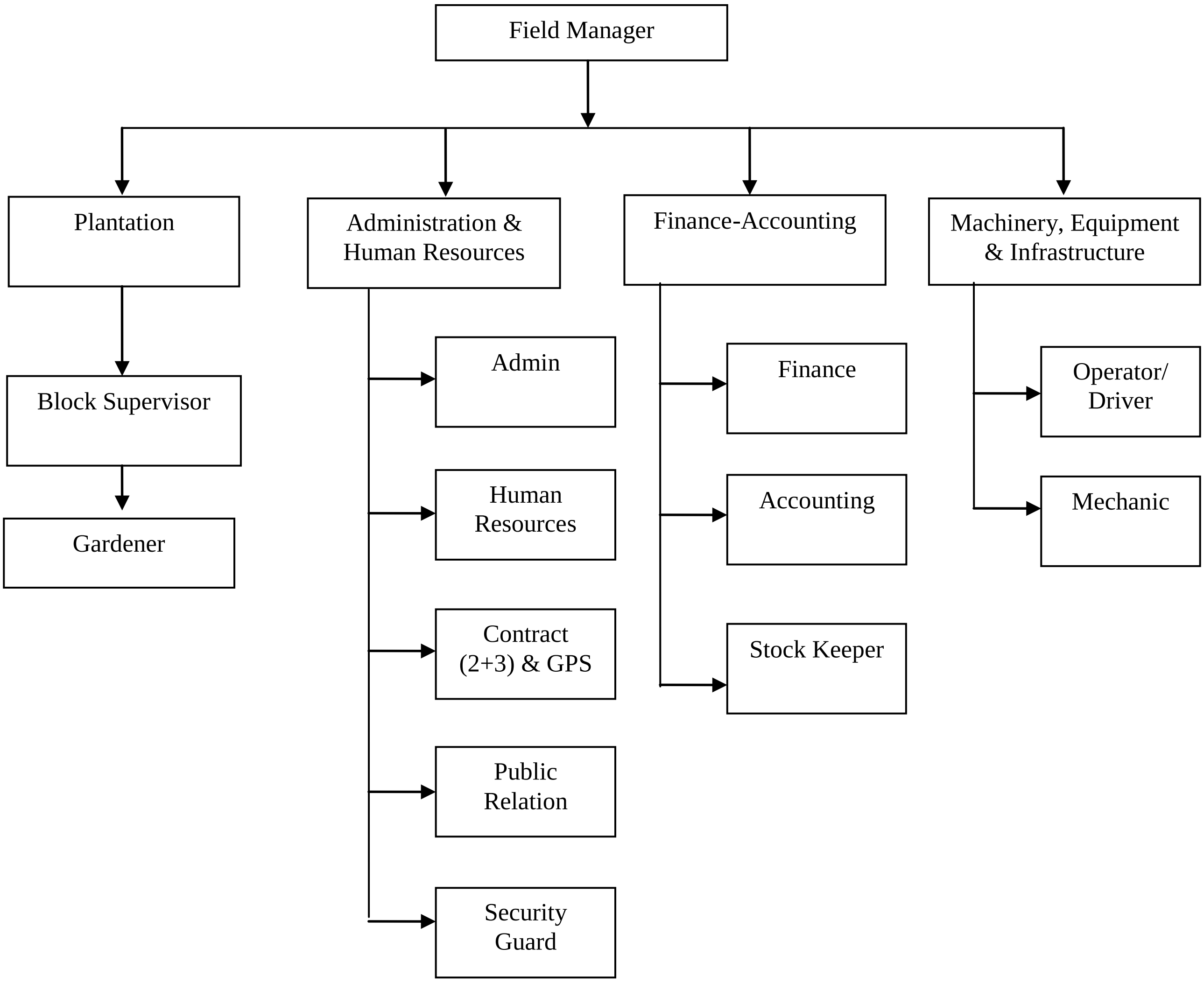
GHG emissions from the project will be monitored annually.

The Managing Director of LTR Co. Limited will be responsible for coordinating the AR-CDM project. The Field Manager will be responsible for providing technical services, including staff recruitment and training. He will also be supervising the implementation of the project activity, as well as organizing a team to carry out the monitoring of the project implementation performance and impacts, including measuring and monitoring of the actual GHG removals by sinks for all areas. The relevant information and data will be documented and archived in both electronic and paper copy. There will be a GIS expert and plantation expert for the project activity.

For each 100 ha there will be a Technical/Field Officer assigned. He will be responsible for the management of that area. Functions of them will be under the guidance of Field Manager. The Board of Directors of the LTR Co. Limited will regularly supervise the process through calling reports.

The LTR Co. Limited has also obtained the expert advisory service from Prime Consultancy Co. Ltd which is a specialized company for CDM and carbon trading for managing this CDM project. The company will provide technical consultation and training in the measuring and monitoring of the actual GHG removals by sinks and leakage generated by the project activity.

The Monitoring Plan which is in Appendix 05 presents the arrangements adopted in implementing and monitoring the project activities. The following diagram presents the management structure for the project activity.



The management structure of LTR has been included in Section E.7. The monitoring of the project will be done by the management mentioned in the diagram of Section E.7.

Name of person(s)/entity(ies) applying the monitoring plan
Mr. Saneu CHOUNRAMANY, Public Relations Director, Lao Thai Hua Rubber Co. Ltd
Mrs. Subin SAETIAO, Chief Financial Officer, Lao Thai Hua Rubber Co. Ltd
Mr. Chairoj THAMMARAT, Managing Director, Lao Thai Hua Rubber Co. Ltd
Mr. Sisamouth BOUNTHAL, Field Manager, Lao Thai Hua Rubber Co. Ltd

Rubber tree establishment and management

The planting of rubber trees will be done properly planned according to the Management Plan of LTR Co. Ltd. The plan has all the instructions on planting and there will be field records of the actual planting. Standard operating procedures (SOPS) and quality control/quality assurance (QC/QA) procedures for inventory including field data collection and data base management will be done as per approved methodology AR-ACM0003.

The project participants have prepared their own manual of SOPs and the top management will continuously monitor the field work.

