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

CONTENTS

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

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

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CDM project activity as part of an industrial plantation for pulpwood in Laos
ver.1
20/03/2006

A.2. Description of the proposed A/R CDM project activity:

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In the subject country, Laos, deterioration of forests and decrease in their areas caused by exceeding slash-and-burn shifting cultivation has been one of the main issues. Plantations are expected to re-extend the forest areas and local economies, and agricultural improvements are required to prevent further losses of forest. However, the limited national budget and the geographical conditions, such as the landlocked location, restrict either domestic or foreign funds for plantations. The local inhabitants are still relying on slash-and-burn farming and no recovery or increase of the forest areas can be foreseen.

This project seeks to make such unfeasible plantation business possible by operating as a CDM project, aiming for an increase of forest area and carbon pools in the subject area while contributing to sustainable development via financial improvement by the project activity and an additional activity to lead the locals to stationary farming.

Oji Lao Plantation Forest Co., Ltd. (LPFL, hereafter) was established in 1999 as a joint company funded by a New Zealand company and the Laotian government. It has a concession for 150,000 ha in Khammouane Province and Borikhamxay Province in Laos and already has launched the business, targeting 7,000 ha plantations par year.

Oji Paper Co., Ltd., took over the LPFL stakes from the New Zealander company and found that part of the area is not suitable for plantation and that profitability cannot be expected if it is operated as a normal industrial plantation business. Unless it is operated as a CDM project, large area will be left not to be planted. When LPFL was taken over, only 1,600 ha were forested, and we are currently building a framework for an immediate start of a full-scale plantation of 7,000 ha per annum.

The plantation sites of LPFL are selected-according to the land-use classification of the Laos government: “farm”, “Degraded Forest”, “grassland”, and “swidden field”. Then, by agreement of the local inhabitants, land lease contracts are signed by the Laos government for LPFL. Based upon “the procedures to define land eligibility” approved at EB22, part of the LPFL plantation sites exceed the forestry threshold defined by the host country and may not be appropriate as a CDM project. The table 1 below clarifies the entire LPFL and the A/R CDM plantation project.

Table A-1. LPFL plantations and CDM project plantations

	Entire LPFL plantations	CDM project plantations
Species	*Eucalyptus Camaldulensis* Hybrid Eucalyptus	Same as on the left
Sites	Potential sites suitable for plantation within the concession area , classified as “Bamboo woods”, “Degraded Forests”, or “Grasslands” by Laotian government	Eligible land in the plantation suitable sites within the concession area: ・Non-forest since 1990 or earlier and not capable of reforestation due to human intervention (i.e., illegal slash-and-burn farming)

		・Unprofitable or barely profitable as non-CDM project business
Areas	Applx. 7,000 ha per year	CDM-eligible land within the entire LPFL plantation area
Logging cycle	7-year cycle: After the final logging of project activity, sprouting or possibly reforestation activity will keep the area as a forest.	Same as on the left
Project period	50 years	30 years (fixed)
Management of Logged timbers	Logged timbers are exported from a Vietnamese port, Vung Ang, (300 km from the site) to Japan and then processed (OK?) for pulp and paper ware. Shrubs removed for site preparation and debris after logging are burned in the site. Part of the biomass are used as biomass energy.	Logged timbers are exported from a Vietnamese port, Vung Ang, (300 km from the site) to Japan and then processed (OK?) for pulp and paper ware. Shrubs removed for site preparation and debris after logging are burned in the site. Part of the biomass are used as biomass energy.
Socio-environmental impact	Consideration is given based upon both the Laotian government's guidelines and LPFL's guidelines.	In addition to the left, ~~it~~ these impacts will be evaluated for CDM project eligibility.

A.3. Project participants:

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Host country: Lao People's Democratic Republic
Project entity: Oji Lao Plantation Forest Co., Ltd. (LPFL, hereafter)

A.4. Technical description of the A/R CDM project activity:

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

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The project will be operated in Khammouane Province and Borikhamxay Province in Lao People's Democratic Republic. The location is indicated in the Figure A-1 below.

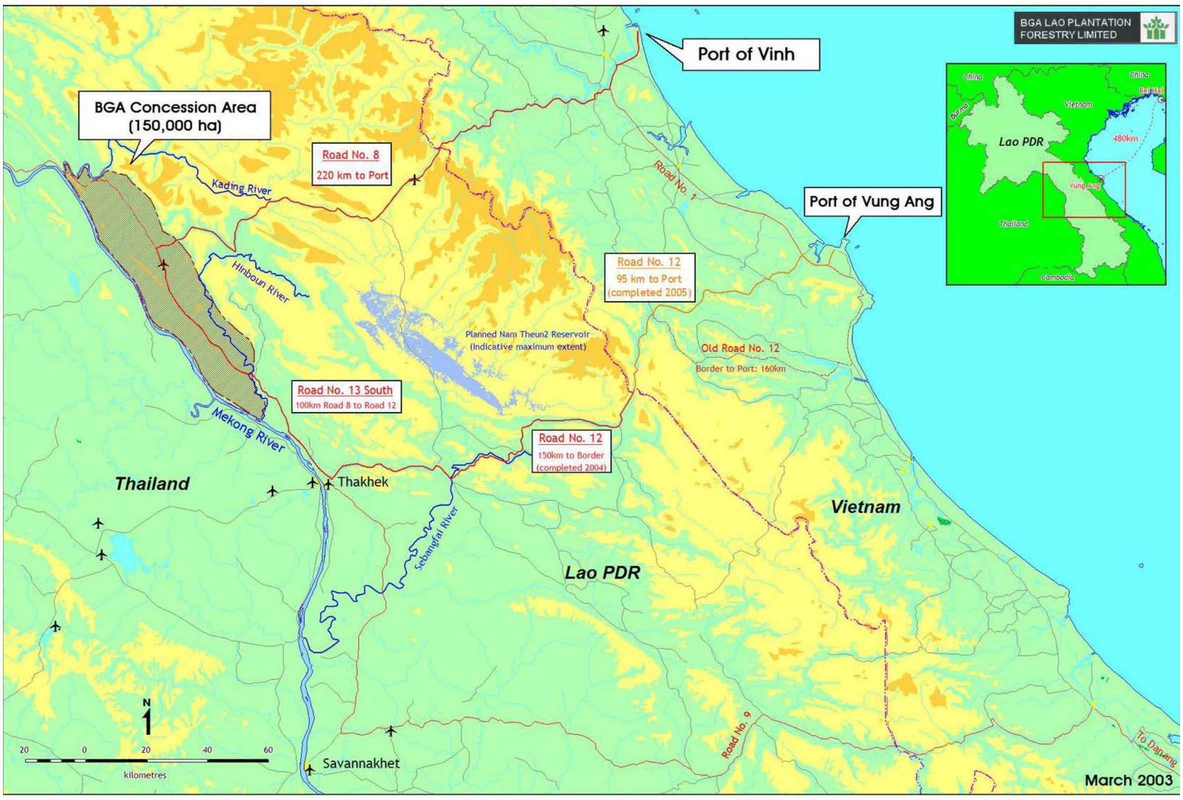

Figure A-1.   Project Area Map

A.4.1.1. Host Party(ies):

>>
Lao People's Democratic Republic

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

>>
Khammouane Province and Bolikhamxay Province

A.4.1.3. City/Town/Community etc:

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Khammouane Province: 65 Villages in Hinboune District
Bolikhamxay Province: 41 Villages in Pakkading District

A.4.1.4. Detail of geographical location and project boundary, including information allowing the unique identification(s) of the proposed A/R CDM project activity:

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The details of geographical location are indicated in Figure A-2. below.

