PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 04

CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) Version 04

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SECTION A. General description of the proposed A/R CDM project activity:

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A.1. Title of the proposed A/R CDM project activity:

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Mitigation of GHG: Rubber based agro-forestry system for sustainable development and poverty reduction in Pakkading, Bolikhamsay Province, Lao PDR.
PDD Version 01 dated 13th July 2009

A.2. Description of the proposed A/R CDM 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 1000 hectares of rubber plantations. 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.

People had been practicing slash and burn in lands belonging to the project area for many years and the natural forests have been cleared before 31st December 1989. Subsequently due to land degradation these lands were abandoned. Since all of these lands have been cleared before 31st December 1989 according to the aerial photographs, this project is developed as a Reforestation CDM project under the Bonn Agreement and Marrakech Accords.

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 25 to 30 year replanting cycles), upkeep of soil, ground water, water infiltration, scope for biological diversity (integration of other species in the inter-rows) being largely a smallholder species for purposes of livelihood, is less profit driven and less exploitation of environment. Rubber wood 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 participation of rural communities in the area. 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 and has been identified as suitable zone for para-rubber tree plantation by Government of Laos (GOL).

The project will allow:

- 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.

Project's contribution towards sustainable development

The project improves degraded and abandoned grasslands/croplands by improving soil condition and maintains the ecological balance in the area. According to the people in the area, the sustainable rubber plantation will replace the slash and burn practice. This would reduce GHG emissions.

The project is expected to result in various social and environmental benefits as it provides multiple benefits. This also contributes to the generation of more than hundred direct and indirect employment opportunities. The larger participation of women in the project activity contributes to the sustainable development by way of gender equality. This creates additional income for rural communities.

Farmers find rubber tree cultivation economically unattractive since they cannot afford to grow rubber trees on their own, unless technical support is offered and a financial package is proposed to help them sustain seven years with no revenue from the land, labour and inputs, plus another four years before the latex production is at its peak. 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 to the villagers whatever the expected return, unless a credit guarantee mechanism is in place and with hard conditions for the rural villagers to afford. The Agricultural Promotion Banks (APB) has been an authority for providing the funding support from Asian Development Bank (ADB) for the fast growing tree plantation in Lao PDR but this leads hardly to success for the individual villager to recover the debt because of marketing problem and maintaining technique[1].

Private investors have to retain their capacity to borrow funds to stay in business and maintain the rubber plantations, technical expertise and jobs in case of prolonged period of low world natural rubber prices.

A.3. Project participants:

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[1] Lang, C., (2003) ADB's Plantation Projects in Laos. This document is available for download at the following URL: http://chrisland.org/2003/10/01/adbs-plantation-projects-in-laos/

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Please list project participants and Party(ies) involved and provide contact information in Annex 1. Information shall be indicated using the following tabular format.

Table A.1 Project Participants

Name of 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)
Lao PDR	• Lao Thai Hua Rubber Co. Ltd	Yes
	• Ministry of Agriculture and Forestry	No
(*) In accordance with the CDM A/R modalities and procedures, at the time of making the CDM-AR-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		
Note: When the CDM-AR-PDD is prepared to support a proposed new baseline and monitoring methodology (form CDM-AR-NM), at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

A.4. Description of location and boundaries of the A/R CDM project activity:

A.4.1. Location of the proposed A/R CDM project activity:

A.4.1.1. Host Party(ies):

>>
Lao Peoples Democratic Republic (Lao PDR)

A.4.1.2. Region/State/Province etc.:

>>
Bolikhamsay Province

A.4.1.3. City/Town/Community etc:

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

The location of the project is part of depleted and underutilized land belonging to three villages. The area is 1000 hectares assessed by Forest Mapping and Planning Division (FMP) of the Department of Forestry (DOF), Ministry of Agriculture and Forestry (MAF).

A.4.2 Detailed geographic delineation of the project boundary, including information allowing the unique identification(s) of the proposed A/R CDM project activity:

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

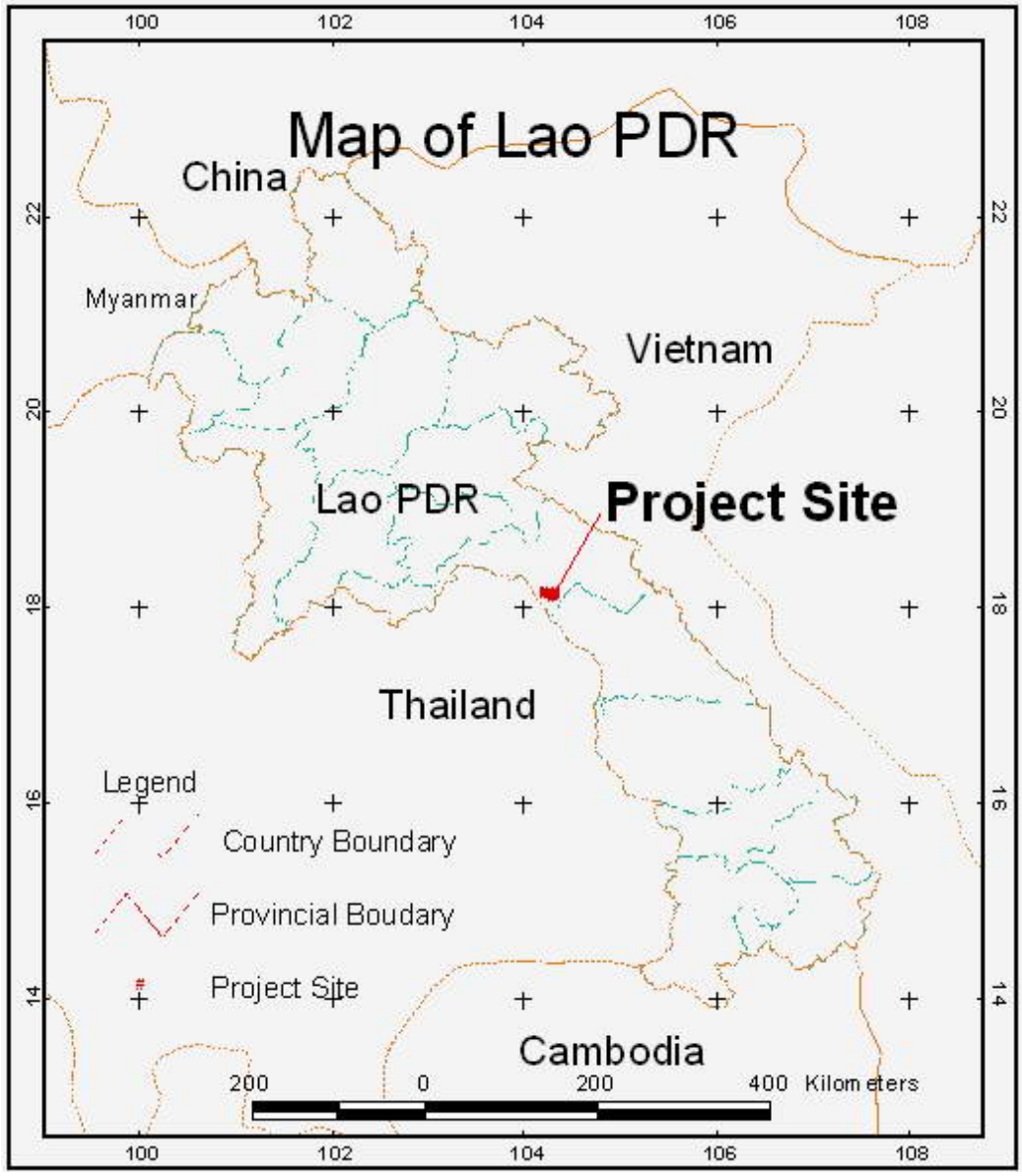


Figure A.2 Land use of rubber plantation area in Pakkading district, Bolikhamsay province, Lao PDR.

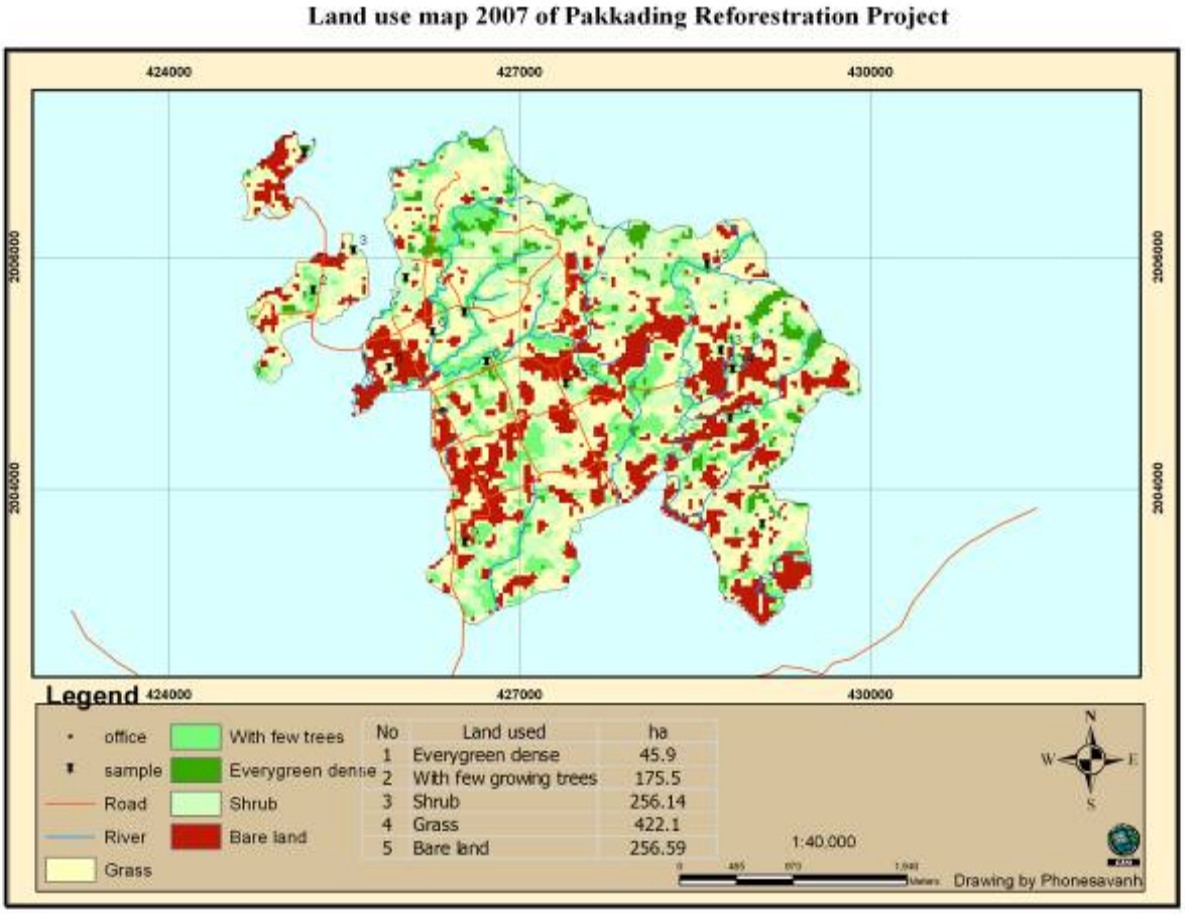
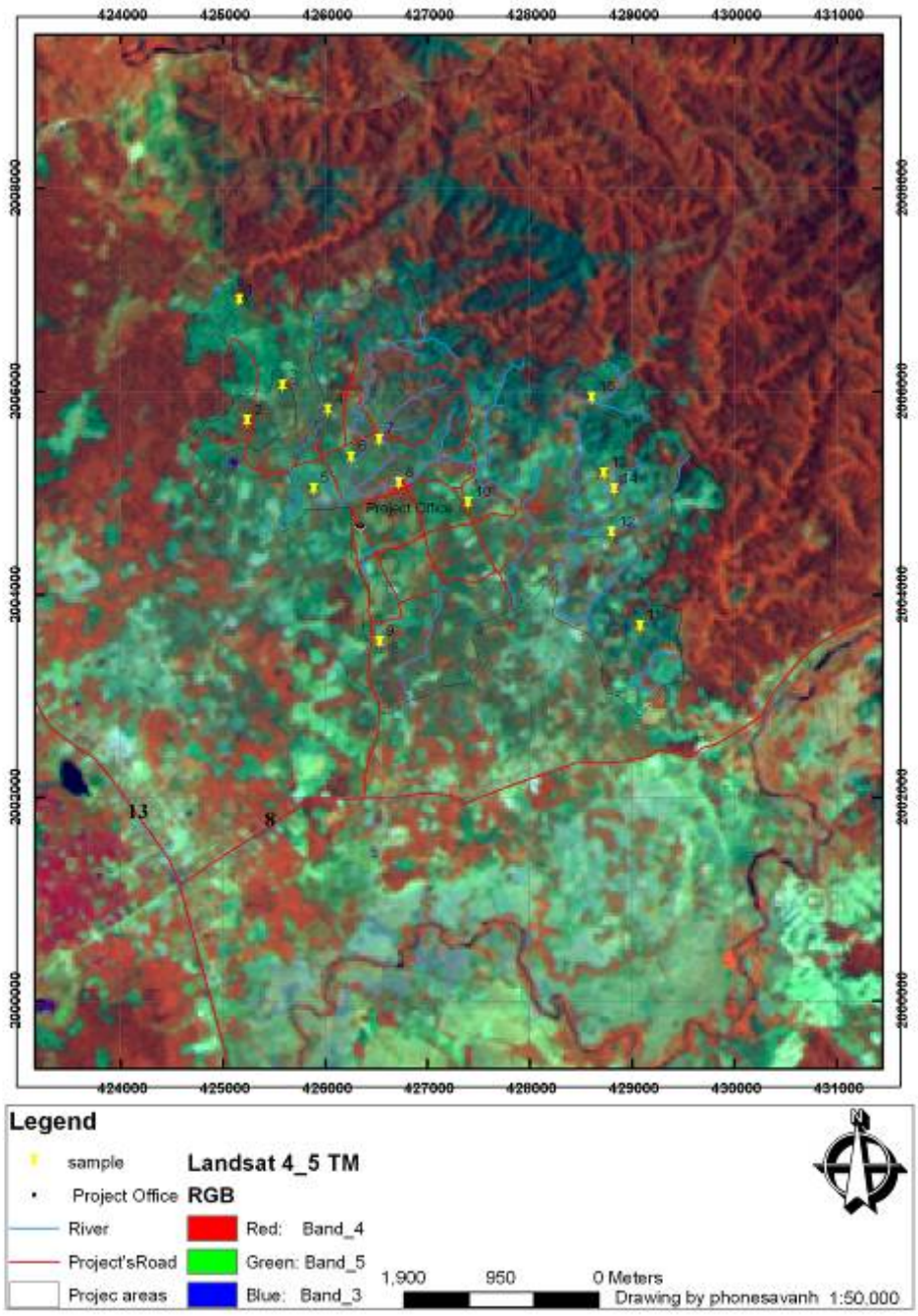


Figure A.3 Location of the project

Location of Pakkading Reforestration Project



A.5. Technical description of the A/R CDM project activity:

A.5.1. Description of the present environmental conditions of the area planned for the proposed A/R CDM project activity, including a concise description of climate, hydrology, soils, ecosystems (including land use):

1. Climate and hydrology

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 Rainfall

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.