- The sensitive areas such as river banks will not be planted with rubber. These areas will be kept as protective areas where indigenous species will be planted as enrichment planting. Special attention will be given to minimize soil erosion during site preparation and planting that involves soil disturbances that may increase soil erosion above the baseline scenario.
- Data on planting schedules, location, and number of plants will be noted by field manager and will be recorded. This practice will be done for all the age classes (2008, 2009 and 2010)
- The survival rate of the planted rubber trees will be studied after three months of planning and vacancy planting will be conducted. Reasons for mortality will be studied and noted. Plant mortality will be continuously monitored. If plants in certain areas within the project are not surviving at the 3rd year, such areas will be excluded from the boundary and will not be included for calculating carbon stocks.
- All the silvicultural practices done at the field will be recorded and achieved at the project data base for further reference.

SECTION C. Duration and crediting period

C.1. Duration of project activity

C.1.1. Start date of project activity

>>

1st June 2008

Project start date was considered the date of land clearance started. Planting was done about 1 month after the land clearing started.

C.1.2. Expected operational lifetime of project activity

>>

30 years and 00 months

C.2. Crediting period of project activity

C.2.1. Type of crediting period

>>

Fixed crediting period

C.2.2. Start date of crediting period

>>

1st June 2008

C.2.3. Length of credting period

>>

30 years

SECTION D. Environmental impacts

D.1. Analysis of environmental impacts

>>

According to the laws and regulations of Lao PDR it is essential to conduct an Initial Environment Examination (IEE) or an Environmental Impact Assessment (EIA) report for such projects. The project participants have complied by conducting an IEE and the report is available at the office of project participant. The positive and negative environmental impacts identified are presented below.

By implementing the project on degraded and abandoned lands, the project activity will increase the forest cover in the area. The environmental impacts of the project activities are minimized due to the environmentally friendly silvicultural methods practiced by project participant to preserve the environmental integrity of the area. These methods include: soil preparation techniques and monitoring of nutrients consumed in order to prevent erosion; minimum use of fertilizers as per the best practices in silviculture.

Anticipated positive environmental impacts are as follows;

(1) Increasing soil condition and preventing soil erosion

Soil condition prior to the project activity was poor. Soil erosion is common in these soils due to lack of soil conservation techniques. If the project had not been implemented, the lands would degrade further and the soil erosion would be severe. This project activity will improve soil condition in the lands.
The litter will be left on soil except a 1 m radius around each tree. Therefore this litter on soil will reduce the runoff thus improving soil condition and increase water retention.

(2) Promoting replanting as a sustainable business in the area.

People in the area have been used to slash and burn for generations thus replanting is not a common practice among them. This reforestation CDM project activity will encourage other investors who are willing to start reforestation projects but have barriers for such activities.

(3) Protecting watershed areas in surrounding areas.

There are many water streams flowing in the area. Increasing vegetation cover in the area will have a direct positive impact on water streams. Watershed areas and environmentally sensitive areas have been identified and enrichment planting with native species will be done in such areas.

(4) Increasing biological diversity

Although there are no rare or endangered species within the lands of project activity, increasing green cover will benefit fauna in the area. The practice of slash and burn in these areas will be prevented with this project. This will not only avoid GHG gases but also have direct impact on increasing the faunal and floral diversity both in project area and surrounding lands.

(5) Impact on climate change

There are many significant environmental credits of natural rubber resource such as ability to lock carbon both in biomass and rubber, rubber plantations functioning as self-sustaining eco-system (annual leaf fall, branches, fruits, twigs, root hairs), cultivation being less demanding on fertilizers and pesticides, promoting soil conservation, up keep of soil, ground water, water infiltration, scope for biodiversity (integration of other species in the inter-rows) being largely a smallholder crop for purposes of livelihood, is less profit driven exploitation of environment area. Rubber wood going into wood based furniture etc which are held in inert form for a considerable period of time and the woody portion remaining in the soil, decomposes in-situ etc., all in favour of natural resources.

D.2. Environmental impact assessment

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Rubber plantation is one of the efforts for the “Green Development” program expanding land for agricultural production and reflecting a transition from subsistence production based on shifting

cultivation to commercial production improving land fertility, speeding up organic fertilizer production, especially for ensuring initiatives in balancing the availability of organic fertilizers for agricultural production.
The project is totally complying with the country's environmental strategy and follows the proper guidelines and regulations. The project participants have had several discussions with the officers of Local Authority and Land Management of the Department of Forestry in the Province and local communities to identify environmentally friendly technologies practiced.

The IEE study has identified the following potential impacts;

1. Small quantities of biomass and soil may lose during project implementation
2. Waste may flow into surrounding water streams during the clearing phase of the project
3. Noise pollution may occur from vehicle and equipment during the operational stage of the project.

The report has identified above impacts as negligible and the project participants have taken necessary steps to minimize such impacts.

Another potential negative impact identified during baseline study is;

4. Risk of fire outbreak

The monitoring plan has included monitoring of proper forest management that will ensure least negative environmental impacts. Mitigatory measures for the negative impacts identified are given below:

Mitigatory and monitoring measures

(1) Site preparation:
Since the lands are degraded, disturbance by soil preparation for vegetation and soil will be negligible. However this will be carried out by professionally trained team under the guidance of field manager.

(2) Waste management:
The staff is not allowed to throw waste everywhere. Instead they will have to dispose the solid waste according to the instructions given by the management.

(3) Air and noise pollution prevention:
Air and noise pollutions due to the project have been identified as negligible in the IEE. However in order to control that, the vehicle and equipment will be serviced regularly to keep them in high efficiency. Manual labor will be used as much as possible to minimize any kind of vehicle emissions.

(4) Fire:
Firebreaks in all plantations have been established, a clean-weeded area of 6-8 m width will be opened around the plantation. Internal firebreaks within the plantation will be established. Firebreaks will be kept free of vegetation throughout the project period. During the dry seasons, patrolling and fire spotting will be conducted.