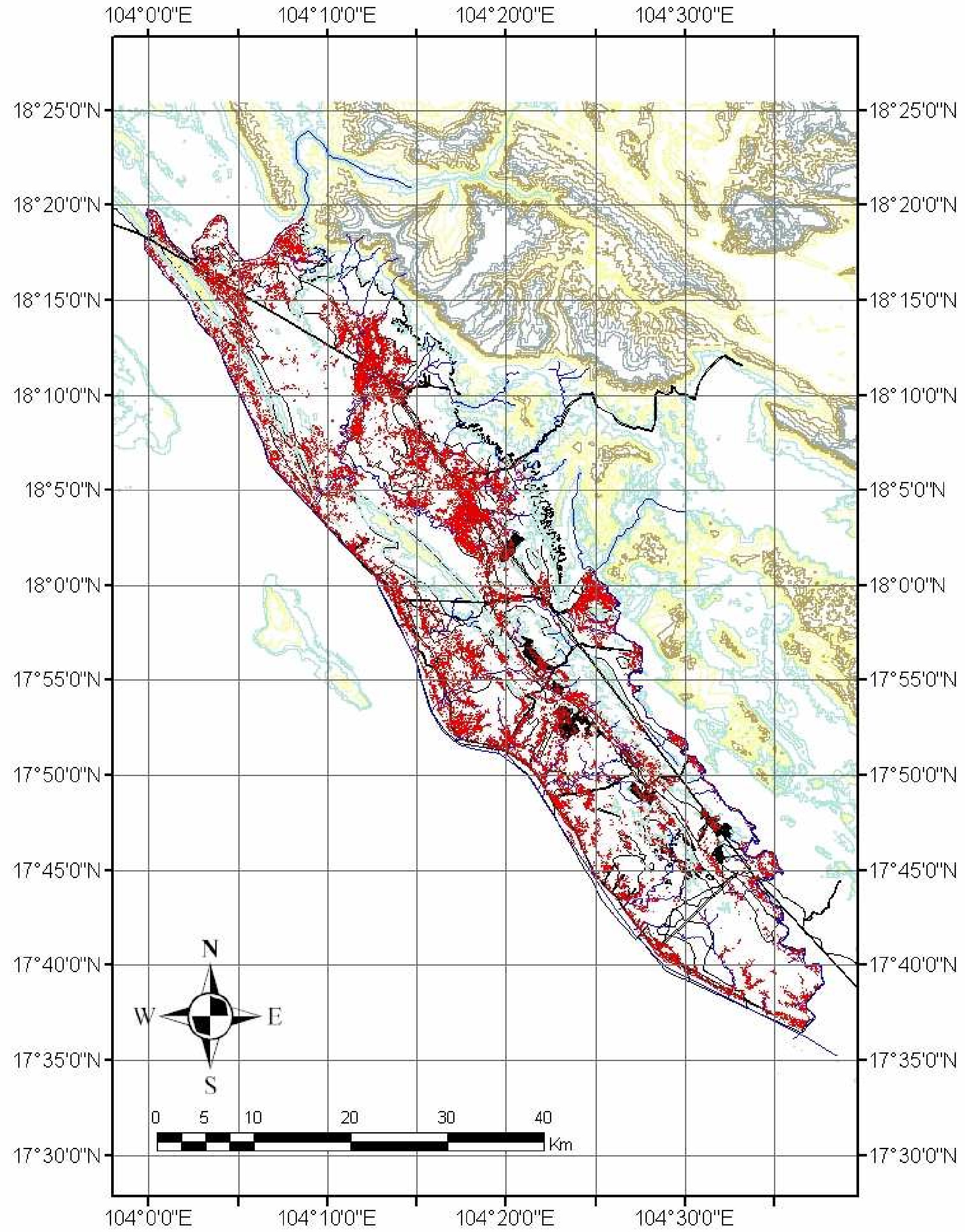

Figure A-2. Project Boundary
(Indicated in red)

A.4.1.5. A description of the present environmental conditions of the area, including a description of climate, hydrology, soils, ecosystems, and the possible presence of rare or endangered species and their habitats:

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The host country, Lao People's Democratic Republic, is a land-locked country bordered by China, Vietnam, Cambodia, Thailand and Myanmar. Its total land area is 23,680,000 ha, which approximates the area of Japan's mainland. Eighty percent of the area is mountainous, from the northern part to the central, at altitudes of between 1,000 m and 2,000 m. In the remaining 20% of the area, there are plateaus with altitudes of less than 200 m or river plains of the main and branch streams of the Mekong.

The A/R CDM project area lies along the Mekong River and the plantation sites are flat with an obliquity of less than 10% at a height of 100 m to 200 m above sea level. The River Mekong flows 1,900 km in Laos and contributes to the local economy as a water resource and a fish resource, as well as for transportation. However, the Khon Waterfalls near the Cambodian boarder prevent use of the Mekong for transportation abroad.

The climate has two distinct seasons; : a rainy season and a dry season. In the middle of April, it begins to rain and continues until mid October. The rainy season in this region is from the middle of April to the middle of October. The project area has an annual rainfall between 2,400 mm and 2,900 mm, which are the heaviest rainfalls in Laos. While the land experiences flooding by heavy rains in the lowlands along the River, the dry seasons may bring drought. The whole country is within the tropical/monsoon climate zone and the temperature is high in the lowlands in the south and less in the mountainous areas in the north. The climate is mild in the project area where the annual average temperature is 24 to 29 degrees Celsius.

The soil in the project area contains mainly red-yellow podzolic (Acrisols), which is typical for plantation areas of Eucalyptus and Acacias in Asia.

In 1970s, forests (tree crown density of more than 20%) used to cover 70% of the total area of Laos. However, there was an outbreak of slash-and-burn-agriculture due to natural population increase, as well as by the Vietnamese war refugees. This has been degrading and decreasing the forests. The forest area was 11,168,000 ha or 47% of the national area as of 1992, and 9,825,000 ha or 41.5% of the national area as of 2002. In other words, 1.3 million ha of forest areas were lost in ten years.

There are 40,000 ha of forest areas out of 150,000 ha of the project area. The forest mainly consists of mixed deciduous woods, such as *Tectona grandis*、*Pahudia cochinchinensis*、*Terminalia nigrovenulosa*, and partly dry depterocarp woods, such as *Shorea siamensis*、*Dipterocarpus intricatus*、*D. tuberculatus.* About 90,000 ha are eligible land for plantation (i.e., bamboo woods, deserted woods, grasslands). The- degraded areas are mainly covered by shrubs, such as *Cratoxylon prunifolium.* The rest of the project area, 20,000 ha, is used for farming, residence or non-vegetation area.

The project area is adjacent to two national reserves.

A.4.2. Species and varieties selected:

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Hybrid species of *Eucalyptus urophylla* and *Eucalyptus grandis*

A.4.3. Specification of the greenhouse gases (GHG) whose emissions will be part of the proposed A/R CDM project activity:

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Table A-2. Potential emission of GHG

Sources	Gas	Included/ excluded	Justification / Explanation
use of fertilizers	CO_2	Excluded	Not applicable
	CH_4	Excluded	Not applicable
	N_2O	Included	
combustion of fossil fuels used in on-site vehicles	CO_2	Included	
	CH_4	Excluded	Potential emission is negligible
	N_2O	Excluded	Potential emission is negligible

A.4.4. Carbon pools selected:

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Table A-3. carbon pool subjected to the project activity

Carbon pools	Selected (answer with yes or no)	Justification / Explanation
Above ground	Yes	Major carbon pool subjected to the project activity
Below ground	Yes	Major carbon pool subjected to the project activity
Dead wood	No	Conservative approach under applicability condition
Litter	No	Conservation approach under applicability condition
Soil organic carbon	No	Conservation approach under applicability condition

A.4.5. Assessment of the eligibility of land:

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The land eligibility as an A/R CDM project is examined below:

(c) Demonstration that the area was not a forest when the project launched

(d) Analysis of the satellite image data captured in November, 2000, and field survey shows that the subject area does not fulfill the above three conditions. (Figure A-3)

(e)

(f) Demonstration that the activity is an A/R project activity.

Analysis of the satellite image data captured in 1992 shows that there was no forest in the subject area.