In addition to the monsoons, the area is occasionally visited by typhoons and tropical depressions. The peak of the typhoon season in the central region of Lao PDR is generally September and October.

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 2,684 mm. The maximum rainfall was recorded in year 2002 as 2777.30 mm and the minimum rainfall was recorded in 1999 as 983.50 mm.

Table A.2 Mean annual rainfall (mm) station KM 20 (1990 to 2002)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1990	3.7	94.0	107.1	67.3	309.1	388.6	434.7	158.4	190.1	153.8	16.0	0	1922.8
1991	0	5.3	82.0	41.3	138.6	642.7	520.0	220.8	94.4	93.7	0	53.7	1892.5
1992	20.4	43.9	11.4	19.1	316.7	364.9	384.2	191.8	247.7	69.7	1.3	56.0	1727.1
1993	0	24.3	33.1	157.1	294.4	411.5	356.7	463.7	210.5	61.7	0	0	2013.0
1994	0	19.6	101.6	43.5	120.0	597.0	901.9	351.3	284.7	53.4	2.0	0	2475.0
1995	0	3.0	6.9	29.8	277.4	213.8	203.8	454.2	173.1	99.1	3.9	0	1465.0
1996	6.7	30.8	48.7	70.1	211.4	353.5	375.0	287.2	187.6	81.9	5.3	0	1658.2
1997	3.3	28.6	12.4	112.4	232.5	363.2	454.6	654.9	267.7	50.8	0	0	2180.4
1998	3.7	8.1	37.6	60.7	238.0	376.7	434.2	177.3	290.4	30.9	13.9	3.9	1675.4
1999	11.0	0	61.5	113.3	216.4	96.6	145.1	110.1	77.8	134.4	12.6	4.7	983.5
2000	0	78.3	5.5	165.9	61.3	327.9	68.0	153.3	110.4	20.3	0	0	990.9
2001	0	21.1	22.9	3.2	160.4	207.9	469.0	646.0	196.4	102.3	3.3	0	1832.5
2002	0	0	94.2	65.0	413.2	510.1	562.3	443.6	619.6	42.9	3.0	23.4	2777.3

1.3 Temperature

According to 14 year (1990-2004) records of temperature, the mean minimum, mean average and mean maximum temperatures were 21.78^{0}C, 26.30^{0}C and 30.86^{0}C respectively. The hottest year recorded was 1996 and the temperatures reported by Boilkhamxay Province are presented in Table A.3.

Table A.3 Temperature (°C & 1/10) Paksan Station, Bolikhamxay Province, Lao PDR

Year	Mean maxi (°C)	Mean (°C)	Mean min (°C)
1990	30.3	26.3	22.3
1991	30.0	26.0	22.0
1992	29.8	25.9	22.1
1993	29.9	25.8	21.7
1994	31.2	26.7	22.2
1995	30.6	26.4	22.3
1996	32.1	26.2	20.3
1997	30.4	26	21.6
1998	31.9	27.5	23.2
1999	30.7	26.1	21.5
2000	31.2	26.3	21.4
2001	31.6	26.6	21.9
2002	31.1	26.4	21.8
2003	31.6	26.5	21.4
2004	30.6	25.8	21.1

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.

2. Topography and soils

2.1 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.

2.2 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, hill tribe agriculture abandons formerly cultivated land. Soil depth profile range from 20 cm in Nam Sang village to 120 cm in Huay Phet village.

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 sensitive 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 no protection of trees cover.

3. Vegetation, ecosystems, rare/endangered species and their habitat

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 affecting the characteristic of secondary habitats that have been cleared of forest cover.

A.5.2. Description of the presence, if any, of rare or endangered species and their habitats:

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 not habitats for fauna. However the following species have been observed in surrounding forests by local communities.

1.	Red Jungle Fowl (Kai Pa)	- *Gallus gallus*
2.	Spotted Woodpecker (Nok Sai Pik Lai Houp Hoa Chai)	- *Hemicircus canente*
3.	Lineated Barbet (Nok Kalok, Nok Khondok Kondeng)	- *Megalaima lagrandieri*
4.	Blue-eared Barbet (Nok Kalok, Nok Khondok Houpha)	- *Megalaima australis*
5.	Blyth's Kingfisher (Nok Ten)	- *Alcedo Hercules*
6.	Blue-bearded Bee-eater (Nok Sithon)	- *Merops viridis*
7.	Slaty-back Forktail (Nok Kai Khoa Lang Thao)	- *Enicurus schistacous*
8.	White-tailed Robin (Nok Tem Poun)	- *Myiomela leucur*
9.	Black-collared Starling (Nok Aing Kho Dam)	- *Strurmus nigricolllis*
10.	Purple-Backed Starling (Nok Aing Kan Lang Mouang)	- *Strurmus sturminus*
11.	White-shouldered Starling (Nok Aing Kan Peak Khao)	- *Strurmus sinensis*
12.	Hill Mina (Nok Salika)	- *Gracula religiosa*
13.	Chinese Pangolin (Lin)	- *Manis pentadactyla*
14.	Asian Slow Loris (Lin Lom)	- *Nycticebus bengalensis*
15.	Phayre's Flying Squirrel (Bang)	- *Hylopetes phayrei*
16.	Chinese Bamboo Rat (On)	- *Rhizomys sinensis*
17.	Hoary Bamboo Rat (On)	- *Rhizomys pruinosus*
18.	Malayan Porcupine (Men)	-*Hysterix brachyura*

A.5.3. Species and varieties selected for the proposed A/R CDM project activity:

The species is *Hevea brasiliensis*, commonly known in English as rubber tree. Rubber trees are well adapted to Laos' natural environment. They have been locally introduced during French's colony 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[2], the project shall not make use of genetically modified organisms.

A.5.4. Technology to be employed by the proposed A/R CDM project activity:

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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:

[2] "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 organisms".

Nurseries will be able to cater 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. The bud-grafting average success rate is 80% at present and is expected to increase to 90% by 2009.

Planting material:
Stumps are more recommended than seedlings in bags. Stumps will be grafted only with clones 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. 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.

Planting density and spacing:
The plantation density will be 476 trees per hectare, for a spacing of 3 m x 7 m between the trees. These 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 2 to 3 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. 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 tapers or farmers beforehand on the LTR Co. Ltd. The number of tapping days is estimated at 300 days per annum and the taper's daily task at 600/700 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.

A.5.5. Transfer of technology/know-how, if applicable:

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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. Considering above factors it can be mentioned that this will have a potential of implementing similar AR-CDM project activities.

A.5.6. Proposed measures to be implemented to minimize potential leakage:

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Under applicability conditions of AR-ACM0002, 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 collect by local communities without compromising the growth of trees planted in the area.

According to the present Land Use maps and the development plans of LTR Company Limited, the lands within the project boundary are depleted and underutilized 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.

The project developer has made all efforts to minimize the leakage associated with the transportation of personnel. In addition, the project proponent does not own live stocks. As a result there is no leakage due to project activity.

However, the project participant is using wooden poles as fence for the project. The leakages from use of wooden poles have been calculated under D.2 Estimate of the *ex ante* leakage. The project participant will construct non-wooden fences from the 4th year onwards.

A.6. Description of legal title to the land, current land tenure and rights to tCERs / lCERs issued for the proposed A/R CDM project activity:

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Lands belonging to the project belong to three villages namely Huay Hai, Huay Phet and Nam Sang. Land use and allocation of three villages in project area are presented in the following table.

Table A.4. Land use allocation for three villages

Land use/villages	Huay Hai (ha)	Huay Phet (ha)	Nam Sang (ha)	Total (ha)
Village Area	2,500	3,400	3,800	9,700
Reserve Forest	1,007	1,831	2,040	4,878
Village Utilization Forest	370	403	504	1,277
Depleted and underutilized land	815	645	745	2205
Agricultural Production area	138	218	228	584
Rice field	140	268	258	666
House and Building area	30	35	25	90

The LTR Co. Ltd has leased 1000 ha of land which is categorized as depleted and underutilized land for this project activity. The period will be 30 years.

A.7. Assessment of the eligibility of the land:

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The methodology AR-ACM0002 (Version 01) states that the latest version of the tool "Procedures to demonstrate the eligibility of lands for afforestration and reforestation CDM project activities" must be used. Therefore the "Procedures to demonstrate the eligibility of lands for afforestration and reforestation

CDM project activities" (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:

Both UNFCCC and Lao PDR DNA definition on forest were considered when assessing the land eligibility. Both definitions are presented below;

The specific eligibility requirements for Afforestation and Reforestation project activities are presented in the paragraphs 8 and 9 of the Annex to decision 19/CP.9 (Modalities and procedures for afforestation and reforestation project activities under the clean development mechanism in the first commitment period of the Kyoto Protocol)

According to this, a forest is defined as follows,

- A single minimum tree crown cover value between 10 and 30 per cent; and
- A single minimum land area value between 0.05 and 1 hectare; and
- A single minimum tree height value between 2 and 5 metres

In terms of the Lao PDR DNA regulations for forest threshold limits, a forest with a minimum tree crown cover value of 30%, a minimum land area value of 1.0 hectare, 5 m in height to the top of the canopy is considered as a forest.

The whole surrounding Pakkading District area including project site were exploited for timber since 1969 by cutting all sizeable big trunk of logs, in diameter 80 to 200 cm, 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 Huay Hai and Huay Phet. Lands belonging to the project area were allocated to do slash and burn. Increasing population with migration from Huaphanh Province brought to increasing agricultural area and the LFAP has to re-allocate for immigrated peoples from Houaphanh Province to provide livelihoods.

As mentioned above, the area was heavily affected by slash and burn, and became increasingly degraded. Some of villagers left their home to neighbouring countries such as Thailand and Vietnam for better income.

In addition to the literature review mentioned above, a detailed survey on existing vegetation prior to the project start was conducted and is presented in Annex 03 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.

"Tool for the identification of degraded or degrading lands for consideration in implementing CDM A/R project activities" (Version 01, Annex 15 of EB 41) was used in demonstrate that the lands within the project boundary are degraded and abandoned. 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 (Annex 06). This complies the 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.

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

In terms of the Bonn Agreement and Marrakech Accords direct human induce 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, satellite images were used. 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 (Figure A.3) and 1982 (Figure A.4) were assessed. 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.

Figure A.3: Identification of relevant aerial photographs of 1992.