SECTION E. Socio-economic impacts

E.1. Analysis of socio-economic impacts

>>
A description about villages joining the project is presented in Appendix. The lands identified for the project are abandoned and/or underutilized areas which belong to 402 families in 4 villages in Pakkading district. There is no displacement occurring due to the project activity. Therefore surrounding communities have no objection in this project. In fact they have positive attitudes towards the AR-CDM project activity due to following reasons:

(1) Increase their income

This project is designed on the basis of the 2+3 model. Land and labour is provided by the villagers. Capital, technology and the market are provided by the project developer. This is a sustainable concept where all parties involved benefit. The project has embraced any villager who would like to work on the basis of this model. Low income families in the area will get more opportunities to increase their income. This will be a support for their livelihood. Before project start 73% live below the official poverty line. Incentives to workers will be provided during peak seasons. The project will in addition pay for land use/lease and taxes and contribute to the village funds.

(2) New employment opportunities

Skilled and unskilled labour will be needed for this project. The project creates direct employment opportunities in the establishment, maintenance, harvesting, and processing of the products throughout the project cycle in the project/villages area.

Previously many of youth in these villages have gone to neighbouring districts and countries such as Thailand, Vietnam for income generating employment. As a result in many cases only the children and older generation remained on their land. Reportedly due to this many youth stopped going to school at a young age. This situation has good potential to change due to newly created employment provided by the project. Youth would have the opportunity to both work and study to reach their potential.

The project developer will promote a working family model where both men and women can actively participate in the project. There are sufficient opportunities where women can work in the project. The social responsibility policy of the company will initially secure access to basic health services for the community as well as secure transport, grants etc for primary and secondary education. These actions also contribute towards a sustainable family lifestyle for the local communities.

(3) Knowledge on silvicultural techniques

The project activity will train employees on proper silvicultural methods that will be benefited by them for their future in career. Additional knowledge will be given to local communities in training on clearing of lands, making of compost production of micro-organisms for fertilizers (bio-fertilizers), and on techniques to establish and maintain agro-forestry plantations with highest levels of returns.

(4) Infrastructure development

Improvements to the infrastructure in the area are being carried out by the project participant. These include renovation and construction of road network, water supply, electricity, construction of village/district meeting hall, fish pond, well etc,. Apart from that the project is committed to consider any claims or feedbacks from the community so that it could respond to the real needs of the people.

The project developer will contribute 1.17 USD (10000 LAK)/ha/year for village fund in each village as additional infrastructure development.

Figure E.1 Community centre constructed by the project participant

(5) Health and Sanitation

The social responsibility policy of the company will initially secure access to basic health services for the community as well as secure transport, grants etc for primary and secondary education. However, in the long run, selected scholarships for higher education will be considered.

(6) Change in lifestyle

Overall the living standard of the villagers will improve from the project. Their livelihood changes from slash and burn practice to more stable employment.

The comments of the neighbouring communities are presented under Stakeholders' comments. There are no historically or culturally important places that would affect within the planting areas.

E.2. Socio-economic impact assessment

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Incorporated to the section E.1

SECTION F. Local stakeholders consultation

F.1. Solicitation of comments from local stakeholders

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Paragraph 12 (b), Annex of the Decision 5/CMP.1 Decision 5/CMP.1 "Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol" states that comments by local stakeholders have been invited, a summary of the comments received has been provided, and a report to the DOE on how due account was taken of any comments has been received.

In compliance with the above CDM rules, stakeholder consultations were conducted during the preparation of the project and continued throughout the implementation. The stakeholder consultations were in the form of formal and informal meetings and awareness programmes. Consultations were helpful in obtaining stakeholder comments.

There were stakeholders who directly benefit from the project (local communities). There were also stakeholders who indirectly involved in the project (government authorities) and who provide comments in order to ensure project implements in a sustainable manner (NGOs).

District officials from Pakkading District and village chiefs/villagers were extensively consulted during the preparation phase. The Vice Governor Mr. Langsy has been following the preparation phase closely.

The officers under him gave full support as the project area had been identified for rubber tree planting and would directly benefit the communities in the 4 village areas in terms of poverty reduction and infrastructure improvement.

During these meetings with local communities and employees brief description of the project was given by the management and the stakeholders' views about the project have been taken into account. The detailed lists of names of the participants for these meetings and the minuets are available in the all project offices. A notice prior to the meeting was prepared and displaced in the area. In addition to this, villagers were informed verbally by project developers. Stakeholders included labourers, surrounding communities including women and children, field manager, officers of Department of Environment, University lecturers and students from Faculty of Forestry of National University of Laos, CDM consultants and other management staff of the site.

Minutes of each meeting were taken by a member of staff and are documented. They will be presented to the DOE during validation. Stakeholders were requested to give their opinions and suggestion both verbally and in written. Open discussions were promoted since many of the labourers could not write.

The Lao DNA also conducted a stakeholder comments before issuing the letter of approval. They published the PDD on the following website and requested comments from stakeholders (http://www.mea.gov.la). This notification was on Vientiane Times dated 14th October 2009. The comments received were addressed by project developer. The comments received are presented under Stakeholders' comments. A site visit was also conducted by the DNA of Lao PDR prior to issuing the Letter of Approval.

F.2. Summary of the comments received

>>

Local communities had abandoned these lands several years ago due to their degraded condition. Their harvest from these lands was too low and was not economically viable. Therefore they were happy to get involved in a project that could re-employ their abandoned lands. They expressed their ideas about receiving an additional income from employment opportunities. Village chiefs expressed their support as villagers would receive jobs, training, land lease payments and social benefits. They further stated that the project would contribute to the village funds. Key point identified from local communities was that their livelihood was about to change from this project. They had been forced to practice slash and burn cultivation since the majority had no other option. Some of them even expressed their view of how slash and burn destroys the fauna and flora of the area. Another point highlighted was that the need for proper advice on planting techniques since they were not used to such practices. During the second meeting they highlighted that by additional working in the sites, their income have increased.

Some of the stakeholders did not have any idea about reforestation projects and they had only participated the initial meeting since they had been invited. They also feared that they would lose their livelihood from the new project activity. After the meetings, they expressed the importance of such meetings where they were able to gather information and also to clear out myths they had regarding such projects.

The Land Issues Working Group (LIWG) of INGO network in Lao PDR was concerned about actual benefit sharing from the project among villages. They also expressed their idea on how shifting cultivation (slash and burn) was important to communities. According to them, loss of slash and burn will result in decreased food security and increased economic poverty.