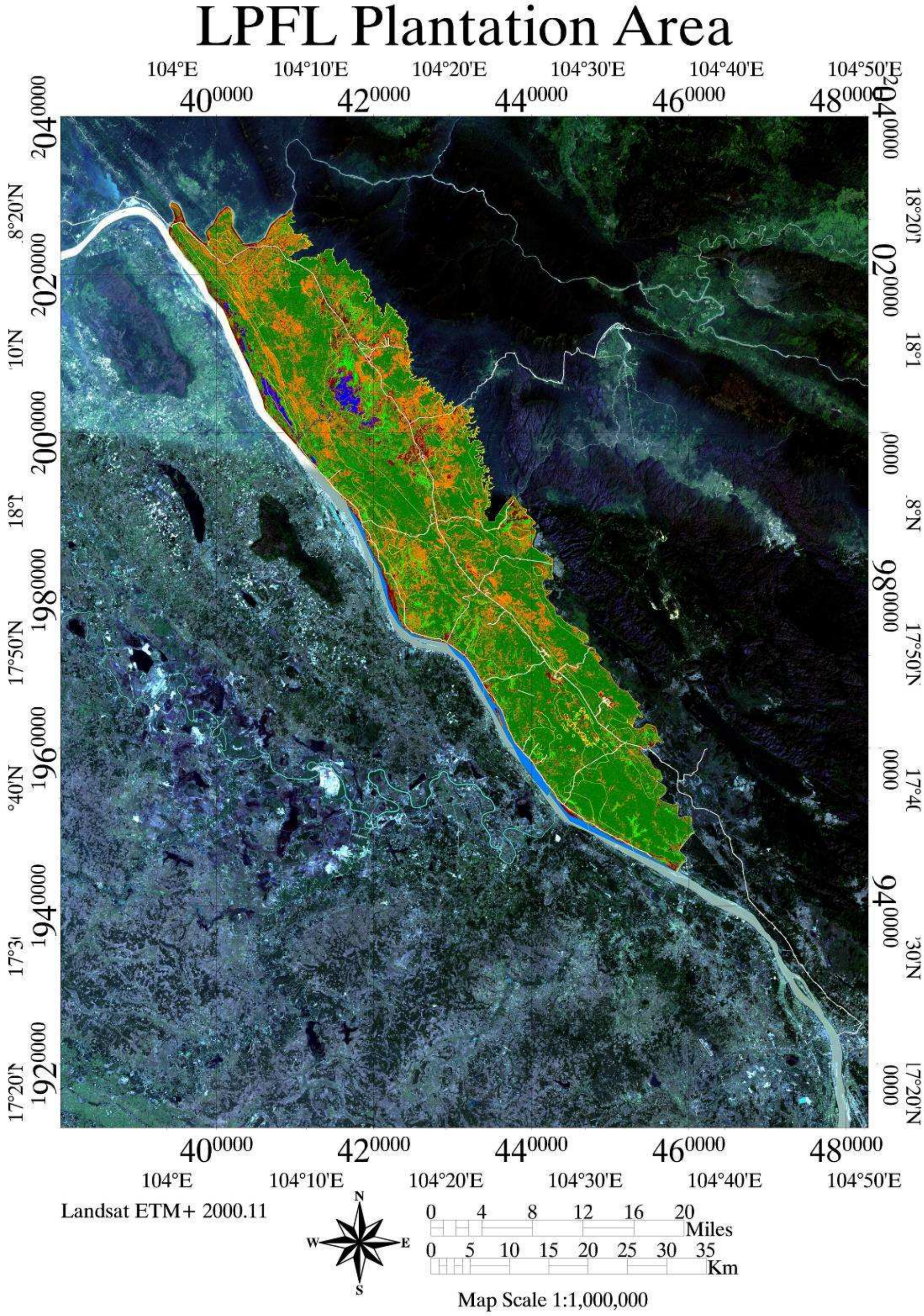

Figure A-3 Land cover classification in the subject area in year 2000

Superimposing on the satellite image captured in Nov.2000:
Concession area framed by yellow line, roads in white, forest and dense shrubs in green, grassland in light green, sparse shrubs in orange, bare land in brown, bare rock land in ochre, swidden area in red, swamp in blue, water in light blue

A.4.6. A description of legal title to the land, current land tenure and land use and rights of access to the sequestered carbon:

>>

The Laotian constitution stipulates that all of the land is the property of the nation. Article 5 of the Forest Law states that every single unit of native forest and forest land in Laos belongs to the state, and. that the government's role is to manage and allocate those lands to organizations, communities, or households, based on the actual situation. In this article, it is stipulated that an individual or organisation will acquire the trees/forests when they are forested by the former's own labour and funds with official permission, and that the individual/organisation who forested may acquire the land ownership, use right, usufruct right, transfer right and inheritance right based upon applicable laws and regulations.

Landownership is not permitted by a foreign organization for a plantation, but land will be leased by the government for the right of use. This forestation project has been already approved by the government, and it has been operated along with the proper right of use of the plantation area by a lease contract. LPFL, the project entity, is a company funded by Oji Lao Plantation Holdings Limited and the Laotian government, in 85% and 15% proportions respectively.

The plantation sites are selected from the official classification "farm", "Degraded Forest", "grassland", and "swidden field", then leasing contracts are signed by the government, according to forestation eligibility survey. Before obtaining the right of use for plantation sites, we make sure the local people agree with the project, considering forestry by-product and charcoals for the local residents. On the actual plantation, sites are carefully selected to protect the environment, including soils and biodiversity. The environmental impact is carefully taken into account.

The rights of the CERs will be held by the project entity, LPFL.

A.4.7. Type(s) of A/R CDM project activity:

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Reforestation

A.4.8. Technology to be employed by the proposed A/R CDM project activity:

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The parent company of the project entity, Oji Paper Co., Ltd., has been operating similar plantation businesses in many areas in the world and possesses sufficient know-how for paper material plantations. In addition, our in-house Forest Research Institute has been studying Eucalyptus breeding. This proposed project will bring in such skills, technologies, know-how, and genetic resources, which will be transferred to the appropriate organisations, such as Laotian forestry institutes.

The following are examples of the possible technology transfers;

- Analysis skill of soil and leaf nutrient for required fertilisation
- Rooting stimulation cloning technology for a tree type with low rhizogenesis ability.

Depending on the actual circumstances, matters will be handled situation by situation according to the developed know-how from past experiences.

A.4.9. Approach for addressing non-permanence:

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Issuance of tCERs

A.4.10. Duration of the proposed A/R CDM project activity / Crediting period:

>>
30 years

A.4.10.1. Starting date of the proposed A/R CDM project activity and of the (first) crediting period, including a justification:

>>
The 1st of January, 2007

A.4.10.2. Expected operational lifetime of the proposed A/R CDM project activity:

>>
30 years

A.4.10.3. Choice of crediting period and related information:

>>
Fixed crediting period was chosen.

A.4.10.3.1. Renewable crediting period, if selected:

>>
N/A

A.4.10.3.1.1. Starting date of the first crediting period:

>>
N/A

A.4.10.3.1.2. Length of the first crediting period:

>>
N/A

A.4.10.3.2 Fixed crediting period, if selected:

>>
30 years

A.4.10.3.2 .1. Starting date:

>>
The 1st of January, 2007

A.4.10.3.2.2. Length:

>>
30 years

A.4.11. Brief explanation of how the net anthropogenic GHG removals by sinks are achieved by the proposed A/R CDM project activity, including why these would not occur in the

absence of the proposed A/R CDM project activity, taking into account national and/or sectoral policies and circumstances:

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The most appropriate baseline scenario is the "status quo" scenario in which non-forest area with grassland and shrubs will continue to cover the land. Part of the project boundary consists of shrubland, but shrub biomass will not be increased in the baseline because the residents living in the vicinity of the boundary continue slash-and-burn farming and using fuelwood. Grass biomass will not be increased, either. Therefore, the carbon stock change is set to null in the baseline.

Growth and logging of the planted trees by the project activity will increase and decrease the carbon stock of above/ below ground biomass pool in the boundary. In the first year of logging and subsequent years, the amounts of growth and logging (i.e., increase and decrease of carbon stock biomass pool) will offset each other.