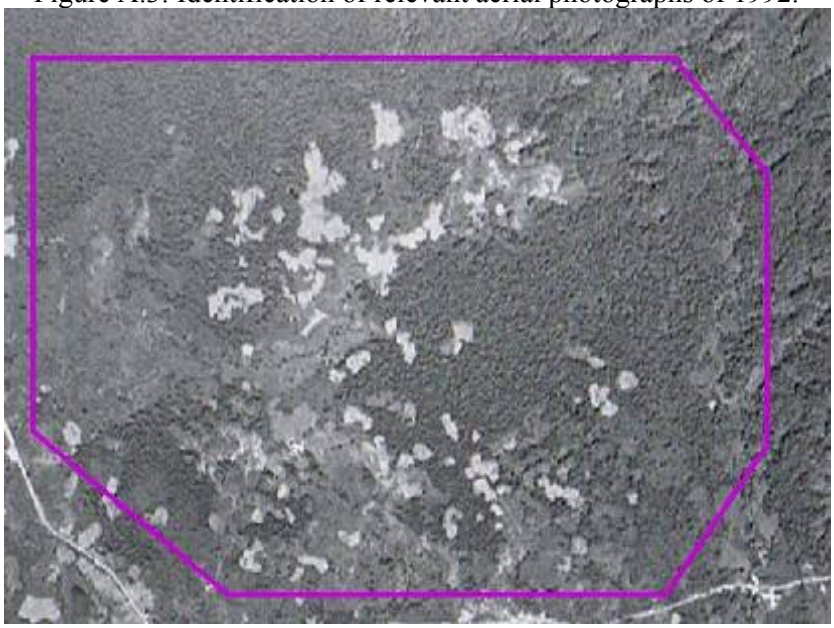
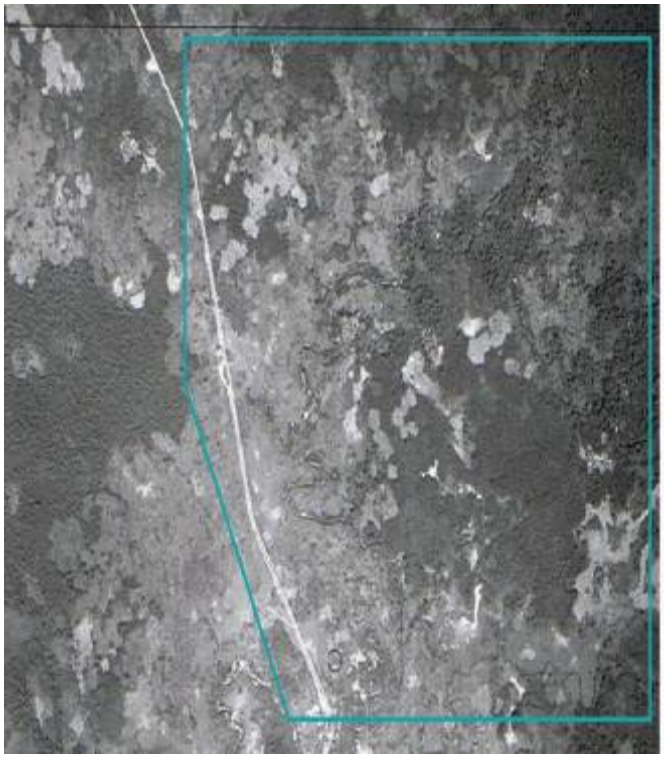


Figure A.4: Identification of relevant aerial photographs of 1982.



(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 which did not contain natural forest by 31st December 1989.

(c) Interviews with local communities
A series of meetings were held at all three villages in order to confirm the land use type by 31st December 1989. The results of the meeting are presented in Annex 03 under Baseline Information. 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 and contributing to addressing 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

A.9. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

>>

Table A.5 Net anthropogenic GHG removals by sinks

Summary of results obtained in Sections C.7., D.1., and D.2.				
Year	**Estimation of baseline net GHG removals by sinks (tonnes of CO_2 e)**	**Estimation of actual net GHG removals by sinks (tonnes of CO_2 e)**	**Estimation of leakage (tonnes of CO_2 e)**	**Estimation of net anthropogenic GHG removals by sinks (tonnes of CO_2 e)**
2008	138.81	87.73	56.72	-107.80
2009	138.81	1128.40	117.27	872.31
2010	138.81	5608.40	173.99	5295.59
2011	138.81	36723.74	0.00	36584.92
2012	138.81	11150.86	0.00	11012.04
2013	138.81	87034.21	0.00	86895.39
2014	138.81	30668.97	0.00	30530.16
2015	138.81	74682.75	0.00	74543.93
2016	138.81	48227.04	0.00	48088.23
2017	138.81	46266.03	0.00	46127.22
2018	138.81	46667.81	0.00	46529.00
2019	138.81	34033.92	0.00	33895.11
2020	138.81	41890.51	0.00	41751.70
2021	138.81	38233.35	0.00	38094.53
2022	138.81	34844.36	0.00	34705.55
2023	138.81	35462.73	0.00	35323.92
2024	138.81	28625.64	0.00	28486.83
2025	138.81	19496.61	0.00	19357.79
2026	138.81	28318.11	0.00	28179.30
2027	138.81	17094.13	0.00	16955.32
2028	138.81	26310.86	0.00	26172.05
2029	138.81	24718.24	0.00	24579.43
2030	138.81	29383.10	0.00	29244.29
2031	138.81	34262.65	0.00	34123.84
2032	138.81	40529.76	0.00	40390.94
2033	138.81	48298.71	0.00	48159.90
2034	138.81	60545.34	0.00	60406.53
2035	138.81	67972.66	0.00	67833.84
2036	138.81	84361.16	0.00	84222.35
2037	138.81	97198.26	0.00	97059.45
Total (tonnes of CO_2 e)	4164.36	1179826.04	347.99	1175313.69

A.10. Public funding of the proposed A/R CDM project activity:

>>

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

SECTION B. Duration of the project activity / crediting period

B.1 Starting date of the proposed A/R CDM project activity and of the crediting period:

>>

1st June 2008

B. 2. Expected operational lifetime of the proposed A/R CDM project activity:

>>

30 years

B.3 Choice of crediting period:

Fixed crediting period

B.3.1. Length of the renewable crediting period (in years and months), if selected:

>>

N/A

B.3.2. Length of the fixed crediting period (in years and months), if selected:

>>

30 years and 0 months

SECTION C. Application of an approved baseline and monitoring methodology

C.1. Title and reference of the approved baseline and monitoring methodology applied to the proposed A/R CDM project activity:

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The approved consolidated afforestation and reforestation baseline methodology **AR-ACM0002/Version 01,** Sectoral Scope: 14, EB 46 have been used to determine the baseline emissions and emission reduction due to the reforestation CDM project activity. The title of this baseline methodology is "Afforestation or reforestation of degraded land without displacement of pre-project activities"

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

• Procedures to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities (Version 01, Annex 18 of EB 35);

• Combined tool to identify the baseline scenario and demonstrate the additionality in A/R CDM project activities (Version 01, Annex 19 of EB 35);

• Tool for the identification of degraded or degrading lands for consideration in implementing A/R CDM project activities (Version 01, Annex 15 of EB 41);

• Tool for estimation of emissions from clearing, burning and decay of existing vegetation due to implementation of an A/R CDM project activity (Version 02, Annex 35 of EB 42);

• Procedure to determine when accounting of the soil organic carbon pool may be conservatively neglected in A/R CDM project activities (Version 01, Annex 15 of EB 33);
• Tool for testing the significance of GHG emissions in A/R CDM project activities (Version 01, Annex 16 of EB 31).

C.2. Assessment of the applicability of the selected approved methodology to the proposed A/R CDM project activity and justification of the choice of the methodology:

>>

Condition: The project activity does not lead to a shift of pre-project activities outside the project boundary, i.e., the land under the proposed AR-CDM project activity can continue to provide at least the same amount of goods and services as in the absence of the project activity;
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. Therefore, it can continue to provide same goods and services as in the absence of project activity.

Condition: Lands to be afforested or reforested are degraded, or degrading and it may be expected that the land would remain degraded in the absence of the project activity;
Applicability: As stated above in Section A.7., Assessment of the eligibility of land, the lands have been identified as degraded or depleted by the Ministry of Agriculture and Forestry, Lao PDR and therefore have met the condition.

Condition: Environmental conditions and human-caused degradation do not permit the encroachment of natural forest vegetation;
Applicability: The areas have been heavily exploited for timber by the Royal Government of Lao during 1960s. Slash and burn practice have been the main income source for the rural communities. Presently these lands have been classified as depleted and underutilized by the Ministry of Agriculture and Forestry. Therefore under natural conditions there is no possibility of encroachment of natural forest vegetation.

Condition: Soil organic carbon pool may be conservatively neglected in the proposed A/R CDM project activity;
Applicability: The tool "Procedures to determine when accounting of the soil organic carbon pool may be conservatively neglected in CDM A/R project activities" (Version 01, Annex 15 of EB 35) was used to neglect accounting of soil organic carbon.

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.

Condition: Carbon stocks in litter and deadwood can be expected to decrease more due to human intervention or increase less in the absence of the project activity, relative to the project scenario;
Applicability: In the perspective of degraded and degrading lands in the project area, carbon stocks in litter and deadwood will continue to decrease more due to human intervention or increase less in the absence of the project activity, compared to the project scenario

Condition: Flooding irrigation is not applied in the project activity.
Applicability: No flooding irrigation is applied for the proposed AR-CDM project activity.

C.3. Assessment of the selected carbon pools and emission sources of the approved methodology to the proposed CDM project activity:

>>

The Modalities and Procedures for afforestation and reforestation project activities, Decision 19/CP.9 identifies an AR-CDM project activity may account for carbon pools above-ground biomass, below-ground biomass, litter, dead wood and soil organic carbon. The carbon pools included and excluded by the project participant are presented in the following table C.1.

Table C.1 Selection and justification of carbon pools

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
Dear wood	No	Conservative approach under applicability condition
Litter	No	Conservative approach under applicability condition
Soil organic carbon	No	Conservative approach under applicability condition

Justifications for excluding certain carbon pools are made under applicability condition of AR-ACM0002. As stated in Section C.2., due to the degrading condition of the land, soil organic carbon has been conservatively excluded. There is few 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 and below-ground carbon pools.

According to AR-ACM0002, the project participants have selected the following emission sources to be included and excluded from the project activity. Since the project participants will use inorganic fertilizers, the N_2O emission from fertilization have been included.

Table C.2 Gases considered from emissions by sources other than resulting from changes in stocks in carbon pools

Source	Gas	Included/ excluded	Justification / Explanation

Burning of biomass	CO_2	Excluded	Have justified under Section D.1
	CH_4	Excluded	Have justified under Section D.1
	N_2O	Excluded	Potential emissions are negligibly small
Fertilizer application	CO_2	Excluded	N/A
	CH_4	Excluded	N/A
	N_2O	Included	

C.4. Description of strata identified using the *ex ante* stratification:

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Stratification was done as per Section 3 of AR-ACM0002 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.

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 C.3 Area of planting

Year	Area (ha)
2008	547.0
2009	55.7
2010	397.3
Total	1000.0

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 will be presented to the DOE for validation and verification.

C.5. Identification of the baseline scenario:

>>

As stated in Section 2 of AR-ACM0002 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 C.6. Therefore according to Part II.B of the "Clean Development Mechanism Guidelines for completing the CDM A/R forms for the Project Design Document (CDM-AR-PDD) and the proposed new baseline and monitoring methodology (CDM-AR-NM)" (Version 09, Annex 12 of EB 42) Section C.5 is kept blank.

C.5.1. Description of the application of the procedure to identify the most plausible baseline scenario (separately for each stratum defined in C.4.):

>>

Presented in Section C.6.

C.5.2. Description of the identified baseline scenario (separately for each stratum defined in Section C.4.):

>>

Presented in Section C.6.

C.6. Assessment and 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.

STEP 0. Preliminary screening based on the starting date of the A/R project activity

The start date of the project is 1st June 2008. The Board had approved the project on 26th December 2007 and project started in June 2008. A copy of the minutes of the Board meeting is in Annex 07. Evidence of the project start date is with the project participant and will be available for DOE during validation.

LTR Co. Ltd being aware of the CDM benefits started enquiring about CDM in year 2007. The Board of Directors of the company only approved the project being implemented after discussing about the CDM benefits under Kyoto Protocol.

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 three 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: Implement agricultural activities with crops including corn, banana, and cassava.
Alternative 3: 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 (11th 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 C.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	Implement agricultural activities with crops including corn, banana and cassava.	Yes
3	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: Implement agricultural activities with crops including corn, banana and cassava.
Alternative 3: 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 because this is a AR-CDM project that would benefit both as a supply of sustainable source of rubber milk and contribution towards addressing global warming through sequestration of Greenhouse Gases from the atmosphere. Board papers relevant to this decision are with the project entity and will be presented to the DOE during validation. Though the Board of Directors have approved this project considering its benefits to the global community through CDM, due to various financial, economic, political and technical reasons, reforestation has not yet been accepted as viable business. As a result, the project participants face following barriers which make this project additional.

(a) Investment barriers

Forest cover in Lao PDR has dwindled during the past century. Total forest cover was reduced from 13,088,000 ha in 1990 to 12,561,000 ha in year 2000 (FAO 2000 & FAO 2001). Among several reasons for this diminishing trend of forest cover, urbanization and related issues play a significant role. Even though the Department of Forestry supplies a certain amount of timber and fuel wood need, it is not sufficient to cater the total demand. Therefore natural forests are illegally cut down for timber and fuel wood. Furthermore, there are no adequate replanting programs in Lao PDR that are aimed in addressing climate change since there is no clear incentives to improve the forest cover.

Establishing such large scale rubber plantations in the country has problems with investment. In Pakkading District such large scale rubber plantations is not recognised as an attractive business due to high cost and risks involved. In fact the project participants have also applied for loans in order to implement this proposed AR-CDM project activity. With the present global economic crisis many

firms/banks/IGOs that are providing loans are not willing to grant such loans for this type of reforestation projects. Therefore implementing the proposed project activity without registering as an AR-CDM activity faces with investment barriers.

Similarly establishing agricultural activities in such a large are of land also have barriers of high cost of establishment and maintenance.

(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.

These communities also lack the skills for plantation management as well as for preventing planted trees from being subject to fire, pest and disease attack. Therefore alternative 1 and 2 faces these technological barriers.

(c) Barriers related to local tradition

Discussions with the local communities have proven they have less knowledge in technical know-how, laws and regulations, present market conditions and practices relating to rubber plantations. They also lack knowledge on environmental friendly agricultural activities although agriculture has been their main income. Slash and burn practice is common among them. Therefore alternative 1 and 2 faces with barriers related to local tradition.