F.3. Report on consideration of comments received

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The comments received from the Land Issues Working Group (LIWG) of INGO network in Lao PDR were discussed at the consultation workshop organized by the Lao DNA on 25th January 2010. It was made clear to them that there will be no decrease in food security or increase in economic poverty since this project does not reduce land for agricultural activities. Evidence was provided to show the negative impacts of shifting cultivation and how the Government of Lao PDR is trying to reduce shifting cultivation in the country. Presently even the Government is promoting alternative livelihoods for farmers involved in shifting cultivation.

The comments received from the stake holders during meetings at Pakkading District reflected their opinion about such rubber projects. This further highlighted their interest in participating in such projects. As agreed by the developer, improvements of infrastructure of the area have been included as a part of the project activities. It was made clear to the local communities that they will not lose their land and the developer will only lease the land for a certain period of time in order to implement this AR CDM project. Developer also agreed to allow local communities to use the space between rubber plants for any kind of agricultural products thus creating an agro-forestry system.

The management will take the service of skilled labourers who are living in surrounding areas and also would provide technical know-how for unskilled labourers. Issues raised in particular meeting were addressed by the project developer during the following meeting where those were solved with all parties openly discussing.

There were no special issues raised by the stake holders against the project implementation. Lack of knowledge on CDM among the local people was the major issue that has been raised frequently. Project team was explained about the CDM and its role comprehensively. According to the minutes of stakeholder meetings, it is really mentioned by stake holders.

Stake holders wanted to know which kinds of benefits that can be gained by the project for them. Project participants were clearly aware the people about the benefits that can be gained by the stake holders.

SECTION G. Approval and authorization

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Appendix 1: Contact information of project participants

Organization:	Lao Thai Hua Rubber Company Limited
Street/P.O.Box:	P.O. Box: 3915 193 Sethathirath Road, Ban Kaoyod, Muang Sisattanak
Building:	
City:	Vientiane
State/Region:	Vientiane Capital
Postfix/ZIP:	
Country:	Lao PDR.
Telephone:	
FAX:	
E-Mail:	
URL:	www.laothaihua.com
Represented by:	
Title:	Public Relations Director
Salutation:	Mr.
Last Name:	CHOUNRAMANY
Middle Name:	
First Name:	Saneu
Department:	
Mobile:	+856 20 2455 886
Direct FAX:	+856 21 262 826
Direct tel:	+856 21 262 663
Personal E-Mail:	schounra@gmail.com

Appendix 2: Affirmation regarding public funding

No ODA (Official Development Assistance) funding will be used.

Norad

Direktoratet for utviklingssamarbeid
Norwegian Agency for Development Cooperation

Postadresse/ *Postal address:* Pb. 8034 Dep. NO-0030 OSLO, Norway
Kontoradresse/ *Office address:* Ruseløkkveien 26, Oslo
Telefon/ *Telephone:* +47 22 24 20 30 Faks/ *Fax:* +47 22 24 20 31
postmottak@norad.no, www.norad.no
Bankgiro/ *Bankaccount:* 6345.05.03012

Lao Thai Hua Rubber Co. Ltd.
P.O.Box 3915
Vientiane Capital

Arkivkode/ File no:

Vår ref./ Our ref.:

Deres/Dykkar ref./ Your ref.:

Vår saksbeh./ Enquiries:
brita naess

Dato/ Date:
03.05.2010

To whom it may concern

This is to confirm that the Norad grant in support of the CDM-LULUCE project *Rubber based agro-forestry system for sustainable development and poverty reduction* is not representing any diversion of ODA funds.

Yours sincerely,

Christian Fougner
Assistant Director
Department of Private Sector Development and the Environment

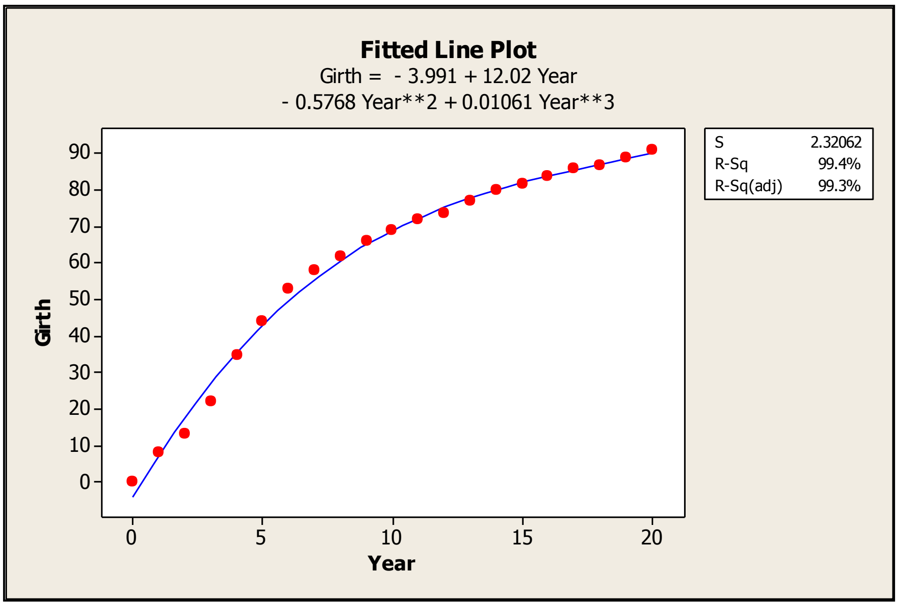
Appendix 3: Applicability of selected methodology

Appendix 3 is left intentionally blank, all information regarding to applicability of selected methodology is provided in section B.2

Appendix 4: Further background information on ex ante calculation of removals by sinks

Volume estimation of Rubber Tree

1. NAFRI in Lao PDR have conducted studies on growth of rubber tree. But these data are only for 4 (four) years. Data on height and diameter at breast height (DBH) were collected.
2. Girth at breast height (GBH) for 20 years was obtained from the project participant.
3. Polynomial Regression analysis was done using Minitab 14.0 for Girth versus Year of planting to obtain girth values between 21-30 years.



4. It was assumed that the rubber tree has a shape of cylinder during the first four years. The equation to calculate volume of a cylinder was used to estimate volume of rubber tree for first 4 years. .

$$Volume = \Pi * Radius^2 * Height$$

5. Since there were no growth models developed in Lao PDR to assess the volume of rubber tree regional growth models had to be used. The study done by Munasinghe et al (2008) "Development of a simple protocol for *in situ* assessment of timber, biomass and carbon in the rubber crop" was used.