GHG emission caused by the project in the boundary is generated by fossil fuel consumption, fertilisation and removal of existing biomass; (1) Fossil fuel is used for site preparation for seven years from the first year, for transport of seedlings every year, and for vehicles every year after the first logging. (2) Fertilisation will be done at the time of seedling planting and two more times in the later years. (3) Removal of the existing biomass will be done only in the first rotation period (i.e., from the inaugural year and for seven years). No removal will be done after the eighth year because the logged site will be forested.

Followings are the expected leakage; vehicle use for transport of logged timbers outside of the boundary and chip process, electricity generated fossil fuel, and fertilisation in the nursery.

The net anthropogenic GHG removals by sinks are calculated as 1,120,209 tonnes of CO2 equivalent.

A.4.11.1. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

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Table A-4. Annual estimation of net anthropogenic GHG removals by sinks.

Years	Annual estimation of net anthropogenic GHG removals by sinks in tonnes of CO2 e
2007	-153,966
2008	-63,872
2009	52,004
2010	176,727
2011	302,545
2012	425,653
2013	544,168
2014	-7,089
2015	-7,089
2016	-7,089
2017	-7,089
2018	-7,089
2019	-7,089
2020	-7,089

2021	-7,089
2022	-7,089
2023	-7,089
2024	-7,089
2025	-7,089
2026	-7,089
2027	-7,089
2028	-7,089
2029	-7,089
2030	-7,089
2031	-7,089
2032	-7,089
2033	-7,089
2034	-7,089
2035	-7,089
2036	-7,089
Total estimated net anthropogenic GHG removals by sinks (tonnes of CO_2 e)	1,120,209
Total number of crediting years	30
Annual average over the crediting period of estimated net anthropogenic GHG removals by sinks (tonnes of CO_2 e)	37,340

A.4.12. Public funding of the proposed A/R CDM project activity:

>>
No public funds are expected.

SECTION B. Application of a baseline methodology

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

>>
Industrial plantation carrying out estimation of amount of carbon absorption using satellite data (tentative title)

B.1.1. Justification of the choice of the methodology and its applicability to the proposed A/R CDM project activity:

>>
This A/R CDM project fulfills the applicability of the chosen methodology as follows:

- *The subject land is not defined as "forest" according to the Marrakesh Agreement.*
  The project boundary does not consist of a land covered by trees that are more than 5 meters in height, with a crown ratio of 30% or more, and spreading to 1.0 ha or more.

- *The subject land will not regenerate by both nature and anthropologenic factors unless this project is implemented.*

The subject area has been repeatedly swidden and damaged by exceeding fuelwood. The forest will never regenerate unless this project is operated.

- *The national and regional laws approve industrial plantations.*

The Laotian government has active action plans for the protection and conservation of forest resources, pursuing the recovery of forest areas by promoting plantations in the "Degraded Forest", enlargement of "regenerated wood" by eradication of slash-and-burn farming.

- *The Plantation is an industrial plantation with a periodic rotation of planting, logging and replanting.*

The proposed project is an industrial plantation in which to plant *Eucalyptus* and *Acacia*, which will be logged and replanted in a cycle of five to seven years.

B.2. Description of how the methodology is applied to the proposed A/R CDM project activity:

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On the basis of the baseline methodology, the baseline scenario is selected by following the procedure below;

Approach 22(a) is appropriate for this baseline. Due to various factors in the project area, such as land cover changes in the past and present, and socio-economic factors, there is no change in land use is expected, either by natural forest regeneration or new investment or technology.

The procedure of the baseline scenario selection is described below:

(1) Possible land use scenarios are theorized; industrial plantations other than this project, environmental plantations, other industries than plantations, transition to farm, forest re-generation, remain with status quo.

(2) Based upon the barrier analysis results for feasibility of each scenario, the baseline scenario is selected. The barriers are; investment, technology, institution, ecological conditions, land tenure.

(3) The methodology adopted by this project is designed for "Existing or historical, as applicable, changes in carbon stocks in the carbon pools within the project boundary "baseline approach.

B.3. Description of how the actual net GHG removals by sinks are increased above those that would have occurred in the absence of the registered A/R CDM project activity:

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This can be demonstrated by the Tool for the demonstration and assessment of additionality.

Use of the Tool for the demonstration and assessment of additionality

The tool for the demonstration and assessment of additionality, which was approved at EB21, was modified to improve ~~it~~ and applied to an examination of the additionality of this A/R CDM project activity. The result demonstrated that this activity is additional and differ from the baseline scenario. The details are described below.

Step 0: Preliminary screening based on the starting date of the A/R project activity

This step is replaced by "Procedure to define eligibility of land (EB22)". The procedure evaluates the subject area for CDM project eligibility. Also, the project boundary is set in this step.

Step 1 : Alternatives to the project activity consistent with current laws and regulations

The alternative scenarios in the subject area are described as follows;

Scenario 1: The host country or the local inhabitants begin environmental or industrial plantations
Scenario 2: Industrial plantations begun by a private/foreign company.
Scenario 3: Natural reforestation Scenario 4: This project scenario, a CDM industrial plantation is begun by a private/foreign company.
Scenario 5: The current non-forest is maintained (status quo).

Substep 1. Enforcement WITH applicable laws and regulations.
This project activity complies with the forestry policy and CDM policy of the Laos government and with the laws of land and the laws of forestry. The government defines the concession area as a "Degraded Forest" by forest and land classification under the Forest Law legislated in 1996.

Definition of "Degraded Forest" classified by Laotian law

Degraded Forest is forest which has been heavily damaged such as land without forest on it or barren land classified for tree planting and/or allocated to individuals and organizations for tree planting, permanent agriculture and livestock production, or for other purposes, in accordance with national economic development plans.

Substep 1b. Selection of the baseline scenario
- The host country has no choice but to rely on foreign capital; Donor, research institutes, NGO, etc., for forestry-related projects due to the limited national budget.
- Forestry conservation programmes operated by NGOs have been applied mainly in the northern areas and hardly in the southern areas where this project will locate.
- Technology possessed by the local forestry-related organisations is not sufficient for efficient forestation.
- The local people repeatedly burn the fields to farm illegally. Natural reforestation is not possible in the subject area due to the illegal slash-and-burn farming.
- The host country is landlocked and has no access to the sea. It attracts little foreign investment.
- The local inhabitants rely on subsistence agriculture. Plantations, which do not provide them with short-term product/profit, offer little incentive to them.

Step 2: Investment Analysis

IRR is applied to the investment comparison analysis for the Scenario 2, an ordinary industrial plantation project, and the proposed project scenario.

In the scenario of an ordinary plantation, continued expenditures for land, plantation, and management are expected prior to logging, and the first revenue will not come before the stumpage sales after logging. The first stumpage sales income takes care of the cost for second and later replantation and management.

The project scenario can expect income from CER in addition to the industrial plantation profits and it adds extra cost to replace CER and CDM operation. The price of CER depends on the emission trading market. IRR is calculated for three different assumed CER unit prices; US$5.00/t CO_2, US$10.00/tCO_2, or US$20.00/t CO_2.

The results indicate that CDM operation costs offset the profitability of CER in case of the price of US$5.00/t CO_2, while the credit price of US$20.00/t CO_2 will give sufficient profitability to operate as a CDM project.

Additionally, further IRRs are calculated on the assumption that the product price rises or declines by 2% as in the sensitivity analysis. (Table B-1)

Table B-1 IRR comparison by scenario

		CDM Plantation Project			Non-CDM plantation
		US$5.00 /t CO_2	US$10.00 /t$CO_2$	US$20.00 /t CO_2	
Baseline		3.61	4.43	6.95	3.11
Without compensation		4.13	5.39	8.29	3.11
Product Price	+2%	4.97	5.91	8.48	4.34
	-2%	2.00	2.59	4.90	1.72

Step 3 : Barrier Analysis

Substep 3a. Identify barriers that would prevent a widespread implementation of the proposed project activity:

a) Investment barriers

- The host country is one of the least less-developed countries; GDP/person US$339.46 (2003)
- The host country is promoting foreign investment by introducing a market economy and open economy policy, but investment from other countries is limited due to the landlocked location, compared to neighbouring countries (Table B-2).