(d) Barriers due to local ecological conditions

The lands belonging to the project activity have been identified and classified as depleted and underutilized by the Government of Laos. Therefore unless proper silvicultural practices are applied, such lands cannot be replanted with rubber. Alternative 1 has barriers due to local ecological conditions.

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. Both alternatives 1 and 2 have these barriers.

(e) Barriers due to social conditions

Many villagers in surrounding area have been engaged in occupations related to agriculture such as labourers in agricultural fields and slash and burn. Many of their income generating opportunities have been collapsed due to various reasons including these agricultural industries being closing down. Majority of these villagers are also unskilled laborers. Therefore alternative 1 and 2 faces with barriers related to social conditions.

(f) Market related constraints:

The developer has high perceived market risk due to high cost of rubber production in these low productivity areas of depleted and underutilized, which make their rubber less competitive. Current market prices of rubber as well as expected rubber industry in Lao PDR provide solid proof for this. Many farmers are facing problems with selling their agricultural products at a reasonable price because

the middlemen in the business try to purchase products at a very low price. Both alternatives 1 and 2 faces with barriers related to market conditions.

Outcome of Step 2a: Barriers (a) to (f) are a list of barriers that may prevent one or more alternatives 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.

Outcome of Sub-step 2b: The land use types that are not prevented by any barriers are as follows.

Alternative 3: 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.

STEP 4: Common practice analysis

The Laos Rubber Master Plan (2006) has analyzed the present situation of rubber plantation in the country. The report states the following facts as limitations for extension of rubber planting in Lao PDR;

- Limited numbers of private investors due to the long immature period,
- Lack of Government Financing,
- Shortage of know-how to extend the sector: presently the only people trained for rubber industry is trained by commercial investors. The Government has no specific training program for all levels.
- Delay between the initiation of a project and its implementation (agreement, financing package)
- Few end-use of the rubber production presently in Lao PDR because high technology and capital input are out of reach for small market capacity countries.

The project developer is trying to remove above barriers 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 removed.
ii) Being an AR-CDM project, the developer expects more the technical support from government, non-government and universities to remove technical barriers
iii) The perceived market risk due to high cost of rubber production can be reduced through the additional revenue from the sale of tCERs.
iv) Since CDM project provides sustainable development of the region, nation as well as global level development, most of the social constrains can be minimized by registering this as an AR-CDM project.

The Board of Directors of the company were persuaded to approve this project based on the above. Without this revenue the company can not justify the project. In addition, the project participant attempts to develop this project activity as a pilot project to demonstrate that rubber projects can be developed as AR-CDM activities. This is important since so far no rubber forestation project have been registered as an AR-CDM project.

C.7. Estimation of the *ex ante* baseline net GHG removals by sinks:

>>

According to decision 5/CMP.1, Appendix A, paragraph 1 (c), "Baseline net greenhouse gas removals by sinks" is 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 afforestation or reforestation project activity under the clean development mechanism (CDM)

As per AR-ACM0002, the baseline is determined *ex ante* and remains fixed during the subsequent crediting period, therefore baseline is not monitored.

Under the applicability conditions of AR-ACM0002:

- Changes in carbon stock of above-ground and below-ground biomass of non tree vegetation may be conservatively assumed to be zero for all strata in the baseline scenario;

- Changes in carbon stock in soil organic carbon (SOC) may be conservatively assumed to be zero for all strata in the baseline scenario.

Therefore the baseline net GHG removals by sinks will be determined as:

$$\Delta C_{BSL} = \Delta C_{BSL,tree}$$

Where:

ΔC_{BSL} - Baseline net greenhouse gas removals by sinks; tCO_2-e

$\Delta C_{BSL,tree}$ - Sum of changes in carbon stocks in above-ground and below-ground biomass of trees in the baseline; tCO_2-e

For strata with no growing trees, ΔC_{BSL}= 0. For strata with a few growing trees, ΔC_{BSL} is estimated using following equations.

$$\Delta C_{BSL,tree,i} = \sum_{t=1}^{t^*} \Delta C_{BSL,AG/BG,i,t} * \frac{44}{12} * 1year$$

Where;

$\Delta C_{BSL,tree,i}$ - Sum of the baseline annual changes in carbon stocks in above-ground and below-ground tree biomass for stratum *i:* tCO_2-e

$\Delta C_{BSL,AG/BG,i,t}$ - Baseline annual net change in carbon stock in above-ground and below-ground tree biomass for stratum *i,* for year *t*: tCO_2-e

i - *1, 2, 3, M_B* strata in the baseline scenario

t - *1, 2, 3, t** years elapsed since the start of the AR-CDM project activity

44/12 - Ration of molecular weight of CO_2 to carbon; tCO_2-e

The $\Delta C_{BSL,AG/BG,i,t}$ was estimated using Carbon gain-loss method.

$$\Delta C_{BSL,AG/BG,i,t} = \Delta C_{G,i,t} - \Delta C_{L,i,t}$$

Where;

$\Delta C_{BSL,AG/BG,i,t}$ - Baseline annual net change in carbon stocks in above-ground and below-ground tree biomass for stratum *i,* for year *t*; t C $year^{-1}$

$\Delta C_{G,i,t}$ - Annual increase in above-ground and below-ground carbon due to biomass growth of living trees in stratum *i*, for year *t*; t C year^{-1}
Note: This is the "potential growth" which is greater than the "observed growth", i.e., $\Delta C_{BSL,AG/BG,i,t}$, by $\Delta C_{L,i,t}$.

$\Delta C_{L,i,t}$ - Annual decrease in above-ground and below-ground carbon stock of living trees due to tree biomass loss for stratum *i,* for year *t*; t C year^{-1}
Note: Conservative assumption that $\Delta C_{L,i,t} = 0$ is allowed for the baseline scenario.

i - *1, 2, 3,* M_B strata in the baseline scenario

t - *1, 2, 3,* *t** years elapsed since the start of the AR CDM project activity

$$\Delta C_{G,i,t} = A_{BSL,i} * \sum_{j=1}^{J} G_{tree,j,i,t} * CF_j$$

Where;

$\Delta C_{G,i,t}$ - Annual increase in carbon due to biomass growth of living trees in stratum *i*, for year *t*; t C year^{-1}

$A_{BSL,i}$ - Area of baseline stratum *i*; ha

$G_{tree,j,i,t}$ - Annual increment of total above-ground and below-ground dry biomass of living trees of species *j* in stratum *i*, for year *t*; t d.m. ha^{-1} year^{-1}

CF_j - Carbon fraction of dry matter for species *j*; t C t^{-1} d.m.

i - *1, 2, 3,* M_B strata in the baseline scenario

j - *1, 2, 3, ... J* tree species in the baseline scenario

t - *1, 2, 3,* *t** years elapsed since the start of the AR CDM project activity

$$G_{tree,j,i,t} = G_{w,j,i,t} * (1 + R_{1_j})$$

$$G_{w,j,i,t} = I_{V,j,i,t} * D_j * BEF_{1,j}$$

Where;

$G_{tree,j,i,t}$ - Annual increment of total above-ground and below-ground dry biomass of living trees of species *j* in stratum *i*, for year *t*; t d.m. ha^{-1} year^{-1}

$G_{w,j,i,t}$ - Average annual above-ground dry biomass increment of living trees of species *j* in stratum *i*, for year *t*; t d.m. ha^{-1} year^{-1}

R_{1_j} - Root-shoot ratio appropriate for biomass increment for species *j*; t d.m. t^{-1} d.m

$I_{V,j,,i,,t}$ - Current annual increment in stem volume of species *j* in stratum *i*, year *t*; m^3 ha^{-1} year^{-1}
Note: $I_{V,j,i,t}$ can be estimated as a constant annual average value over a period including the year *t* (Periodical Annual Increment).
Note: *t* is likely to be different than age of individual trees in the year *t*.

D_j - Basic wood density for species *j*; t d.m. m^{-3}

$BEF_{1,j}$ - Biomass expansion factor for conversion of annual net increment (including bark) in stem biomass to total above-ground tree biomass increment for species *j*; t d.m. t^{-1} d.m.

i - *1, 2, 3,* M_B strata in the baseline scenario

j - *1, 2, 3, ... J* tree species in the baseline scenario

t - *1, 2, 3,* *t** years elapsed since the start of the AR CDM project activity

ID number[3]	Data variable	Data unit	Value applied	Data Source	Comment
$G_{w,j,i,t}$	Average annual above-ground dry biomass increment of living trees of species *j* in stratum *i*, for year *t*;	t d.m. ha^{-1} $year^{-1}$	3.0	IPCC GPG-LULUCF, 2003 Table 3A.1.5	
R_I	Root-shoot ratio appropriate for biomass increment	t d.m. t^{-1} d.m	0.42	IPCC GPG-LULUCF, 2003 Table 3A.1.8	
$A_{BSL,i}$	Area of baseline stratum *i*	ha	65.17	Calculated using satellite maps	
CF_j	Carbon fraction of dry matter for species *j*	t C t^{-1} d.m.	0.5	IPCC Default value	

Table C.5. Annual estimation of baseline net anthropogenic GHG removals by sinks

[3] Please provide ID number for cross-referencing in the PDD.

Year	Annual estimation of baseline net anthropogenic GHG removals by sinks in tonnes of CO_2e
2008	138.81
2009	138.81
2010	138.81
2011	138.81
2012	138.81
2013	138.81
2014	138.81
2015	138.81
2016	138.81
2017	138.81
2018	138.81
2019	138.81
2020	138.81
2021	138.81
2022	138.81
2023	138.81
2024	138.81
2025	138.81
2026	138.81
2027	138.81
2028	138.81
2029	138.81
2030	138.81
2031	138.81
2032	138.81
2033	138.81
2034	138.81
2035	138.81
2036	138.81
2037	138.81
Total estimated baseline net GHG removals by sinks (tonnes of CO_2 e)	4164.36
Total number of crediting years	30
Annual average over the crediting period of estimated baseline net GHG removals by sinks (tonnes of CO_2 e)	138.81

C.8. Date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

>>
6th August 2008

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SECTION D. Estimation of *ex ante* actual net GHG removals by sinks, leakage and estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period

D.1. Estimate of the *ex ante* actual net GHG removals by sinks:

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Ex ante actual net GHG removals by sinks were calculated using the following equations from AR-ACM0002. A conservative approach was used in making estimates for values. Therefore;

$$\Delta C_{ACTUAL} = \Delta C_P - GHG_E$$

Where;

ΔC_{ACTUAL} - Actual net greenhouse gas removals by sinks; t CO_2-e

ΔC_P - Sum of changes in the C stocks in all selected carbon pools and the loss of existing (pre-project) woody non-tree biomass due to site-preparation, and/or to competition from forest (or other vegetation) planted as part of the AR-CDM project activity in the project scenario; t CO_2-e

GHG_E - Increase in non-CO_2 GHG emissions as a result of the implementation of the proposed AR-CDM project activity within the project boundary; t CO_2-e

1. Estimation of changes in the carbon stocks

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.

$$\Delta C_P = \sum_{t=1}^{t^*} \Delta C_t * \frac{44}{12} * 1 year - E_{BiomassLoss}$$

Where;

ΔC_P - Sum of the changes in C stock in all selected carbon pools and the loss of existing (pre-project) woody non-tree biomass due to site-preparation, and/or to competition from forest (or other vegetation) planted as part of the AR-CDM project activity in the project scenario; t CO_2-e

ΔC_t - Annual change in carbon stock in all selected carbon pools for year *t* (excluding loss of existing (pre-project) biomass due to site-preparation (including burning), and/or to competition from forest (or other vegetation) planted as part of the AR-CDM project activity); t C $year^{-1}$

$E_{BiomassLoss}$ - Increase in CO2 emissions from loss of existing (pre-project) woody non-tree biomass due to site-preparation (including burning), and/or to competition from forest (or other vegetation) planted as part of the AR-CDM project activity; t CO_2-e

t - *1, 2, 3, ...t** years elapsed since the start of the AR project activity; year

44/12 - Ratio of molecular weights of CO_2 and carbon; t CO_2-e t^{-1} C

The methodological tool "Estimation of emissions from clearing, burning and decay of existing vegetation due to implementation of an A/R CDM project activity" (Version 02, EB 42) was used to estimate the $E_{BiomassLoss}$. The project participant have selected not to account emissions from felling, clearance, decay or burning of existing biomass during site preparation since it has met the following conditions.

Evidence collected both by the project participants and village chief from all three 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.

Further, in accordance with the guidance contained in paragraph 35 of the EB 42 meeting report, GHG emissions due to removal of herbaceous vegetation as a component of non-tree vegetation are neglected under applicability conditions of AR-ACM0002. Therefore since the criteria under Section II of the methodological tool have been met, the emissions from felling, clearance, decay or burning of existing biomass during site preparation have not been accounted.

ΔC_t was estimated using the following equation:

$$\Delta C_t = \sum_{i=1}^{M_{PS}} (\Delta C_{AG,i,t} + \Delta C_{BG,i,t} + \Delta C_{d,SOC_t})$$

Where;

ΔC_t - Annual change in carbon stock in all selected carbon pools for year *t* (excluding loss of existing (pre-project) biomass due to site-preparation (including burning), and/or to competition from forest (or other vegetation) planted as part of the AR-CDM project activity); t C year^{-1}

$\Delta C_{AG,i,t}$ - Annual change in carbon stock in above-ground biomass of trees for stratum *i*, (possibly average over a monitoring period); t C year^{-1}

$\Delta C_{BG,i,t}$ - Annual change in carbon stock in below-ground biomass of trees for stratum *i*, (possibly average over a monitoring period); t C year^{-1}

$\Delta C_{d,SOCt}$ - Default annual change in carbon stock in the soil organic carbon pool for time *t* t C year^{-1}

i - *1, 2, 3, ... M_{PS}* strata in the project scenario

t - *1, 2, 3, ... t** years elapsed since the start of the AR-CDM project activity

For this reforestation project activity $\Delta C_{d,SOCt}$ was excluded from accounting and therefore no soil organic carbon was estimated.