Total timber volume (m^3) = -0.02 + 0.394 ($DBH^2 * H_t$)	-Model 1 (R^2=0.8984)
Total timber volume (m^3) = -0.13 + 9.87 DBH^2	- Model 2 (R^2=0.9131)

Model 2 was used in estimating tree volume since height data were not available for entire 30 year period.

6. Both results were combined to obtain volume of a rubber tree for a period of 30 years.
7. First five years was considered as establishment phase and rubber is planted at a density of 476 trees/ha. Any mortality during this establishment phase is refilled maintaining the standard density of 476 trees/ha.
8. From 6th year onwards, the mortality rate of (1%) was taken to estimate the tree density in each year.

Appendix 5: Further background information on monitoring plan

In accordance with decision 5/CMP.1, Section H, the project participant shall include a monitoring plan as part of the AR-PDD. This Monitoring Plan is prepared for the Rubber Reforestation CDM project activity, which proposes to generate net anthropogenic GHG removals by implementing sustainable Rubber plantations in 969.20 ha of land belonging to four villages (Huay Hai, Huay Phet, Nam Sang and Sonephansay village) that are currently degraded and abandoned lands.

This Monitoring Plan (MP) fulfils the CDM requirement that the project activity should have credible and accurate monitoring procedures to enable the evaluation of project performance and verification of the net anthropogenic GHG emission removals. It sets out a number of monitoring procedures that follow the provisions outlined in the Project Design Document and the Monitoring Methodology.

Objectives of the Monitoring Plan

This MP provides guidance on monitoring of project activity. It assists the project participant in establishing a reliable and transparent monitoring and operating procedures and facilitates data collection, recording and estimation of emission reduction and relevant project information required for the verification process.

Specific objectives of this plan are to;
• Guide on monitoring procedures of the reforestation activity and the associated responsibilities of each team member of the activity.
• Provide instructions on data collection, storage, and management information systems.
• Prepare proper spreadsheet database for recording data and estimation of the emissions and net GHG removals.
• Guide on monitoring environmental and socio-economic impacts that are anticipated from the project activity.

1. Monitoring of the baseline net GHG removals by sinks

According to AR-ACM0003 the baseline is determined *ex ante* and will remain fixed during the entire crediting period. Therefore no monitoring of the baseline is needed.

For *ex post* estimation of the actual net greenhouse gas removals by sinks stratification will be carried out according to the stratification done to *ex ante* estimations.

2. Monitoring the geographical boundary of the AR-CDM project activity

- Conduct field survey of the boundary of areas with actual tree planting in all areas.
- Measuring geographical positions (latitude and longitude of plot) using GPS.
- Configuration of the actual boundary.
- If the actual boundary falls outside of the designed boundary in section A, additional information for the part of lands that are outside the designed boundary in section A will be provided; the eligibility of these lands as a part of the AR-CDM project activity will be justified; and the projected baseline scenario will be demonstrated to be applicable to these lands. Otherwise, these lands will not be accounted as a part of the AR-CDM project activity. Such changes in boundary will be communicated to the DOE and are subject to verification during the project.
- Enter the measured geographical positions into the database and calculate the eligible area in Huay Hai, Huay Phet, Nam Sang and Sonephansay.
- The project boundary and the plants established will be monitored throughout the entire crediting period. If the boundary is changed during the crediting period, the specific location and area of the

deforested land will be identified; the boundary will be modified and reported to DOE for subsequent verifications. The deforested area will then be excluded from the project monitoring. Similarly, if the planting on certain lands within the project boundary fails, and other land uses take the place, these lands will be documented and excluded from the verification.

3. Monitoring of the management of the forest

- Monitor the survival of planted species and ensure their proper maintenance.
- Fertilization: tree species, location, amount and type of fertilizer applied, etc., including fertilization during the first three years after planting;

4. Monitoring the actual net GHG removals by sinks

a) Stratification and sample size
49 circular plots of 0.1 ha (1000m^2) with radius of 17.84 m will be established systematically with a random start for each strata based on the year of planting. Stratification for *ex ante* estimation of the actual net GHG removals by sinks was done according to the year of planting. Stratification for sampling will be the same as above. These plots will be monitored and the information will be collected and recorded.

b) Monitoring frequency
The planting activity commenced from 2008 to 2010. First monitoring will be conducted in 2012 with subsequent monitoring interval of 5 years, i.e., in 2017, 2022, 2027, 2032 and 2037 respectively.

c) Measuring and estimating carbon stock changes over time
Carbon stock changes over time will be measured according to the procedures above.

d) Monitoring GHG emissions by sources as the results of the A/R CDM project activity
GHG emissions from the project will be monitored annually.

5. Monitoring the leakage

The project participant will make sure that no grazing activities are allowed within the project area for the entire period. The project will be protected by a fence to avoid such activities. Amount of wood used for fencing will be monitored.

6. Quality Assurance and Quality Control (QA/QC)
A quality assurance and quality control (QA/QC) procedure will be implemented in order to ensure calculations are credible and transparent.

(a) Collecting reliable field measurements and Precise field monitoring

The team involved in field monitoring will be carefully trained in data collection and analysis. Each team member has been assigned in duties related to monitoring actual GHG removal. Data collection will be conducted by the trained team. Those responsible for the measurement work are trained in all aspects of the field data collection and data analyses. It is good practice to develop Standard Operating Procedures (SOPs) for each step of the field measurements, which will be adhered to at all times. These SOPs describe in detail above and all steps to be taken of the field measurements and contain provisions for documentation for verification purposes so that future field personnel can check past results and repeat the measurements in a consistent fashion. To ensure the collection and maintenance of reliable field data:
a) Field-team members will be fully aware of all procedures and the importance of collecting data as accurately as possible;

b) Field teams will establish test plots if needed in the field and measure all pertinent components using the SOPs to estimate measurement errors;
c) The document will list all names of the field team and the project leader will certify that the team is trained;
d) New staff will be adequately trained.

(b) Verifying the methods used to collect field data

The data collected by the team will be verified by taking random checks from stands, including their re-measurement by a senior member of the monitoring team. In case of errors, they are corrected and recorded for each stratum.