Table B-2 Foreign direct investment between 1995 and 2003

Invested Country	Investment amount (million US$)	
	Total FDI	From Japan
Laos	502	18
Vietnam	14,594	2,153
Thailand	31,924	8,096
Myanmar	3,484	116
Cambodia	1,618	N/A

(Source: Statistics of Foreign Investment in ASEAN 2004)

b) Technological barriers

- The host country does not have an organisation for a large-scale plantation and technology for raising seedlings and planting as they have little experience with industrial plantations. In addition to providing the necessary materials, equipment and technical training, it is necessary to create organisations to raise seedlings and for planting.

- The host country does not have developed infrastructures and markets for planting materials. To launch an industrial plantation, it will be necessary to introduce vehicles, materials, and chip mill facilities.

c) Institutional barriers

- The local inhabitants hold the rights of use of forest resources, but no land ownership. The land classification and related rights are quite unclear.
- Fire protection awareness is very low among the locals; no fire belt, fire protection system, or advanced notification system has been established for field burning.

d) Barriers due to local ecological conditions

In the subject area, the locals continue illegal field burning. This activity lowers the land productivity. Their present low-level planting skills will not grow high quality planting trees in the area. Selection of species, weeding, fertilisation, etc have to be applied in accordance with the low productivity of the land. Therefore, plantation technology transfer must precede this project.

Substep 3b. Show that the identified barriers would not prevent a widespread implementation of at least one of the alternatives

- The alternative scenario, "staying as the present non-forest status" land-use will not be prevented by the aforementioned barriers.

STEP 4 Impact of CDM Registration

- Based upon the international rules defined by the Kyoto Protocols, the country risks of the host country, such as political turbulence, will be reduced if the host country approves this project.
- This proposed A/R CDM activity will clarify the current confusing situation of rights of land-use, by promoting the systems of land, stumpage and logging on which acquired credits are based. It reduces the country risks and institutional risks so that the investment climate will be improved. Then, the investment criterion of this project will be lowered.
- In this A/R CDM activity, the technology for raising seedlings, planting, chip processing and fire protection will be transferred to the locals. Formation of a Community Forest will reduce the risk of fire in the subject area.
- The transferred technology and industry will promote the official policies concerning the forest and poverty, generating employment, and improving the working environment.

The conclusion of the additionality test

A financial comparison of an ordinary industrial plantation scenario and the proposed project scenario shows that the project IRR is high enough when it is operated as a CDM project and the credit price is not low.

This proposed project complies with the forestry policy and CDM policy of the Laos government and with the laws of land and the laws of forestry. Also, the result tells us that the local inhabitants in the subject area continue illegal slash-and-burn farming and that natural reforestation is not possible due to this activity.

The alternative scenario, “staying with the present non-forest status” land-use will not be prevented by the barrier.

It is, therefore, concluded that this proposed project is additional.

B.4. Detailed baseline information, including the date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

>>
The baseline was selected by Oji Paper Co., Ltd. on the 20th of March, 2006.

SECTION C. Application of a monitoring methodology and of a monitoring plan

C.1. Title and reference of approved monitoring methodology applied to the project activity:

>>

Industrial plantation carrying out estimation of amount of carbon absorption using satellite data (tentative title)

C.2. Justification of the choice of the methodology and its applicability to the proposed A/R CDM project activity:

>>

This A/R CDM project fulfills the conditions for the adopted methodology as described below.

- *The subject land is non-forest, as defined by the Marrakesh Accords.*

The project boundary does not contain a land which spread over 1.0ha with trees of 5 meters height in 30% tree crown ratio.

- *The plantation is for an industrial purpose with planned periodic clear-cuts, logging and reforestation.*

The proposed project has a 7-year cycle for repeated planting of *Eucalyptus* and *Acacia*.

- *The project includes the business of exporting woody materials.*

The proposed project exports logged timbers as woodchips.

- *Satellite image data will be continuously available for analysis.*

The project entity continuously collects satellite image data and will have them analysed throughout the project period.

- *The subject land is unlikely regenerated by either the natural or anthropogenic factors.*

Repeated slash-and-burn farming and excessive logging for charcoals makes reforestation impossible unless the project is implemented.

C.3. Sampling design and stratification:

3. Stratification

Stratification and substratification is carried out based upon existing species and the species and ages of planting trees, which are largely responsible for the difference in carbon stocks.

（1） Collect local information about existing vegetation from the field survey with land cover classification from satellite data analysis.
（2） Stratify lands by existing vegetation.
（3） Conduct substratification based on species and ages of trees according to the project activity implementation . Field passes and the like are classified as off-site substrata. Obtain location information based on the monitoring outcomes.
（4） Lands information and results of the stratification and substratification are to be managed in GIS.

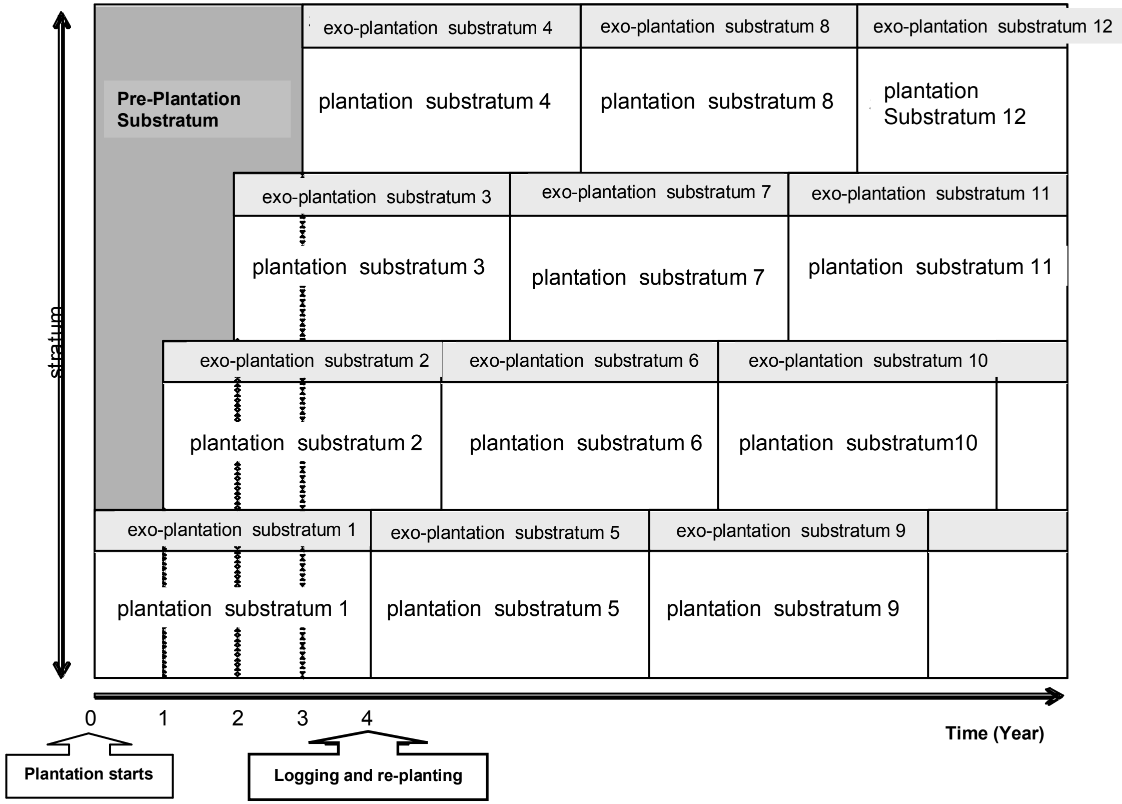

Figure C-1 Change of each substrata area in the strata by time

4. Sampling framework

- Sample size

Sample size is determined using the Optimum allocation formula proposed by Wenger (1984). The precision level is set to ±10% of the mean at the 95% confidence level, and an extra 10% of the calculated sample number is to be added.

$$n = \left(\frac{t}{A}\right)^2 \left(\sum_{i=1}^{L} W_i S_i \sqrt{C_i}\right)\left(\sum W_i S_i \Big/ \sqrt{C_i}\right) \qquad \textbf{(C1)}$$

Where:

n	total number of sample plots,
t	tabular value of Student's t,
i	stratum number,
L	the number of strata,
W_h	N_h/N,
N_h	area of stratum i
N	area of boundary
S	stratum standard deviation,
A	allowable error expressed in units of the mean,
C_h	the cost of selecting a sample plot in stratum i.