The planting of trees will be in 2008, 2009 and 2010. Therefore i = 1, 2, 3. t = 1, 2, 3, …, 30 since the project period is 30 years.

1.1 Changes in Carbon Stock in Tree Biomass

Step 1: The mean carbon stock in above-ground and below-ground biomass per unit area was estimated using the Biomass Expansion Factors (BEF) method.

$$C_{AB\_tree,l,j,i,sp,t} = V_{l,j,i,sp,t} * D_j * BEF_{2,j} * CF_j$$

Where;

$C_{AB\_tree,l,j,i,sp,t}$ - Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}

$V_{l,j,i,sp,t}$ - Stem volume of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; m^3 tree^{-1}

D_j - Basic wood density of species *j*; t d.m. m^{-3}

BEF_{2j} - Biomass expansion factor for conversion of stem biomass to above-ground tree biomass for species *j*; dimensionless

CF_j - Carbon fraction of biomass for tree species *j*; t C t^{-1} d.m.

l - Sequence number of trees on plot *sp*

i -*1, 2, 3, ... M_{PS}* strata in the project scenario

j -*1, 2, 3, ... S_{PS}* tree species in the project scenario

t - *1, 2, 3, ... t** years elapsed since the start of the AR-CDM project activity

Since the only species used for the project was rubber, *j* = 1.

Step 2: The carbon stock in above-ground biomass was converted to the carbon stock in below-ground biomass using following equation.

$$C_{BB\_tree,l,j,i,sp,t} = C_{AB\_tree,l,j,i,sp,t} * R_j$$

Where;

$C_{BB\_tree,l,j,i,sp,t}$ - Carbon stock in below-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}

$C_{AB\_tree,l,j,i,sp,t}$ - Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}

R_j - Root-shoot ratio appropriate for biomass stock, for species *j*; dimensionless

ID number[4]	Data variable	Data unit	Value applied	Data Source	Comment
D_j	Basic wood density of rubber	t d.m. m^{-3}	0.53	IPCC GPG-LULUCF, 2003 Table 3A.1.9-2	
$V_{l,j,i,sp,t}$	Stem volume of rubber tree	m^3 tree^{-1}		Estimated using regional data	
BEF_2	Biomass expansion factor for conversion of stem biomass to above-ground tree biomass for rubber	t d.m t^{-1} d.m.	1,2	IPCC GPG-LULUCF, 2003 Table 3A.1.10	
CF_j	Carbon fraction of biomass for	t C t^{-1} d.m.	0.5	IPCC default value	
R_j	Root-shoot ratio appropriate for biomass stock, for rubber	t C t^{-1} C	0.26, 0.43	IPCC GPG-LULUCF, 2003 Table 3A.1.8	

According to AR-ACM0002 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 Annex 08.

Step 3: Using above values, the carbon stock in above-ground and below-ground biomass was calculated for all trees in plot *sp* in stratum *i* at time *t* (i.e. the summation over all trees *l* by species *j* followed by summation over all species *j* present in plot *sp*). The following equation was used.

$$C_{tree,i,sp,t} = \sum_{j=1}^{S_{ps}} \sum_{l=1}^{N_{j,i,sp,t}} (C_{AB\_tree,l,j,i,sp,t} + C_{BB\_tree,l,j,i,sp,t})$$

Where;

$C_{tree,i,sp,t}$ - Carbon stock in trees on plot *sp* of stratum *i* at time *t*; t C

[4] Please provide ID number for cross-referencing in the PDD.

$C_{BB\_tree,l,j,i,sp,t}$ - Carbon stock in below-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}
$C_{AB\_tree,l,j,i,sp,t}$ - Carbon stock in above-ground biomass of tree *l* of species *j* in plot *sp* in stratum *i* at time *t*; t C tree^{-1}
$N_{j,i,sp,t}$ - Number of trees of species *j* on plot *sp* of stratum *i* at time *t*
l - Sequence number of trees on plot *sp*
i - *1, 2, 3, ...* M_{PS} strata in the project scenario
j - *1, 2, 3, ...* S_{PS} tree species in the project scenario
t - *1, 2, 3, ... t** years elapsed since the start of the AR-CDM project activity

Step 4: The mean carbon stock in tree biomass for each stratum were calculated.

$$C_{tree,i,t} = \frac{A_i}{A_{sp_i}} \sum_{sp=1}^{P_i} C_{tree,i,sp,t}$$

Where;
$C_{tree,i,t}$ - Carbon stock in trees in stratum *i*, at time *t*; t C
$C_{tree,i,sp,t}$ - Carbon stock in trees on plot *sp* of stratum *i* at time *t*; t C
A_{spi} - Total area in all sample plots in stratum *i*; ha
A_i - Area of stratum *i*; ha
sp - *1, 2, 3, ...* P_i sample plots in stratum *i* in the project scenario
i - *1, 2, 3, ...* M_{PS} strata in the project scenario
t - *1, 2, 3, ... t** years elapsed since the start of the AR-CDM project activity

Table D.1 Area planted in each year

Stratum number	Area of stratum *i* (ha)
i = 1	A_1 = 547.0
i = 2	A_2 = 55.7
i = 3	A_3 = 397.3

Step 5: Annual changes in carbon stocks were calculated using the following equation.

$$\Delta C_{AG,i,t} + \Delta C_{BG,i,t} = \frac{C_{tree,i,t_2} - C_{tree,i,t_1}}{T}$$

Where;
$\Delta C_{AG,i,t}$ - Annual change in carbon stock in above-ground biomass of trees for stratum *i*; t C year^{-1}
$\Delta C_{BG,i,t}$ - Annual change in carbon stock in below-ground biomass of trees for stratum *i*; t C year^{-1}
$C_{tree,i,t}$ - Carbon stock in trees in stratum *i*, at time *t*; t C
T - Number of years between monitoring time *t*2 and *t*1 ($T = t2 - t1$); year
i - *1, 2, 3, ...* M_{PS} strata in the project scenario
t - *1, 2, 3, ... t** years elapsed since the start of the AR-CDM project activity

1.2.2 ***GHG emissions from fertilizer application***

The tool "Estimation of direct nitrous oxide emission from nitrogen fertilization" (Version 01, Annex 16 of EB 33) was used in calculating the GHG emissions from fertilizer application.
The direct nitrous oxide emissions from nitrogen fertilization were estimated using the following equations.

$$N_2O_{direct-N,t} = \left(F_{SN,t} + F_{ON,t}\right) \cdot EF_1 \cdot MW_{N_2O} \cdot GWP_{N_2O}$$

$$F_{SN,t} = \sum_i^I M_{SF_i,t} \cdot NC_{SF_i} \cdot (1 - Frac_{GASF})$$

$$F_{ON,t} = \sum_j^J M_{OF_j,t} \cdot NC_{OF_j} \cdot (1 - Frac_{GASM})$$

Where;

$N_2O_{direct-N,t}$	- Direct N_2O emission as a result of nitrogen application within the project boundary, tCO_2-e in year t
$F_{SN,t}$	- Mass of synthetic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X, tN in year t
$F_{ON,t}$	- Mass of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X, tN in year t
$M_{SFi,t}$	- Mass of synthetic fertilizer type *i* applied, tonne in year t
$M_{OFj,t}$	- Mass of organic fertilizer type *j* applied, tonne in year t
EF_1	- Emission Factor for emissions from N inputs, tonne-N_2O-N (t-N input)$^{-1}$
$Frac_{GASF}$	- Fraction that volatilizes as NH_3 and NO_X for synthetic fertilizers, dimensionless
$Frac_{GASM}$	- Fraction that volatilizes as NH_3 and NO_X for organic fertilizers, dimensionless
MW_{N2O}	- Ratio of molecular weights of N_2O and N (44/28), tonne-N_2O (t-N)$^{-1}$
GWP_{N2O}	- Global Warming Potential for N_2O, kg-CO_2-e (kg-N_2O)$^{-1}$ (IPCC default = 310, valid for the first commitment period)
NC_{SFi}	- Nitrogen content of synthetic fertilizer type i applied, g-N (100 g fertilizer)$^{-1}$
NC_{OFj}	- Nitrogen content of organic fertilizer type j applied, g-N (100 g fertilizer)$^{-1}$
I	- Number of synthetic fertilizer types
J	- Number of organic fertilizer types

ID number[5]	Data variable	Data unit	Value applied	Data Source	Vintage
EF_1	Emission Factor for emissions from N inputs	tonne-N_2O-N (t-N input)$^{-1}$	0.01	IPCC 2006 Guidelines	Most updated
$Frac_{GASF}$	Fraction that volatilizes as NH_3 and NO_X for synthetic fertilizers	dimensionless	0.1	IPCC 2006 Guidelines	Most updated
$Frac_{GASM}$	Fraction that volatilizes as NH_3 and NO_X for organic fertilizers	dimensionless	0.2	IPCC 2006 Guidelines	Most updated
$F_{SN,t}$	Mass of synthetic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X	tN in year t		Estimated	Annually
$F_{ON,t}$	Mass of organic fertilizer nitrogen applied adjusted for volatilization as NH_3 and NO_X	tN in year t		Estimated	Annually
NC_{SFi}	Nitrogen content of synthetic fertilizer type i applied	g-N (100 g fertilizer)$^{-1}$	0.2	Producers of synthetic fertilizers purchased	Before project starts
NC_{OFj}	Nitrogen content of organic fertilizer type j applied	g-N (100 g fertilizer)$^{-1}$	0.0107	Organic fertilizer manufacturer or lab determination	Before project starts
MW_{N2O}	Ratio of molecular weights of N_2O and N	tonne-N_2O (t-N)$^{-1}$	44/28	Default data	Most updated
GWP_{N2O}	Global Warming Potential for N_2O	kg-CO_2-e (kg-N_2O)$^{-1}$	310	IPCC Default data	Most updated

Table D.2 Estimation of GHG emissions from fertilizer application

[5] Please provide ID number for cross-referencing in the PDD.

Year	Mass of synthetic fertilizer	Mass of organic fertilizer	Mass of synthetic fert. Nitrogen applied adjusted for volatilization as NH_3 & NO_x	Mass of organic fert. Nitrogen applied adjusted for volatilization as NH_3 & NO_x	Emission factor for emissions from N inputs	Ratio of molecular weights of N_2O & N	Global warming potential for N_2O	Direct N_2O emission
	$M_{SFi,t}$	$M_{OF,j,t}$	$F_{SN,t}$	$F_{ON,t}$	EF_1	MW_{N2O}	GWP_{N2O}	$N_2O_{direct\text{-}N,t}$
	t	t	t-N	t-N	N_2O-N (t-N input)$^{-1}$	t N_2O (t-N)$^{-1}$	g-CO_2e (kg N_2O	tCO_2e
2008	56	120	10.08	1.03	0.01	1.57	310	54.11
2009	128	400	23.04	3.42	0.01	1.57	310	128.92
2010	120	800	21.60	6.85	0.01	1.57	310	138.58
2011	144	800	25.92	6.85	0.01	1.57	310	159.63
2012	152	800	27.36	6.85	0.01	1.57	310	166.64
2013	160	800	28.80	6.85	0.01	1.57	310	173.66
2014	160	2,000	28.80	17.12	0.01	1.57	310	223.70
2015	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2016	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2017	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2018	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2019	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2020	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2021	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2022	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2023	200	2,000	36.00	17.12	0.01	1.57	310	258.77
2024	150	2,000	27.00	17.12	0.01	1.57	310	214.93
2025	150	2,000	27.00	17.12	0.01	1.57	310	214.93
2026	150	2,000	27.00	17.12	0.01	1.57	310	214.93
2027	150	2,000	27.00	17.12	0.01	1.57	310	214.93
2028	150	2,000	27.00	17.12	0.01	1.57	310	214.93
2029	100	2,000	18.00	17.12	0.01	1.57	310	171.08
2030	100	2,000	18.00	17.12	0.01	1.57	310	171.08
2031	100	2,000	18.00	17.12	0.01	1.57	310	171.08
2032	100	2,000	18.00	17.12	0.01	1.57	310	171.08
2033	100	2,000	18.00	17.12	0.01	1.57	310	171.08
2034	100	2,000	18.00	17.12	0.01	1.57	310	171.08
2035	100	2,000	18.00	17.12	0.01	1.57	310	171.08
2036	100	2,000	18.00	17.12	0.01	1.57	310	171.08
2037	100	2,000	18.00	17.12	0.01	1.57	310	171.08

D.2. Estimate of the *ex ante* leakage:

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The project has identified degraded and abandoned lands for the reforestation activity. Under applicability conditions of AR-ACM0002, the land used for this project can continue to provide same amount of goods and services. Consequently, as a result of this proposed AR-CDM project, there will not be any displacement of activities to other locations.

Further, 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.

The tool "Estimation of GHG emissions related to displacement of grazing activities in A/R CDM project activity" (Version 2) Annex 12 of EB 39 was used in identification of leakages due to displacement of grazing activities. According to the Flow chart for estimation process since there will be no displacement of grazing activities within the project area, the leakage will be zero. The project participant will also make sure that no grazing activity will be allowed within the project period. A wooden fence will be constructed all around the project boundary.