(c) Verifying data entry and analysis techniques

Reliable carbon estimates will require proper entry of data into the data analysis spreadsheets. Possible errors in this process will be minimized by cross checking these entries of both field data and laboratory data. To ensure more precise output, internal tests will be incorporated into the spreadsheets to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data will be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot will not be used in the analysis.

(d) Data maintenance and achieving

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

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

7. Monitoring the environmental and socio-economic impacts

Environmental and socio-economic impacts will be monitored along with monitoring forest management.

Appendix 6: Geographic delineation of project boundary

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Appendix 7: Summary of post registration changes

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Appendix 8: Baseline Information

The proposed project activity will be implemented on degraded and underutilized lands in Huay Hai, Huay Phet, Sonephansay and Nam Sang villages in Pakkading Distrcit in Lao PDR. Satellite images, aerial photographs, land use maps, interviews local communities and detailed ground survey were used for the baseline study.

The land use of the area before 31st December 1989 was studied during the initial stage of the baseline survey. This was done to exclude all areas that consisted forests. The satellite images that were interpreted for Forest and Land cover assessed by FMP of DOF in 2005 were used. For further assessment of forest and land cover, the aerial photographs of 1992 and 1982 were assessed. The aerial photograph of 1992 (1:40,000) was taken by Finmap Company of Finland and the 1982 aerial photograph (1:30,000) were processed by Russian company. All forested lands were excluded from the project area.

Landsat 4_5 TM satellite image of year 2007 was used in identifying land use types existed before the project started. This map was used along with the map of the project area provided by the project participant. The area was stratified according to the following major vegetation types.

1. Barren land (lands with heavily degraded condition) – 218.51 ha
2. Grasslands – 201.45 ha
3. Lands with shrubs on degraded soil – 415.03 ha
4. Degraded forests – 134.22 ha

There were 419.96 ha of land comprising of bare land and grass. These lands were not able to withstand shrubs or any growing tree due to degraded condition. The reasons are mainly due to increased slash and burn during the past. Soil erosion was a common observation on these lands. There were few patches of land with cash crops grown by the villagers. However they were not willing to continue with such agricultural activities due to poor fertility of these lands.

The definitions of forest types and land use types of the Forestry Strategy to the year 2020 of the Lao PDR (July 2005) published by the Ministry of Agriculture and Forestry was used in identifying baseline vegetation. Definitions:

Current Forest

Current Forest includes natural forests and plantation forests. It is used to refer to land with a tree canopy cover of more than 20% and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 m.

Degraded Forests

These are forests that have been heavily damaged, to the extent they are without forest or barren, that are classified for tree planting and/or allocation to individuals or organizations for tree planting, permanent agriculture and livestock production or other purposes in accordance with national economic development plans.

Note: These areas do not meet the current forest criteria due to the degraded condition without any human induced replanting programs.

Shrub lands

Shrub lands include areas which have plants with average height between 50 cm – 3m and a crown cover greater than 10%. These lands are clearly below the National forest threshold limit.

Barren land and Rock (R)

These are unfertile or seriously degraded land on shallow soil and rocky areas on which neither trees nor grasses can grow.

Forested areas which were identified by the satellite images were excluded from any kind of planting and were considered as protected areas. As the next step, a detailed ground survey was conducted to check the data obtained from satellite image. These surveys identified the existing vegetation types within the area.

Local communities from all four villages were interviewed as the next step to identify the land use type of these lands. The following table presents the area of lands belonging to each village. The table is further presented in minutes of stakeholder meetings.

Land use/villages	Huay Hai (ha)	Huay Phet (ha)	Nam Sang (ha)	Sonephansay (ha)	Total Area (ha)
Village Area	2,500	3,400	3,800	Data N/A	9700
Reserve Forest	1,007	1,831	2,040	Data N/A	4878
Village Utilization Forest	370	403	504	Data N/A	1277
Depleted and underutilized land	815	645	745	363	2568
Agricultural Production area	138	218	228	153	737
Rice field	140	268	258	30	696
House and Building area	30	35	25	8.4	98

Village chiefs from all four villages confirmed that lands allocated for the project were from the Depleted and underutilized lands. These letters are available with the project proponent and will be presented to DOE during validation. It was identified that these lands had been subjected to heavy clearing during 1980s by the Government as well as local communities. All the valuable timber was taken out from these lands. The remaining trees and shrubs were destroyed by slash and burn. One highlighted point was that fire due to slash and burn frequently destroyed vegetation on these lands since people were not able to properly control the fire. Destroying surrounding land from fire was a common occurrence in these lands.

Commonly found grasses included the following.

No.	Local name	Scientific name
1	ຫ້ຍາດອກແຂມ	*Thysanolaena maxima*
2	ຫຍ້າກະຈິບດອກໃຫ່ຍ	*Pennisetum pedicellatum*
4	ຫັ້ຍາຍຸບ	*Mimosa pudica*
5	ຫ້ຍາຍຸງ	*Nayraudia reynaudiana*
6	ຫັ້ຍາເລົາ	*Saccharum spontaneum*
7	ຫ້ຍາຄາ	*Imperata cylindrical*

Another 415.03 ha were identified in the satellite images and field surveys as lands with shrubs but no growing trees. The following shrubs were abundant in these areas.

No.	Local name	Scientific name
1	ກົກປໍສາ	*Broussonetia pipyrifera*
2	ກົກເລັບມື	*Cassia tora*
3	ກົກໂສມ	*Aeschynomene aspera*
4	ກົກເຂືອບີ	*Crassocephalum crepidioides*

5	ກົກໂຫງເຫງ	*Physalis minima*
6	ເຄືອໝາກຕໍາແຍ	*Mucuna pruriens*
7	ເຄືອຈິ່ງຈໍ້ເຫຼືອງ	*Merremia vitifolia*
8	ຫ້ຍາຂີວ ຫຼື ຫ້ຍາຝລັງ	*Chromolaena odorata*
10	ຜັກກູດງ້ອງ	*Diphazium esculentum*
11	ຂ່າປ່າ	*Alpinia* spp.
12	ເຄືອແຫມ	*Coscinium fenestratum*
13	ໝາແໜ່ງປ່າ	*Amomum* spp.
14	ຢາຫົວ	*Smilax glabra*
15	ກົກເຕີຍປ່າ	*Pandanus fibrosus*
16	ເຄືອຫວາຍ	*Calamus viminalis*
17	ກົກເບອ້າ	*Melastoma sanguineum*

Another 134.28 ha were identified as land with few growing trees. These lands were classified as Degraded Forests according to the MAF definitions. A forest expert identified the existing few trees within the land use category. The following trees were found in these areas.