The mean value (= estimated value) to calculate a standard deviation at the first monitoring occasion is different from the one at the second monitoring occasion and later occasions.
a mean of carbon stocks of plots measured at the site prior to the first monitoring is to be used (Refer C2). The second and later monitoring occasions use a relational expression (Refer C.3.1.3.1.) derived from satellite data and field surveys and carbon stock estimated from satellite data of the plots (C3).

$$S_i = \sqrt{\frac{\sum \left(x_k - \bar{x}\right)^2}{n-1}} \qquad \textbf{(C2)}$$

$$S_i = \sqrt{\frac{\sum (x_k - x_{ext,k})^2}{n-1}} \qquad \textbf{(C3)}$$

Where:

x_k	measured value for plot k
$\bar{x}$	average of measured values
$x_{est,k}$	estimated value by satellite data for plot k

- Locating sampling sites

  Sample plots are to be selected with random numbers and satellite data. This is based on a method proposed by Stolbovoy et al (2005).

(3) Draw a quadrate along the longitude and latitude of the outer circumference of the project boundary. Obtain the number of pixels of the satellite data in the drawn quadrate. Generate random numbers from the pixels without duplication and apply them consistently to each corresponding pixel in the boundary.

(4) Identify each corresponding pixel on the map in numerical order from 1 and the corresponding location will be selected as a sample plot if the pixel is within the boundary. If a pixel corresponds with a location outside of the boundary, such as 8,10,11,17 circled in red, then it will not be selected as a plot. This will be continued untill the sample size is sufficient.

- Plot size and subplot layout (nest)
  - Planted trees biomass：The plot size is based on 10 ㎡ along the layout of planted trees.
  - Existing vegetation biomass：This square plot will be also applied to shrubs. As for grasses, circle plots of 1m radius are to be laid at the center of a square plot.
  - Soil biomass: Quarter a square plot and conduct sampling of the soil from each quartered square.

- Frequency of surveys

Regular monitoring of above-ground biomass in each stratum will be undertaken once every five year. At first planting, existing vegetation (shrubs and grasses) is measured for biomass. Carbon stock in the soil pool will be measured in a previous year of planting, as well as just before planting. Below-ground biomass pools will be estimated from the above-ground biomass pools data.

C.4. Monitoring of the baseline net GHG removals by sinks and the actual net GHG removals by sinks:

C.4.1. Actual net GHG removals by sinks data:

C.4.1.1. Data to be collected or used 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, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
4.1.1.01	Stratum ID	Stratification	Alpha		Before the	100%	Electronic	Each stratum has

		map	numeric		start of the project		and paper	a particular combination of soil type, climate, existing vegetation and landform
4.1.1.02	Sub-stratumID	Stratification map	Alpha numeric		Before the start of the project	100%	Electronic and paper	Each sub-stratum has a particular year to be planted under each stratum
4.1.1.03	Confidence level		%		Before the start of the project	100%	Electronic and paper	For the purpose of QA/QC and measuring and monitoring precision control
4.1.1.04	Precision level		%		Before the start of the project	100%	Electronic and paper	
4.1.1.05	Sample plotID	Project and plot map	Alpha numeric		Before the start of the project	100%	Electronic and paper	Numeric series ID will be assigned to each permanent sample plot
4.1.1.06	Plot location	Project and plot map and GPS locating		m	5years	100%	Electronic and paper	Using GPS to locate before start of the project and at time of each field measurement
4.1.1.07	Tree species	Project design map			5years	100%	Electronic and paper	Arranged in PDD
4.1.1.08	Age of plantation	Plot measurement	year	m	5 years	100%samplin g plot	Electronic and paper	Counted since the planted year

4.1.1.09	Number of trees	Plot measurement	number	m	5 years	100% trees in plots	Electronic and paper	Counted in plot measurement
4.1.1.10	Diameter at breast height (DBH)	Plot measurement	cm	m	5 year	100% trees in plots	Electronic and paper	Measuring at each monitoring time per sampling method
4.1.1.11	Mean DBH	Calculated via 4.1.1.10	cm	c	5 year	100% of sampling plots	Electronic and paper	Calculated via 4.1.1.09 and 4.1.1.10
4.1.1.12	Tree height	Plot measurement	m	m	5 year	100% trees in plots	Electronic and paper	Measuring at each monitoring time per sampling method
4.1.1.13	Mean tree height	Calculated via 4.1.1.12	m	c	5 year	100% of sampling plots	Electronic and paper	Calculated via 4.1.1.9 and 4.1.1.12
4.1.1.14	Merchantable volume	Calculated	$m^3 ha^{-1}$	c/m	5 year	100% of sampling plots	Electronic and paper	Calculated via 4.1.1.11 and 4.1.1.1t
4.1.1.15	Wood density	National inventory for LULUCF	t d.m. m^{-3}	e	5 year	100% of sampling plots	Electronic and paper	Species specific
4.1.1.16	Biomass expansion factor (BEF)	National inventory for LULUCF	dimensionless	e	5 year	100% of sampling plots	Electronic and paper	Species specific
4.1.1.17	Carbon fraction	IPCC	t C.(t d.m) $^{-1}$	e	5 year	100% of sampling plots	Electronic and paper	IPCC default value
4.1.1.18	Root-shoot ratio	National inventory for LULUCF	Dimensionles s	e	5 year	100% of sampling plots	Electronic and paper	Species specific
4.1.1.19	Carbon stock in aboveground biomass of plots	Calculated from equation	t C ha-$^{-1}$	c	5 year	100% of sampling plots	Electronic and paper	Calculated via 4.1.1.14-4.1.1.17

4.1.1.20	Carbon stock in belowground biomass of plots	Calculated from equation	t C ha^{-1}	c	5 year	100% of sampling plots	Electronic and paper	Calculated via 4.1.1.18-4.1.1.19
4.1.1.21	Mean Carbon stock in aboveground biomass per unit area per stratum per species	Calculated from plot data	t C ha^{-1}	c	5 year	100% of strata and sub-strata	Electronic and paper	Calculated from 4.1.1.09-4.1.1.19
4.1.1.22	Mean Carbon stock in belowground biomass per unit area per stratum per species	Calculated from plot data	t C ha^{-1}	c	5 year	100% of strata and sub-strata	Electronic and paper	Calculated from 4.1.1.09 and 4.1.1.20
4.1.1.23	Area of stratum and sub-stratum	Stratification map and data	ha	m	5 year	100% of strata and sub-strata	Electronic and paper	Actual area of each stratum and sub-stratum
4.1.1.24	Carbon stock in	Calculated	t C	c	5 year	100% of strata and	Electronic and paper	Calculated via 4.1.1.21 and 4.1.1.23
4.1.1.25	Carbon stock in belowground biomass of stratum per species	Calculated	t C	c	5 year	100% of strata and sub-strata	Electronic and paper	Calculated
4.1.1.26	Carbon stock change in aboveground biomass of stratum per species	Calculated	t C yr^{-1}	c	5 year	100% of strata and sub-strata	Electronic and paper	Calculated via 4.1.1.24
4.1.1.27	Carbon stock change in belowground	Calculated	t C yr^{-1}	c	5 year	100% of strata and sub-strata	Electronic and paper	Calculated via 4.1.1.25

	biomass of stratum per species							
4.1.1.28	Total carbon stock change	Calculated	t CO_2-e yr^{-1}	c	5 year	100% project area	Electronic and paper	Summing up carbon stock change in 4.1.1.26 and 4.1.1.27 for all strata,