The tool "Calculation of GHG emissions due to leakage from increased use of non-renewable woody biomass attributable to an A/R CDM project activity" (Version 01) Annex 11 of EB 39 was used to calculate the leakage due to use of non-renewable woody biomass for fences. Total length of the fence is 22.739 km and the following table presents the amount of wooden poles used. Average weight of a pole was estimated as 5 kg.

Table D.3 Quantity of poles used for fencing

Year	Distance (km)	Poles
2008	9.827	7000
2009	12.912	14472

The project participant will use 80% of these poles from renewable sources and 20% from non-renewable sources. The definition of renewable biomass (Annex 18 of EB 23) was used in identifying renewable biomass for the project activity. The use of wooden poles will be replaced at the end of 3rd year. Non-wooden fences will be used from the 4th year of project commencement.

The calculations were based on following equations:

$$\Delta WB_{NRB,y} = \Delta WB_{used,y} - \Delta WB_{\mathrm{Re}newable,y}$$

$$LK_{NRB,y} = \Delta WB_{NRB,y} * BEF_2 * CF * (1+R) * \frac{44}{12}$$

Where:

$\Delta WB_{NRB,y}$ - Increase in woody biomass, over its use in the baseline scenario, that comes from non-renewable sources in year *y*, t d.m.

$\Delta WB_{used,y}$ - Increase in woody biomass, over its use in the baseline scenario, from sources outside of the project boundary due to project implementation in year *y*, t d.m.

$\Delta WB_{Renewable,y}$ - Increase in woody biomass, over its use in the baseline scenario, that comes from renewable sources from outside the project boundary in year *y*, t d.m.

$LK_{NRB,y}$ - Leakage from the increase in woody biomass, over its use in the baseline scenario, that comes from non-renewable sources due to project implementation in year *y*, t CO_2

BEF_2 - Biomass expansion factor for converting biomass of extracted round wood to total above-ground biomass (including bark); t d.m t^{-1} d.m.

CF - Carbon fraction of dry matter; t C t^{-1} d.m.

R - Average root-to-shoot ratio for the species of trees from which the woody biomass originates; t C t^{-1} C

ID number[6]	Data variable	Data unit	Value applied	Data Source	Comment
$\Delta WB_{used,y}$	Increase in woody biomass, over its use in the baseline scenario, from sources outside of the project boundary due to project implementation in year *y*	t d.m.		Direct measurement by sampling and weighing of wooden poles	
$\Delta WB_{Renewable,y}$	Increase in woody biomass, over its use in the baseline scenario, that comes from renewable sources from outside the project boundary in year *y*	t d.m.		Estimated using project records	
BEF_2	Biomass expansion factor for converting biomass of extracted round wood to total above-ground biomass (including bark)	t d.m t^{-1} d.m.	3.4	IPCC GPG-LULUCF, 2003 Table 3A.1.10	
CF	Carbon fraction of dry matter	T C t^{-1} d.m.	0.5	IPCC default value	
R	Average root-to-shoot ratio for the species of trees from which the woody biomass originates	t C t^{-1} C	0.3	Conservative default value of the methodological tool	

Table D.4 Estimates of *ex-ante* Leakage

[6] Please provide ID number for cross-referencing in the PDD.

Year	t	Increase in woody biomass from sources outside (t d.m.) $\Delta WB_{used,y}$	Increase in woody biomass from renewable sources (t d.m.) $\Delta WB_{Renewable,y}$	Increase in woody biomass from non renewable sources (t d.m.) $\Delta WB_{NRB,y}$	Biomass expansion factor (td.m t^{-1}d.m.) BEF_2	Carbon fraction of dry matter (tC t^{-1}d.m.) CF	Root-shoot Ratio (tC t^{-1}C) R	Leakages from increase in woody biomass from non renewable sources (tCO_2) $LK_{NRB,y}$
2008	1	35	28.00	7.00	3.4	0.5	0.3	56.72
2009	2	72.36	57.89	14.47	3.4	0.5	0.3	117.27
2010	3	107.36	85.89	21.47	3.4	0.5	0.3	173.99
2011	4	0	0.00	0.00	3.4	0.5	0.3	0.00
2012	5	0	0.00	0.00	3.4	0.5	0.3	0.00
2013	6	0	0.00	0.00	3.4	0.5	0.3	0.00
2014	7	0	0.00	0.00	3.4	0.5	0.3	0.00
2015	8	0	0.00	0.00	3.4	0.5	0.3	0.00
2016	9	0	0.00	0.00	3.4	0.5	0.3	0.00
2017	10	0	0.00	0.00	3.4	0.5	0.3	0.00
2018	11	0	0.00	0.00	3.4	0.5	0.3	0.00
2019	12	0	0.00	0.00	3.4	0.5	0.3	0.00
2020	13	0	0.00	0.00	3.4	0.5	0.3	0.00
2021	14	0	0.00	0.00	3.4	0.5	0.3	0.00
2022	15	0	0.00	0.00	3.4	0.5	0.3	0.00
2023	16	0	0.00	0.00	3.4	0.5	0.3	0.00
2024	17	0	0.00	0.00	3.4	0.5	0.3	0.00
2025	18	0	0.00	0.00	3.4	0.5	0.3	0.00
2026	19	0	0.00	0.00	3.4	0.5	0.3	0.00
2027	20	0	0.00	0.00	3.4	0.5	0.3	0.00
2028	21	0	0.00	0.00	3.4	0.5	0.3	0.00
2029	22	0	0.00	0.00	3.4	0.5	0.3	0.00
2030	23	0	0.00	0.00	3.4	0.5	0.3	0.00
2031	24	0	0.00	0.00	3.4	0.5	0.3	0.00
2032	25	0	0.00	0.00	3.4	0.5	0.3	0.00
2033	26	0	0.00	0.00	3.4	0.5	0.3	0.00
2034	27	0	0.00	0.00	3.4	0.5	0.3	0.00
2035	28	0	0.00	0.00	3.4	0.5	0.3	0.00
2036	29	0	0.00	0.00	3.4	0.5	0.3	0.00
2037	30	0	0.00	0.00	3.4	0.5	0.3	0.00

SECTION E. Monitoring Plan

E.1. Monitoring of the project implementation:

>>

Monitoring will be organized according to Section III of AR-ACM0002. 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.

E.1.1. Monitoring of forest establishment and management:

>>

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 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.

ID number[7]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[8]	Recording frequency	Number of data points / Other measure of number of collected data.	Comment
GPS1	GPS coordinates	Numeric	M – using GPS	Start of the project and once in every 5 years	100%	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.

Rubber tree establishment and management

[7] Please provide ID number for cross-referencing in the PDD.

[8] Please provide full reference to data source.

The planting of rubber trees will be done properly planned according to the Management Plan of LTR Co. Ltd. The plan has all the instruction 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-ACM0002.

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.

ID number[9]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[10]	Recording frequency	Number of data points / Other measure of number of collected data.	Comment
	Site preparation		M	At each planting period	100%	To ensure planting in done according to the Management Plan of LTR Co. Ltd.
	Survival rate	%	M	3 months after planting and 3 years		Calculated in permanent sample plots that are established

[9] Please provide ID number for cross-referencing in the PDD.

[10] Please provide full reference to data source.

				after planting		

E.1.2. If required by the selected approved methodology, describe or provide reference to, SOPs and quality control/quality assurance (QA/QC) procedures applied.

>>

Not applicable.

Commonly accepted practices of forest management will be adopted by the project participant.

ID number[11]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[12]	Recording frequency	Number of data points / Other measure of number of collected data.	Comment
N/A						

E.2. Sampling design 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. Further information will be presented to DOE at validation.

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

- *Ex post* stratification

Ex post stratification will be studied and evaluated during each monitoring. 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.

[11] Please provide ID number for cross-referencing in the PDD.

[12] Please provide full reference to data source.

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 Winrock Terrestrial Sampling Calculator (Walker, S.M., Pearson, T., Brown, S. 2007) from http://www.winrock.org/Ecosystems/tools.asp. The targeted precision for biomass estimation within each stratum was +/- 10% of the mean at a 95% confidence interval. Total number of sample plots is 45 (2008 stratum – 26, 2009 stratum – 3 and 2010 stratum – 16)

E.3. Monitoring of the baseline net GHG removals by sinks, if required by the selected approved methodology:

>>

According to AR-ACM0002 the baseline is determined *ex ante* and will remain fixed during the entire crediting period. Therefore no monitoring of the baseline is needed.

ID number[13]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[14]	Recording frequency	Number of sample plots at which the data will be monitored	Comment
N/A						

E.4. Monitoring of the actual net GHG removals by sinks:

>>The following data in E.4.1 will be monitored during the project activity. The project participant has retained a conservative approach when estimates were made using measured and existing published data.

[13] Please provide ID number for cross-referencing in the PDD.

[14] Please provide full reference to data source.

PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 04

E.4.1. Data to be collected in order to monitor the verifiable changes in carbon stock in the carbon pools within the project boundary resulting from the proposed A/R CDM project activity:

>>

ID number[15]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[16]	Recording frequency	Number of sample plots at which the data will be monitored	Comment
A_i	Area of stratum *i*	ha	M	5 year	100%	Will be using Geographic Information System (GIS). GPS will be used to obtain coordinates
A_{spi}	Total area of all sample plots in stratum *i*	ha	M	5 year	100%	Field measurement
DBH	Diameter breast height of tree	cm	M	Annually	100%	Field measurement in sample plots. For *ex ante* estimations, mean *DBH* values have been estimated for rubber tree using growth models and yield tables.
H	Height of tree	m	M	Annually	100%	Field measurement in sample plots. For *ex ante* estimations, mean *H* values have been estimated for rubber tree using growth models and yield tables.
t_2 and t_1	Years of monitoring activity	year	M	5 year	100%	Used for calculation: $T = t_2 - t_1$
N	Number of trees	Numeric value	M	5 year	100%	Field measurement in sample plots.
$V_{l,j,I,sp,t}$	Stem volume of tree	m^3 $tree^{-1}$	C	5 year	100%	Calculated using allometric equations using *DBH* and *H*
D_j	Basic wood density	t d.m. m^{-3}	E	5 year	100%	Species specific value

[15] Please provide ID number for cross-referencing in the PDD.

[16] Please provide full reference to data source.

	of Rubber					
$BEF_{2,j}$	Biomass expansion factor for Rubber	-	E	5 year	100%	Species specific value
CF_j	Carbon fraction of dry matter for Rubber	tC t^{-1}d.m	D	5 year	100%	IPCC Default value
R_j	Root-shoot ratio appropriate for biomass stock	d.m kg^{-1} d.m	E	5 year	100%	Species specific value

PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 04

E.4.2. Data to be collected in order to monitor the GHG emissions by the sources, measured in units of CO_2 equivalent, that are increased as a result of the implementation of the proposed A/R CDM project activity within the project boundary:

>>

Data and parameters monitored in estimating GHG emissions related to fossil fuel combustion

ID number[17]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[18]	Recording frequency	Number of sample plots at which the data will be monitored	Comment
N/A						

[17] Please provide ID number for cross-referencing in the PDD.

[18] Please provide full reference to data source.

Data and parameters monitored in estimating direct nitrous oxide emissions from nitrogen fertilization.

ID number[19]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[20]	Recording frequency	Number of sample plots at which the data will be monitored	Comment
$M_{SFi,t}$	Mass of synthetic fertilizer type *i* applied in year t	t	M	Annually	100%	Keep records of quantities purchased and used. Cross check with synthetic fertilizer purchased and quantity used and total area applied at project level
$M_{OFj,t}$	Mass of organic fertilizer type *j* applied in year t	t	M	Annually	100%	Keep records of quantities purchased and used. Cross check with organic fertilizer purchased and quantity used and total area applied at project level

[19] Please provide ID number for cross-referencing in the PDD.

[20] Please provide full reference to data source.

E.5. 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.

E.5.1. If applicable, please describe the data and information that will be collected in order to monitor leakage of the proposed A/R CDM project activity:

>>

ID number[21]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[22]	Recording frequency	Number of data points	Comment
$\Delta WB_{used,y}$	Increase in woody biomass, over its use in the baseline scenario, from sources outside of the project boundary due to project implementation in year *y*	t d.m	M – data maintained by the project	Annually	100%	Taking samples and weighing
$\Delta WB_{Renewable,y}$	Increase in woody biomass, over its use in the baseline scenario, that comes from renewable sources from outside the project boundary in year *y*	t d.m	M – data maintained by the project	Annually	100%	The definition of renewable biomass provided by Executive Board will be used to identify renewable biomass
BEF_2	Biomass expansion factor for converting biomass of extracted round wood to total above-ground biomass (including bark)	t d.m t^{-1} d.m.	D - IPCC GPG-LULUCF, 2003 Table 3A.1.10	5 year	100%	

[21] Please provide ID number for cross-referencing in the PDD.

[22] Please provide full reference to data source.

CF	Carbon fraction of dry matter	t C t^{-1} d.m.	D – IPCC default value	5 year	100%	
R	Average root-to-shoot ratio for the species of trees from which the woody biomass originates	t C t^{-1} C	D - Conservative default value of the methodological tool	5 year	100%	

E.5.2. Specify the procedures for the periodic review of implementation of activities and measures to minimize leakage, if required by the selected approved methodology:

>>

Not applicable

E.6. Provide any additional quality control (QC) and quality assurance (QA) procedures undertaken for data monitored not included in section E.1.3:

>>

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 will be 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.