No.	Local name	Scientific name
1	ໄມ້ຍາງງ	*Diptherocapus alatus*
2	ໄມ້ແຄທອງ	*Hopea odorata*
3	ໄມ້ແຄຂະຍອມ	*Shorea roxburghii*
4	ໄມ້ໝາກຄອມ	*Microcos paniculata*
5	ໄມ້ມ່ວງປ່າ	*Mangifera caloneura*
6	ໄມ້ໝາກກອກ	*Spondias pinnata*
7	ໄມ້ແຕ້ຄ່າ	*Afzelia xylocarpa*
8	ໄມ້ແຕ້ຣໍ	*Sindora siamensis*
9	ໄມ້ຂີ້ເຫຼັກປ່າ	*Cassia garrettiana*
10	ໄມ້ສະຝາງປ່າ	*Peltophorum dasyrrhachis*
11	ໄມ້ດູ່	*Pterocarpus macrocarpus*
12	ໄມ້ພອກ	*Parinari anamensis*
13	ໄມ້ກຽງປ່າ	*Syzygium megacarpum*
14	ໄມ້ຫວ້າປ່າ	*Syzygium cumini*
15	ໄມ້ແຄຝອຍ	*Sthereospermum funbriatum*
16	ໄມ້ຕອງໂຄບ	*Macaranga denticulate*
17	ໄມ້ຕອງຄັເທົ້າ	*Mallotus barbatus*
18	ໄມ້ປໍແຜ	*Trema orientalis*

19	ໄມ້ເດື່ອກ້ຽງ	*Ficus racemosa*
20	ໄມ້ກໍ່ໝາມ	*Castanopsis argyrophylla*
21	ໄມ້ບົກ	*Ivingia malayana*
22	ໄມ້ເຄັງ	*Dialium indum*
23	ໄມ້ຕິ້ວສົ້ມ	*Cratoxylum fomosum*
24	ໄມ້ຕິ້ວກ້ຽງ	*Cratoxylum cochinghinense*
25	ໄມ້ທະໂລ້	*Schima wallichii*
26	ໄມ້ປໍຫູ	*Hibiscus macrophyllus*
27	ໄມ້ເປືອຍເລືອດ	*Terminalia corticosa*
28	ໄມ້ມູກ	*Wrightia pubescens*
29	ໄມ້ແຄລ້າວ	*Fernandoa adenohpylla*
30	ໄມ້ຫ່ຽປ່າ	*Triadica cochinchinensis*

There are water streams flowing through the project area. The vegetation along these streams was identified as special areas where no rubber planting will be done. These areas were excluded from the project area.

Details of sample plots for areas with few growing trees

A sample size of 50 X 50 m (0.25 ha) was selected for assessing the floral diversity. Fifteen sample plots from 3 areas were selected to increase the accuracy. Plots were first chosen on the land use map and then GPS coordinates were noted. A GPS was used in the field to locate each plot.

The details of the sample plots are as follows.

Plot 1 – Nam Sang

No	Lao name	Scientific name	No. of trees
1	ຕອງໂຄບ	*Macaranga riloba*	8
2	ປໍຫູ	*Hibiscus macrophyllus*	8
3	ໄມ້ຮຽ	*Melia azedarch*	4

Plot 2 – Nam Sang

No	Lao name	Scientific name	No. of trees
1	ຕອງໂຄບ	*Macaranga riloba*	7
2	ປໍຫູ	*Hibiscus macrophyllus*	8
3	ໄມ້ຮຽ	*Melia azedarch*	4

Plot 3 – Nam Sang

No	Lao name	Scientific name	No. of trees
1	ຕອງໂຄບ	*Macaranga riloba*	2

2	ປໍຫູ	*Hibiscus macrophyllus*	0
3	ໄມ້ຮຽ	*Melia azedarch*	6

Plot 1 – Huay Phet

No	Lao name	Scientific Name	No. of trees
1	ໝັງດຳ	*Diospyros mum*	1
2	ຕອງໂຄບ	*Macaranga riloba*	3
3	ຕິ້ວເຫຼິງ	*Cratoxylon polyanthum*	1
4	ສີໂຄຕົ້	*Cinnamomum iners*	1
5	ຂີ້ໝູ	*Ormosia cambodiana*	1
6	ເຂົ້າສາ	*Memecyclon harmandii*	1
7	ກໍ່ເດືອຍ	*Castanopsis acumnatissima*	1
8	ປໍຫູ	*Hibiscus macrophyllus*	1

Plot 2 – Huay Phet

No	Lao name	Scientific Name	No. of trees
1	ກົກກົ່ມ	*Adina cordfolia*	1
2	ຕອງໂຄບ	*Macaranga riloba*	4
3	ເຂົ້າສາ	*Memecyclon harmandii*	1
4	ໄມ້ຮຽ	*Melia azedarch*	1
5	ໄມ້ ໝີ່	*Litsea polyantha*	2
6	ບົກຄາຍ	*Chaetocapus castanocarpus*	1
7	ໄມ້ ຕີ ເປັດ	*Alstonia scholaris*	1
8	ໄມ້ ກໍ່ເດືອຍ	*Castanopsis acumnatissima*	1

Plot 3 - Huay Phet

No	Lao name	Scientific Name	No. of trees
1	ກໍ່ເດືອຍ	*Castanopsis acumnatissima*	1
2	ປໍຫູ	*Hibiscus macrophyllus*	2
3	ສີໂຄຕົ້	*Cinnamomum iners*	1
4	ກົກຫວ້າ	*Eugenia jambolana*	1
5	ໄມ້ຮຽ	*Melia azedarch*	2
6	ຂັດເຄົ້າ	*Randia stenantha*	1