C.4.1.2. Data to be collected or used 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, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
4.1.2.01	Amount of synthetic fertilizer N applied per unit area	Monitoring activity	kg N ha^{-1} yr^{-1}	m	annually	100%	Electronic and paper	For different tree species and/or management intensity
4.1.2.02	Amount of organic fertilizer N applied per unit area	Monitoring activity	kg N ha^{-1} yr^{-1}	m	annually	100%	Electronic and paper	For different tree species and/or management intensity
4.1.2.03	Area of land with N applied	Monitoring activity	ha^{-1} yr^{-1}	m	annually	100%	Electronic and paper	For different tree species and/or management intensity
4.1.2.04	Amount of	Calculated	t N yr^{-1}	c	annually	100%	Electronic	Calculated via 4.1.2.01 and

	synthetic fertilizer N applied						and paper	4.1.2.03
4.1.2.05	Amount of organic fertilizer N applied	Calculated	t N yr^{-1}	c	annually	100%	Electronic and paper	Calculated via 4.1.2.02 and 4.1.2.03
4.1.2.06	Fraction that volatilises as NH3 and NOx for synthetic fertilizers	GPG 2000, IPCC Guideline	dimensionles s	e	Before start of monitoring	100%	Electronic and paper	IPCC default value (0.1) is used
4.1.2.07	Fraction that volatilises as NH3 and NOx for organic fertilizers	GPG 2000, IPCC Guidelines	dimensionles s	e	Before start of monitoring	100%	Electronic and paper	IPCC default value (0.2) is used
4.1.2.08	Emission factor for emission from N input	GPG 2000, IPCC Guidelines	N_2O-N (tonnes N $input)^{-1}$	e	Before start of monitoring	100%	Electronic and paper	IPCC default value (1.25%) is used
4.1.2.09	Direct N_2O emission of N input	Calculated	t CO_2-e yr^{-1}	c	annually	100%	Electronic and paper	Calculated via 4.1.2.04-4.1.2.08
4.1.2.10	Amount of diesel consumption	Monitoring activity	litter	m	annually	100%	Electronic and paper	
4.1.2.11	Emission factor for diesel	GPG 2000, IPCC Guidelines , national inventory	kg CO_2-e l^{-1}	e	annually	100%	Electronic and paper	IPCC default value (3.86) was used
4.1.2.12	Number of plot	Monitoring activity	count	m	annually	100%	Electronic and paper	Counted in plot measurement

4.1.2.13	Aboveground biomass of non-tree	Monitoring activity	tonnes d.m. ha^{-1}	m	annually	100%	Electronic and paper	Measured before site preparation
4.1.2.14	Belowground biomass of non tree	Monitoring activity	tonnes d.m. ha^{-1}	m	annually	100%	Electronic and paper	Measured before site preparation
4.1.2.15	Aboveground biomass of tree	Monitoring activity	tonnes d.m. ha^{-1}	m	annually	100%	Electronic and paper	Measured before site preparation
4.1.2.16	Belowground biomass of tree	Monitoring activity	tonnes d.m. ha^{-1}	m	annually	100%	Electronic and paper	Measured before site preparation
4.1.2.17	Carbon fraction for non-tree	GPG 2000, IPCC Guidelines, national inventory	tonnes C $(tonne\ d.m.)^{-1}$	e	annually	100%	Electronic and paper	IPCC default value (0.5) is used
4.1.2.18	Carbon fraction for non-tree	GPG 2000, IPCC Guidelines, national inventory	tonnes C $(tonne\ d.m.)^{-1}$	e	Annually	100%	Electronic and paper	IPCC default value (0. 5) is used
4.1.2.19	Root to shoot ratio	Calculated	tonnes C	c	annually	100%	Electronic and paper	Calculated from 4.1.2.15 and 4.1.2.16
4.1.2.20	Carbon stock in non-tree biomass	Calculated	tonnes C	c	annually	100%	Electronic and paper	Calculated via 4.1.2.17
4.1.2.21	Carbon stock in tree biomass	Calculated	tonnes C	c	annually	100%	Electronic and paper	Calculated via 4.1.2.18
4.1.2.22	Decrease of CO_2 as a result of biomass removals	Calculated	tonnes CO_2 – e yr^{-1}	c	annually	100%	Electronic and paper	Calculated via 4.1.2.20 and 4.1.2.21

C.4.1.3. Description of formulae and/or models used to monitor the estimation of the ex-post actual net GHG removals by sinks:

Net GHG removals by the project activity is calculated with an equation as shown below:

$$\Delta C_{ACT} = \Delta C_A + \Delta C_B - GHG_E \qquad \textbf{(C4)}$$

ΔC_{ACT} : actual net GHG removals by sinks

ΔC_A : annual carbon stock change in aboveground biomass

ΔC_B : annual carbon stock change in below-ground biomass

GHG_E : annual GHG emissions by sources within the project boundary as a result of the implementation of an A/R CDM project activity

C.4.1.3.1. Description of formulae and/or models used to monitor the estimation of the verifiable changes in carbon stock in the carbon pools within the project boundary (for each carbon pool in units of CO_2 equivalent):

>>

Annual changes of carbon stock in each carbon pool within the project boundary are estimated by the following formulae.

$$\Delta C_i = (\Delta C_{A,i} + \Delta C_{B,i}) \cdot 44/12 \qquad \textbf{(C5)}$$

$$\Delta C_{A,i} = (C_{A,i,t2} - C_{A,i,t1})/(t2 - t1) \qquad \textbf{(C6)}$$

$$\Delta C_{B,i} = (C_{B,i,t2} - C_{B,i,t1})/(t2 - t1) \qquad \textbf{(C7)}$$

Where:

ΔC_i	verifiable changes in carbon stock in the carbon pools for stratum i, tonnes $CO_2 yr^{-1}$
$\Delta C_{A,i}$	changes in carbon stock in aboveground biomass for stratum i, tonnes C yr^{-1}
$\Delta C_{B,i}$	changes in carbon stock in below-ground biomass for stratum i, tonnes C yr^{-1}
$C_{A,i,t}$	carbon stock in aboveground biomass for stratum i at time t, tonnes C
$C_{B,i,t}$	carbon stock in below-ground biomass for stratum i at time t, tonnes C
44/12	ratio of molecular weights of carbon and CO_2, dimensionless
t1, t2	year when measured

Above-ground biomass carbon stocks at a certain time are estimated with both the results from field surveys and the analysis of satellite image combined. Carbon stocks of below-ground biomass pools are calculated in a root/shoot ratio.

Aboveground biomass

The carbon stock in the pool of above-ground biomass at a point of time “t”, in a stratum “i” is estimated by an allometric method.

Step 1

Diameters at Breast Height （DBH, at 1.3 m above ground） and tree heights (H)of living trees in plots are measured. The subject trees are to be higher than 3cm DBH.

Step 2

Estimate the above ground biomass for each plot.

$$B_{A,k} = \sum_n f(DBH_n, H_n) \quad \textbf{(C8)}$$

Where

$B_{A,k}$	aboveground biomass for plot k, tonnes ha^{-1}
$f(DBH, H)$	an allometric equation for estimating aboveground biomass of individual tree from DBH and H
n	tree ID in plot k.

Step 3

Extract the spectral information for each stratum from corresponding pixel of satellite image.

Step 4

A relational expression between above-ground biomass and satellite data is to be created from calculated above-ground biomass $B_{A,k}$ by field survey and satellite data.

$$B_{sat,A,p} = g(SatData_p) \quad \textbf{(C9)}$$

Where

$B_{sat,A,p}$	biomass amount of pixel p, estimated from satellite data, tonnes ha^{-1}
$g(SatData)$	an equation for estimating aboveground biomass from satellite data.