(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.

Data *(Indicate ID number)*	Uncertainty level of data (High/Medium/Low)	**Explain QA/QC procedures planned for these data, or why such procedures are not necessary.**

E.7. Please describe the operational and management structure(s) that the project operator will implement in order to monitor actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity:

>>

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 Annex 04 presents the arrangements adopted in implementing and monitoring the project activities. Further details on the infra-structure of project entity will be presented to the DOE at time of validation.

E.8. Name of person(s)/entity(ies) applying the monitoring plan:

>>

The following team assisted the project participant in preparing the baseline and monitoring methodology.

Dr. Marc Morival: Prime Consultancy Co. Ltd, Lao PDR
S. Anuradha Vanniarachchy: Prime Consultancy Co. Ltd, Lao PDR
Dr. Chanthaphone PHON-ASA, Faculty of Forestry, National University of Laos

SECTION F. Environmental impacts of the proposed A/R CDM project activity:

F.1. Documentation on the analysis of the environmental impacts, including impacts on biodiversity and natural ecosystems, and impacts outside the project boundary of the proposed A/R CDM project activity:

>>

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 is poor. Soil erosion is common in these soils due to lack of soil conservation techniques. If the project is not implemented, the lands will 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 1m 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.

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.

F.2. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken an environmental impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation:

>>

No significant negative environmental impacts have been identified due to environmentally friendly techniques adopted by this AR-CDM project activity. However the IEE have 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 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.

F.3. Description of planned monitoring and remedial measures to address significant impacts referred to in section F.2. above:

>>

The project is totally complying with the country's environmental strategy and follows the proper guidelines and regulations. An IEE have been conducted and further impact assessments will be conducted as and when required. 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 monitoring plan has included monitoring of proper forest management that will ensure least negative environmental impacts. Some of the measures are given below:

Mitigatory and monitoring measures

(1) Risk of been a monoculture:
Mitigation measures will be taken to avoid the potential negative impacts of establishing pure Rubber plantations including careful pest control, low planting density and appropriate fertilizer application. A separate area of land is considered as conservation forest. Heavily degraded steep areas and trees along water bodies are protected by the project participant. Lands that are reforested are degraded lands and therefore increase in biodiversity will be occurred due to the project activity.

(2) 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.

(3) 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.

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

(5) 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.

(6) Monitoring fauna and flora
Killing any wildlife in and around the project area by the employees has been strictly prohibited by the management. The field manager will monitor this and take necessary actions if such incident occurs.

SECTION G. Socio-economic impacts of the proposed A/R CDM project activity:

G.1. Documentation on the analysis of the major socio-economic impacts, including impacts outside the project boundary of the proposed A/R CDM project activity:

>>

The lands identified for the project are abandoned and underutilized areas which belong to 402 families in 3 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

Low income families in the area will get more opportunities to increase their income. This will be a support for their livelihood. 73% live below the official poverty line. Incentives to workers will be provided during peak seasons. A comparison of income to the villagers from land was done with and without the project and is presented in Annex 05. According to the results before the project villagers had an average annual income of US $ 346 per ha. Once the project is implemented the average annual income is US $ 481 per ha. The project will pay for land and other taxes and contribute to the village funds.

(2) New employment opportunities

Skilled and unskilled labour will be needed for this project during its period. 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 better employment. As a result only the children and older generation were remained in most of the families. Due to this many youth had stopped going to school at younger ages. This situation will change due to newly created employment from the project. Youth would have the opportunity to both work and study.

(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.

Figure F.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 Stake holders' comments. There are no historically or culturally important places that would affect within the planting areas.

G.2. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken a socio-economic impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to supporting documentation:

>>

There are no significant negative socio-economic impacts under this project activity.

G.3. Description of planned monitoring and remedial measures to address significant impacts referred to in section G.2 above:

>>

People from outside the region coming for employment will be monitored and illicit liquor, gambling among the employees will be prohibited by the project developer. The field manager will monitor this and take necessary actions if such incident occurs.

If the project activity fails by lack of proper pest and fire control, there is a risk of loosing employment and it will affect the economy in the area. However this anticipated risk will be mitigated by providing proper know-how on forest management and continuous monitoring.

SECTION H. Stakeholders' comments:

H.1. Brief description of how comments by local stakeholders have been invited and compiled:

>>

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.

District officials from Pakkading District and village chiefs/villagers were extensively consulted during the preparation phase November 2007-May 2008. The Vice Governor Mr. Langsy of the District 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 3 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 stake holders' 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, 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 villagers are benefited from the project since they receive additional income from getting employment opportunities in various places including plant nurseries and replanting sites. Therefore they have no objection.

H.2. Summary of the comments received:

>>

There were no objections to this project since the villagers get new employment opportunities. Village chiefs expressed their support as villagers would receive jobs, training 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 to practice slash and burn cultivation since 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 will lose their livelihood of slash and burn practice will stop 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.

H.3. Report on how due account was taken of any comments received:

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The comments received from the stake holders 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.

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.

Annex 01

CONTACT INFORMATION ON PARTICIPANTS IN THE PROPOSED A/R CDM PROJECT ACTIVITY

Organization:	**Lao Thai Hua Rubber Company Limited**
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City:	Vientiane
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URL:	www.laothaihua.com
Represented by:	
Title:	Managing Director
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Annex 02

INFORMATION REGARDING PUBLIC FUNDING

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

Annex 03

BASELINE INFORMATION

The proposed project activity will be implemented on degraded and underutilized lands in Huay Hai, Huay Phet 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. Lands with heavily degraded condition (bare land) – 256.59 ha
2. Lands covered with grass and few cash crops. (these lands were having frequent fire due to slash and burn practices) – 422.10 ha
3. Lands with shrubs on degraded soil – 256.14 ha
4. Lands with few growing trees – 175.50 ha
5. Lands with trees which are excluded from the project – 45.90 ha

Dense forests which were identified by the satellite images were excluded from any kind of planting and were considered as protected areas. All five land use types were observed in all areas belonging to Huay Hai, Huay Phet and Nam Sang. 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 three villages were interviewed as the next step to identify the land use type of these lands. 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.

In accordance with the approved methodology AR-ACM0002 (Version 01, Sectoral Scope 14, EB 46) baseline stratification can be done according to the major vegetation types. Therefore major vegetation types that were considered for baseline net GHG removals by sinks were;

1. Lands with heavily degraded condition (bare land) – 256.59 ha
2. Lands covered with grass and few cash crops. (these lands were having frequent fire due to slash and burn practices) – 422.10 ha
3. Lands with shrubs on degraded soil – 256.14 ha
4. Lands with few growing trees – 175.50 ha

There were 678.69 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. Commonly found grasses included the following.

No.	Local name	Scientific name
1	ຫ້ຍາດອກແຂມ	*Thysanolaena maxima*
2	ຫຍ້ານະຈິບດອກໃຫ່ຍ	*Pennisetum pedicellatum*
4	ຫ້ຍາຍຸບ	*Mimosa pudica*
5	ຫ້ຍາຍຸໆ	*Nayraudia reynaudiana*
6	ຫ້ຍາເລົ້	*Saccharum spontaneum*
7	ຫ້ຍາຄາ	*Imperata cylindrical*

Another 256.14 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	ກ໋ກປ໋ສາ	*Broussonetia pipyrifera*
2	ກ໋ກເລັບມ້	*Cassia tora*
3	ກ໋ກໂສມ	*Aeschynomene aspera*
4	ກ໋ກເຮືອບ	*Crassocephalum crepidioides*
5	ກ໋ກໂຫງເຫງ	*Physalis minima*
6	ເຄືອໝາກຕ໋ແຍ	*Mucuna pruriens*
7	ເຄືອຈິ່ງຈໍ້ເຫຼືອງ	*Merremia vitifolia*
8	ຫ້ຍາຂີ້ ຫຼື ຫ້ຍາຜລັ	*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	ກົກເຍອ້າ	*Melastoma sanguineum*

Another 175.5 ha were identified as land with few growing trees. However only 65.17 ha were considered for the project since total project area was 1000 ha and the remaining 110.33 ha were excluded from the project area. The following trees were found in these areas.

No.	Local name	Scientific name
1	ໄມ້ຍາງ	*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	ໄມ້ແຕ້ຮໍ	*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	ໄມ້ຕອງຄັເຫົ້າ	*Mallotus barbatus*
18	ໄມ້ປໍແຟ	*Trema orientalis*
19	ໄມ້ເດື່ອກ້ຽງ	*Ficus racemosa*
20	ໄມ້ກໍ່ໝາມ	*Castanopsis argyrophylla*
21	ໄມ້ບົກ	*Ivingia malayana*

22	ไม้เค้ๆ	*Dialium indum*
23	ไม้ติ้อสิ้ม	*Cratoxylum fomosum*
24	ไม้ติ้อก้ังๆ	*Cratoxylum cochinghinense*
25	ไม้ทะโล้	*Schima wallichii*
26	ไม้ปอหู	*Hibiscus macrophyllus*
27	ไม้เปือยเลือด	*Terminalia corticosa*
28	ไม้มูก	*Wrightia pubescens*
29	ไม้แดล้าว	*Fernandoa adenohpylla*
30	ไม้ห่งป่า	*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	ตองโลบ	*Macaranga riloba*	8
2	ปอหู	*Hibiscus macrophyllus*	8
3	ไม้ฮ่ม	*Melia azedarch*	4

Plot 2 – Nam Sang

No	Lao name	Scientific name	No. of trees
1	ตองโลบ	*Macaranga riloba*	7
2	ปอหู	*Hibiscus macrophyllus*	8
3	ไม้ฮ่ม	*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	ໄມ້ຮຽນ	*Melia azedarch*	6

Plot 1 – Huay Phet

No	Lao name	Scientific Name	No. of trees
1	ໝັ່ງດຳ	*Diospyros mum*	1
2	ຕອງໂຄບ	*Macaranga riloba*	3
3	ຕີ້ວເຫຼືງ	*Cratoxylon polyanthum*	1
4	ສີໄຄຕົ້ນ	*Cinnamomum iners*	1
5	ຂີ້ໝູ	*Ormosia cambodiana*	1
6	ເຂົ້າສານ	*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	ກົກຖົ່ມ	*Adina cordfolia*	1
2	ຕອງໂຄບ	*Macaranga riloba*	4
3	ເຂົ້າສານ	*Memecyclon harmandii*	1
4	ໄມ້ຮຽນ	*Melia azedarch*	1
5	ໄມ້ ໝີ່	*Litsea polyantha*	2
6	ບົກຄາຍ	*Chaetocapus castanocarpus*	1
7	ໄມ້ ຕີນເປັດ	*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	ສີໄຄຕົ້ນ	*Cinnamomum iners*	1
4	ກ໊ວາຫວ້າ	*Eugenia jambolana*	1
5	ໄມ້ຮຽມ	*Melia azedarch*	2
6	ຂັດເຄົ້າ	*Randia stenantha*	1

Plot 4 – Huay Phet

No	Lao name	Scientific Name	No. of trees
1	ແຄນຍ່ອງ	*Melia azedarch*	9
2	ປໍຫູ	*Hibiscus macrophyllus*	8
3	ຕອງໂຄບ	*Macaranga riloba*	4
4	ແຄນ	*Hopea odorata*	3

Plot 5 – Huay Phet

No	Lao name	Scientific Name	No. of trees
1	ໄມ້ ສະໂກ	*Anthocephalus indicus*	2
2	ຕີນເປັດ	*Alstonia scholaris*	3
3	ຮຽມ	*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	ไม้ตองโลบ	*Macaranga denticulata*	3
2	ไม้ ตื๋อเฒื่อๆ	*Cratoxylon polyanthum*	3
3	ไม้ บาก	*Anisoptera costata*	8
4	ไม้ จิกดิ่ง	*Vatica astrotricha*	1
5	ไม้ตีนเปิด	*Alstonia scholaris*	2
6	ไม้หาด	*Artocarpus aspurula*	1
7	ไม้ธัง	*Pentacm siamensis*	1
8	ไม้ซาด	*Dipterocarpus obtusifolius*	1
9	ไม้กะเด๋าช้างๆ	*Melia azedarach*	1
10	ไม้เปือยลาม	*Lagerstroemia balansae*	2

Plot 2 – Huay Hai

No	Local Name	Scientific Name	No. of trees
1	ไม้ มูก	*Wrightia tomentosa*	5
2	ไม้ ยมผา	*Ailanthus malabarica*	1
3	ไม้ธัง	*Pentacm siamensis*	2
4	ไม้ ดอกแดล้าอ	*Haplophragma adenophyllum*	4
5	ไม้ ลองดอม	*Manglietia conifera*	1
6	ไม้คูม	*Cassia fistula*	1
7	ไม้ปดาม	*Pterocymbbium javanicum*	2

Plot 3 – Huay Hai

No	Local Name	Scientific Name	No. of trees
1	ไม้ ปดาม	*Pterocymbbium javanicum*	18
2	ไม้ตองโลบ	*Macaranga denticulate*	5
3	ไม้ ธัง	*Pentacm siamensis*	1
4	ไม้ สีไลติ้น	*Eucalyptus* spp.	1
5	ติ้นมังดำ	*Diospyros mum*	1
6	ติ้นหมาก	*Areca catechus*	1