Plot 4 – Huay Phet

No	Lao name	Scientific Name	No. of trees

1	ແຄ ຍ່ອງ	*Melia azedarch*	9
2	ປໍຫູ	*Hibiscus macrophyllus*	8
3	ຕອງໂຄບ	*Macaranga riloba*	4
4	ແຄ	*Hopea odorata*	3

Plot 5 – Huay Phet

No	Lao name	Scientific Name	No. of trees
1	ໄມ້ ສະໂກ	*Anthocephalus indicus*	2
2	ຕີ ເປັດ	*Alstonia scholaris*	3
3	ຮຽ	*Melia azedarch*	4
4	ຕອງໂຄບ	*Macaranga riloba*	4
5	ສະຝາງ	*Peltophorum dasyrachis*	2
6	ຫວ້າ	*Eugenia jambolana*	1
7	ປໍຫູ	*Hibiscus macrophyllus*	2

Plot 1 – Huay Hai

No	Local Name	Scientific Name	No. of trees
1	- Ä´É-ªº¤-Â£®	*Macaranga denticulata*	3
2	ໄມ້ ຕິ້ວເຫຼືອງ	*Cratoxylon polyanthum*	3
3	ໄມ້ ບາກ	*Anisoptera costata*	8
4	ໄມ້ ຈິກດົງ	*Vatica astrotricha*	1
5	ໄມ້ຕີ ເປັດ	*Alstonia scholaris*	2
6	ໄມ້ຫາດ	*Artocarpus aspurula*	1
7	ໄມ້ຮັງ	*Pentacm siamensis*	1
8	ໄມ້ຊາດ	*Dipterocarpus obtusifolius*	1
9	ໄມ້ກະເດົາຊ້າງ	*Melia azedarach*	1
10	ໄມ້ເປືອຍລາ	*Lagerstroemia balansae*	2

Plot 2 – Huay Hai

No	Local Name	Scientific Name	No. of trees
1	ໄມ້ ມູກ	*Wrightia tomentosa*	5
2	ໄມ້ ຍົມພາ	*Ailanthus malabarica*	1
3	ໄມ້ຮັງ	*Pentacm siamensis*	2
4	ໄມ້ ດອກແຄລ້າວ	*Haplophragma adenophyllum*	4
5	ໄມ້ ລວງຄອມ	*Manglietia conifera*	1
6	ໄມ້ຄູ	*Cassia fistula*	1
7	ໄມ້ປີດາ	*Pterocymbbium javanicum*	2

Plot 3 – Huay Hai

No	Local Name	Scientific Name	No. of trees
1	ໄມ້ ປີດາ	*Pterocymbbium javanicum*	18
2	ໄມ້ຕອງໂຄບ	*Macaranga denticulate*	5
3	ໄມ້ ຮັງ	*Pentacm siamensis*	1
4	ໄມ້ ສີໂຄຕັ້	*Eucalyptus* spp.	1
5	ຕັ້ ັງດໍາ	*Diospyros mum*	1
6	ຕັ້ ໝາກ	*Areca catechus*	1

Plot 4 – Huay Hai

No	Local Name	Scientific Name	No. of trees
1	ໄມ້ ປີດາ	*Pterocymbbium javanicum*	12
2	ໄມ້ຕອງໂຄບ	*Macaranga denticulate*	4
3	ກະຖິ່ ງລິງ	*Acacia auriculiformis*	5
4	ໄມ້ໝາກບິກ	*Irvingia malayana*	2
5	ໄມ້ເປືອຍ	*Lagerstroemia balansae*	1
6	ຕັ້ ໄຮ	*Ficus gibbosa*	1
7	ຕັ້ ກະດອງ	*Podocarpus neriifolius*	1
8	ຕັ້ ປັ ດິງຂາວ	*Dalbergia kerrii*	1

Plot 5 – Huay Hai

No	Lao name	Name of Science	No. of trees
1	ໄມ້ ບິກ	*Irvingia malayana*	1
2	ໄມ້ ຊີ	*Vatica harmandiana*	1
3	ຮຽ	*Melia azedarch*	1
4	ຕອງໂຄບ	*Macaranga riloba*	3

5	ປໍຫູ	*Hibiscus macrophyllus*	12
6	ຮຽ	*Melia azedarch*	7
7	ຕອງໂຄບ	*Macaranga riloba*	6

Plot 6 – Huay Hai

No	Lao name	Name of Science	No. of trees
1	ຮຽ	*Melia azedarch*	1
2	ປໍຫູ	*Hibiscus macrophyllus*	7
3	ຮຽ	*Melia azedarch*	2
4	ຕອງໂຄບ	*Macaranga riloba*	3

Plot 7 – Huay Hai

No	Lao name	Name of Science	No. of trees
1	ໄມ້ ປໍດາ	*Pterocymbbium javanicum*	5
5	ປໍຫູ	*Hibiscus macrophyllus*	3
6	ຮຽ	*Melia azedarch*	8
7	ຕອງໂຄບ	*Macaranga riloba*	1

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History of the document

Version	**Date**	**Nature of revision**
06.0	EB 66 13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the project design document form for afforestation and reforestation CDM project activities" (EB 66, Annex 10).
05	EB 55, Annex 22 30 July 2010	Restructuring to reflect changes applied in the design of approved A/R CDM baseline and monitoring methodologies.Due to the overall modification of the document, no highlights of the changes are provided.
04	EB 35, Annex 20 19 October 2007	• Restructuring of section A; • Section "Monitoring of forest establishment and management" replaces sections: "Monitoring of the project boundary", and "Monitoring of forest management"; • Introduced a new section allowing for explicit description of SOPs and quality control/quality assurance (QA/QC) procedures if required by the selected approved methodology; • Change in design of the section "Monitoring of the baseline net GHG removals by sinks" allowing for more efficient presentation of data.
03	EB 26, Annex 19 29 September 2006	Revisions in different sections to reflect equivalent forms used by the Meth Panel and facilitating the transparent selection of an approved methodology for the proposed A/R CDM project activity.
02	EB 23, Annex 15a 24 February 2006	Inclusion of a section on the assessment of the eligibility of land and the Sampling design and stratification during monitoring.
01	EB15, Annex 6 03 September 2004	Initial adoption.
Decision Class: Regulatory **Document Type:** Form **Business Function:** Registration		