Plot 4 – Huay Hai

No	Local Name	Scientific Name	No. of trees

1	ไม้ ปดาม	*Pterocymbbium javanicum*	12
2	ไม้ตอๆโลบ	*Macaranga denticulate*	4
3	กะถิ่มนาลิ๋	*Acacia auriculiformis*	5
4	ไม้ฆากบิก	*Irvingia malayana*	2
5	ไม้เปือย	*Lagerstroemia balansae*	1
6	ติ้มไธ	*Ficus gibbosa*	1
7	ติ้มกะดอๆ	*Podocarpus neriifolius*	1
8	ติ้มปันดิงฃาอ	*Dalbergia kerrii*	1

Plot 5 – Huay Hai

No	Lao name	Name of Science	No. of trees
1	ไม้ บิก	*Irvingia malayana*	1
2	ไม้ ฮิ	*Vatica harmandiana*	1
3	ฮูม	*Melia azedarch*	1
4	ตอๆโลบ	*Macaranga riloba*	3
5	บ๋ฆู	*Hibiscus macrophyllus*	12
6	ฮูม	*Melia azedarch*	7
7	ตอๆโลบ	*Macaranga riloba*	6

Plot 6 – Huay Hai

No	Lao name	Name of Science	No. of trees
1	ฮูม	*Melia azedarch*	1
2	บ๋ฆู	*Hibiscus macrophyllus*	7
3	ฮูม	*Melia azedarch*	2
4	ตอๆโลบ	*Macaranga riloba*	3

Plot 7 – Huay Hai

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

Therefore the baseline net GHG removals by sinks will be determined as:

$$\Delta C_{BSL} = \Delta C_{BSL,tree}$$

Where:

ΔC_{BSL} - Baseline net greenhouse gas removals by sinks; tCO_2-e

$\Delta C_{BSL,tree}$ - Sum of changes in carbon stocks in above-ground and below-ground biomass of trees in the baseline; tCO_2-e

For strata with no growing trees, ΔC_{BSL}= 0. For strata with a few growing trees, ΔC_{BSL} is estimated using following equations.

$$\Delta C_{BSL,tree,i} = \sum_{t=1}^{t^*} \Delta C_{BSL,AG/BG,i,t} * \frac{44}{12} * 1year$$

Where;

$\Delta C_{BSL,tree,i}$ - Sum of the baseline annual changes in carbon stocks in above-ground and below-ground tree biomass for stratum *i:* tCO_2-e

$\Delta C_{BSL,AG/BG,i,t}$ - Baseline annual net change in carbon stock in above-ground and below-ground tree biomass for stratum *i,* for year *t*: tCO_2-e

i - *1, 2, 3, M_B* strata in the baseline scenario

t - *1, 2, 3, t** years elapsed since the start of the AR-CDM project activity

44/12 - Ration of molecular weight of CO_2 to carbon; tCO_2-e

The $\Delta C_{BSL,AG/BG,i,t}$ was estimated using Carbon gain-loss method.

$$\Delta C_{BSL,AG/BG,i,t} = \Delta C_{G,i,t} - \Delta C_{L,i,t}$$

Where;

$\Delta C_{BSL,AG/BG,i,t}$ - Baseline annual net change in carbon stocks in above-ground and below-ground tree biomass for stratum *i,* for year *t*; t C year^{-1}

$\Delta C_{G,i,t}$ - Annual increase in above-ground and below-ground carbon due to biomass growth of living trees in stratum *i*, for year *t*; t C year^{-1}
Note: This is the "potential growth" which is greater than the "observed growth", i.e., $\Delta C_{BSL,AG/BG,i,t}$, by $\Delta C_{L,i,t}$.

$\Delta C_{L,i,t}$ - Annual decrease in above-ground and below-ground carbon stock of living trees due to tree biomass loss for stratum *i,* for year *t*; t C year^{-1}
Note: Conservative assumption that $\Delta C_{L,i,t} = 0$ is allowed for the baseline scenario.

i - *1, 2, 3,* M_B strata in the baseline scenario

t - *1, 2, 3,* *t** years elapsed since the start of the AR CDM project activity

$$\Delta C_{G,i,t} = A_{BSL,i} * \sum_{j=1}^{J} G_{tree,j,i,t} * CF_j$$

Where;

$\Delta C_{G,i,t}$ - Annual increase in carbon due to biomass growth of living trees in stratum *i*, for year *t*; t C year^{-1}

$A_{BSL,i}$ - Area of baseline stratum *i*; ha

$G_{tree,j,i,t}$ - Annual increment of total above-ground and below-ground dry biomass of living trees of species *j* in stratum *i*, for year *t*; t d.m. ha^{-1} year^{-1}

CF_j - Carbon fraction of dry matter for species *j*; t C t^{-1} d.m.

i - *1, 2, 3,* M_B strata in the baseline scenario

j - *1, 2, 3, ... J* tree species in the baseline scenario

t - *1, 2, 3,* *t** years elapsed since the start of the AR CDM project activity

$$G_{tree,j,i,t} = G_{w,j,i,t} * (1 + R_{1_j})$$

$$G_{w,j,i,t} = I_{V,j,i,t} * D_j * BEF_{1,j}$$

Where;

$G_{tree,j,i,t}$ - Annual increment of total above-ground and below-ground dry biomass of living trees of species *j* in stratum *i*, for year *t*; t d.m. ha^{-1} year^{-1}

$G_{w,j,i,t}$ - Average annual above-ground dry biomass increment of living trees of species *j* in stratum *i*, for year *t*; t d.m. ha^{-1} year^{-1}

R_{1_j} - Root-shoot ratio appropriate for biomass increment for species *j*; t d.m. t^{-1} d.m

$I_{V,j,,i,,t}$ - Current annual increment in stem volume of species *j* in stratum *i*, year *t*; m^3 ha^{-1} year^{-1}
Note: $I_{V,j,i,t}$ can be estimated as a constant annual average value over a period including the year *t* (Periodical Annual Increment).
Note: *t* is likely to be different than age of individual trees in the year *t*.

D_j - Basic wood density for species *j*; t d.m. m^{-3}

$BEF_{l,j}$ - Biomass expansion factor for conversion of annual net increment (including bark) in stem biomass to total above-ground tree biomass increment for species *j*; t d.m. t^{-1} d.m.

i - *1, 2, 3,* M_B strata in the baseline scenario

j - *1, 2, 3, ... J* tree species in the baseline scenario

t - *1, 2, 3,* *t** years elapsed since the start of the AR CDM project activity

ID number[23]	Data variable	Data unit	Value applied	Data Source	Comment
$G_{w,j,i,t}$	Average annual above-ground dry biomass increment of living trees of species *j* in stratum *i*, for year *t*;	t d.m. ha^{-1} $year^{-1}$	3.0	IPCC GPG-LULUCF, 2003 Table 3A.1.5	
R_l	Root-shoot ratio appropriate for biomass increment	t d.m. t^{-1} d.m	0.42	IPCC GPG-LULUCF, 2003 Table 3A.1.8	
$A_{BSL,i}$	Area of baseline stratum *i*	ha	65.17	Calculated using satellite maps	
CF_j	Carbon fraction of dry matter for species *j*	t C t^{-1} d.m.	0.5	IPCC Default value	

[23] Please provide ID number for cross-referencing in the PDD.

Annex 04

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 1000 ha of land belonging to three villages (Huay Hai, Huay Phet and Nam Sang) 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-ACM0002 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 and Nam Sang.
- 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

45 permanent sample plots of 25 m X 40 m (0.1 ha) 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.

Annex 05
Comparison of income for local community

No	Description of average income before project	Before project per year per ha	Description of average income after project	After project per year per ha
1	Income from harvest = 1.2 tonnes per year (1.2 * 2,200,000)	2640000	Clearing 350000 kip (3 times in 1 year = 350000 kip * 3)	1050000
2	Other income = 300,000 kip	300000	Maintenance 90,000 kip ha per month (= 90,000 kip * 12 months)	1080000
3			Holing and Planting 1,950 kip per plant. 476 planted per ha (1,950 kip * 476 planted)	928000
4			Landlease 8 USD per ha per year (8*8500)	68000
5			Other income as worker (common work = 25,000 kip per day, hard worker = 30,000 kip per day and special worker as chemistry = 50,000 kip per day).	960000
	Total (in KIP)	**2940000**	**Total (in KIP)**	**4086000**
	Total (in US $)	**345.88**	**Total (in US $)**	**480.71**

Annex 06

Letter from Ministry of Agriculture and Forestry

Lao People's Democratic Republic
Peace Independence Democracy Unity Prosperity

Ministry of Agriculture and Forestry
Permanent Secretary Office

No: 0130 /PSO. MAF
Date: 21 JAN 2009

To: Sigurd Klakeg, Deputy Director General
Economic Policy Department
P.O. Box 8008 Dep
Ministry of Finance
N0-0030 Oslo, Norway

Re: Team Carbon Clean Development Mechanism (CDM) Project Application, Lao Thai Hua Rubber Co. Mitigation of Green House Gas (GHG): Rubber based agro-forestry system for sustainable development and poverty reduction in Pakkading, Bolikhamxay Province, Lao PDR

Dear Sir,

I herewith would like to endorse the above project proposal as the approach is to created sustainable interventions with nature by planting trees in depleted or underutilized land. combined with food crops in open space between the trees, using organic methods. This opportunity represents tangible benefits for the environment, local communities and investors adhering to social responsible corporate policies.

This first proposed Clean Development Mechanism Land Use, Land Use Change and Forestry (CDM LULUCF) project is aimed to be implemented in Pakkading District, Bolikhamxay Province by planting of 500,000 rubber trees and food crops, resulting in substantial impact in mitigation of GHG, combined with poverty reduction. The project will be implemented by the Lao Thai Hua Co, aiming at the following targets:

- sustainable livelihood with tangible economic impact over 3,500 people and profit sharing with local communities in poverty stricken areas in Pakkading District;
- estimated mitigation of 0.8million tons of GHG saving of over 60.000 tons of carbon by use of organic fertilizers instead of carbon based chemical fertilizers;
- production of bio gas for energy use in the production process;
- non emission policy for plantation management;
- protection of nature.

The project strengthens the National Plan of Sustainable development by avoiding GHG emission, due to sequestration of CO2 by the established plantation. I hope you will be able to consider positively the above project

Your faithfully,

Rounthong BOUAHOM

The Permanent Secretary,
Ministry of Agriculture and Forestry
Vientiane, Lao PDR

Annex 07
Minutes of the Board meeting on 26th December 2007

Minutes of Board Meeting on 26th December 2007
Vientiane

Point 7 of the agenda :

Decision of establishing rubber based agro-forestry Plantation in Pakkading, Bolikhamsay Province, Lao PDR

" The Board has taken good notice of the preparatory study of managers and decided to endorse the recommendations for establishing a 1,000 ha plantation in Pakkading identified as one of the poorest districts in Laos as per mid May 2007 pending consultation with relevant governmental departments at national, provincial and local levels and extensive hearings of directly involved stakeholders at local level including the peoples of the villages directly involved in the project. Social responsible corporate approaches will be applied as part of the general policies
The Board has decide to allocate 42 million USD for the life cycle of 30 years of the plantation. Contribution of sales of CERs will be actively pursued to finance part of the budget through the Kyoto CDM system: estimated 15 million dollar .
CDM experts will be recruited in this regard to ensure proper procedures be followed

This point being adopted by consent of members. "

For Thai Hua Rubber Public Co., Ltd.
Luckchai Kittipol

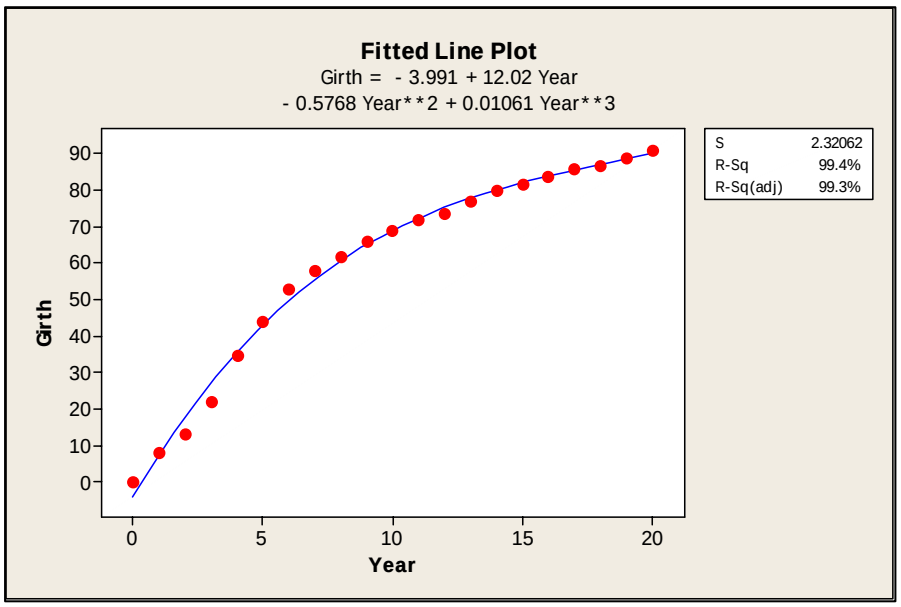
For NCX Holding Co., Ltd.
Khanchai Kiasrithanakorn

For Chengshan Corp. Ltd.
Zhang Jianwei

Annex 08

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.

PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 04

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History of the document

Version	Date	Nature of revision
04	EB35, 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	EB26, Annex 19 29 September 2006	Revisions in different sections to reflect equivalent forms used by the Meth Panel and assist in making more transparent the selection of an approved methodology for a proposed A/R CDM project activity.
02	EB23, Annex 15a/b 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