Step 5

Estimate biomass amount of the whole pixels corresponding to Stratum i, and sum the biomass amount and convert to carbon stock.

$$C_{A,i,t} = \sum_{p} (A_p \cdot B_{sat,A,p}) \cdot CF_j \quad \textbf{(C10)}$$

Where

$C_{A,i,t}$	carbon stock in aboveground biomass for stratum i at time t, tonnes C
A_p	area of pixel p, ha
CF_j	carbon fraction of dry biomass in tree species j, tonnes C (tonne d.m.)$^{-1}$

Step 6

In this step the validity of the above method will be discussed. First, the measurements are taken at the time of logging because it enables to obtain the most accurate measurable quantity from bone-dry weight of wood material (equal to the weight of merchantable volume). This method using satellite images (Method A) will be compared to the ordinary method (Method B) to find the validity of Method A. Method B estimates from the mean biomass stock per unit area for each stratum by plot measurement and then multiplied by the area of the stratum. In this step, the estimate amounts of carbon stock will be generated.

A truckload of wood is defined as a unit area（hereafter loading unit area）. The difference between the mass of measured merchantable volume per loading unit area and the estimated biomass stock from each method A and method B, respectively, will be compared. The mean square of the entire loading unit area is defined as a value of accuracy of each method A and B for comparison.

Substep 6-1

Determine an expansion factor from the weight of merchantable volume to aboveground biomass.

Substep 6-2

Calculate the above-ground biomass from the weight of merchantable volume per loading unit.

$$UB_{m,u} = W_u \cdot BEF_j \quad \textbf{(C11)}$$

where

$UB_{m,u}$	aboveground biomass for loading unit u, tonnes
W_u	weight of merchantable volume for loading unit u, tonnes

BEF_j	biomass expansion factor for conversion of weight of merchantable volume to aboveground tree biomass, dimensionless

Substep 6-3
Applying method A, calculate the above-ground biomass per loading unit area. Extract the corresponding pixels with the loading units from satellite images to be used for estimation.

$$UB_{sat,u} = \sum_{p} (A_p \cdot B_{sat,A,u,p}) \quad \textbf{(C12)}$$

where

$UB_{sat,u}$	aboveground biomass for loading unit u, tonnes
A_p	area of pixel p, ha
$B_{sat,A,u,p}$	above-ground biomass of a pixel p in a loading unit u estimated from satellite data, tonnes ha^{-1}

Substep 6-4
Calculate above-ground biomass per loading unit area for each unit by method B that applies the mean above-ground biomass per unit area measured in plot for each stratum.

$$UB_{plot,u} = A_u \cdot \overline{B}_{A,i} \quad \textbf{(C13)}$$

$$\overline{B}_{A,i} = \frac{1}{N_i} \sum_{k} B_{A,i,k} \quad \textbf{(C14)}$$

Where

$UB_{plot,u}$	aboveground biomass for loading unit u, tonnes
A_u	area of loading unit u, ha
$\overline{B}_{A,i}$	mean aboveground biomass in the stratum i,tonnes ha^{-1}
$B_{A.i,k}$	above-ground biomass of a plot k in a stratum i calculated from plot measurement, tonnes ha^{-1}
N_i	number of plot within strarum i, count

Substep 6-5
Each year after the first logging period, a mean square calculated by the above-ground biomass per loading unit estimated by method A or method B and the measured weight of merchantable volume will be calculated for the entire loading units logged in a previous year.

$$MS_{sat} = \sum_{u} (UB_{sat,u} - UB_{m,u})^2 \quad \textbf{(C15)}$$

$$MS_{plot} = \sum_{u} (UB_{plot,u} - UB_{m,u})^2 \quad \textbf{(C16)}$$

Substep 6-6

Verify the method A of satellite images estimates more accurately than method B.

$$MS_{sat} < MS_{plot} \quad \textbf{(C17)}$$

If the accuracy of the method with mean biomass is higher than method A, the formula (10) of step 6 will not be used, but the carbon stock in aboveground biomass for stratum i at time t will be estimated by the following formula.

$$C_{A,i,t} = A_i \cdot \overline{B}_i \cdot CF_j \quad \textbf{(C10')}$$

Belowground biomass

The below-ground biomass is calculated from the above-ground carbon stock in the pool and root-shoot ratio.

$$C_{B,i,t} = C_{A,i,t} \cdot R_j \quad \textbf{(C18)}$$

Where

R_j root-to-shoot ratio for species j, dimensionless.

C.4.1.3.2. Description of formulae and/or models used to monitor the estimation of the GHG emissions by the sources, measured in units of CO_2 equivalent, that are increased s a result of the implementation of the proposed A/R CDM project activity within the project boundary (for each source and gas, in units of CO_2 equivalent):

>>

GHG emissions within the project boundary as a result of the implementation of the project activity will be calculated as shown below:

$$GHG_E = E_{fuelburn} + E_{biomassloss} + N_2O_{direct\_N_{fertilizer}} \quad \textbf{(C19)}$$

Where

GHG_E the increase in GHG emission as a result of the implementation of the proposed A/R CDM project activity within the project boundary, tonnes CO_2 –e yr^{-1}

$E_{fuelburn}$ GHG emission as a result of burning of fossil fuels within the project boundary, tonnes CO_2 –e yr^{-1}

$E_{biomassloss}$ CO_2 emission as a result of biomass removals within the project boundary, tonnes CO_2 –e yr^{-1}
$N_2O_{direct\_N_{fertilizer}}$ N_2O emission as a result of direct nitrogen application within the project boundary, tonnes CO_2 –e yr^{-1}

GHG emissions from burning fossil fuels

Step 1
Measure fossil fuel consumption: The consumption of fossil fuel resulted from vehicle use for transport of seedlings, logging and site preparation, and also resulted from the use of machinery for preparation of the plantation site.

Step 2
Select emission factors

Step 3
Estimate GHG emissions

$$E_{fuelburn} = (AC_{diesel} \cdot EF_{diesel} + AC_{gasoline} \cdot EF_{gasoline}) \cdot 0.001 \quad \textbf{(C20)}$$

Where

AC_{diesel} amount of diesel consumption, litter
$AC_{gasoline}$ amount of gasoline consumption, litter
EF_{diesel} emission factor for diesel, kg CO_2 $litter^{-1}$
$EF_{gasoline}$ emission factor for gasoline, kg CO_2 $litter^{-1}$
0.001 conversion kg to tonnes

Decrease in carbon stocks in the living biomass of existing vegetation

Estimate the decrease of carbon stocks assuming that the entire biomass within the boundary is lost.

Step 1
Allocate ten to fifteen plots in each stratum by following the locating method of sampling site, the plot size as well as the layout of plots mentioned in B.2.

Step 2
Measure the grass biomass. Collect the above- and below-ground parts of grass in a sub-plot and measure the bone-dry weight.

Step 3

Calculate the total grass biomass of a stratum.

Calculate an average above-ground biomass from the measured data.

$$\overline{B}_{non-tree,i} = \frac{1}{N_i}\sum_{p}(B_{non-tree,A,p} + B_{non-tree,B,p}) \quad \textbf{(C21)}$$

where

$\overline{B}_{non-tree,i}$	average non-tree biomass stock for strarum i, tonnes d.m. ha^{-1}
N_i	number of plot within strarum i, count
$B_{non-tree,A,k}$	aboveground biomass of non-tree vegetation for plot k, tonnes d.m. ha^{-1}
$B_{non-tree,B,k}$	below-ground biomass of non-tree vegetation for plot k, tonnes d.m. ha^{-1}

Calculate the carbon stock in the living biomass of s stratum

$$C_{non-tree,i} = A_i \cdot \overline{B}_{non-tree,i} \cdot CF_{non-tree,i} \quad \textbf{(C22)}$$

where

$C_{non-tree,i}$	carbon stock in non-tree living biomass for stratum i, tonnes C
. A_i	area of stratum i, ha
$CF_{non-tree,i}$	carbon fraction of dry biomass in non-tree vegetation for stratum i, tonnes C (tonne d.m.)$^{-1}$

-

Step 4
The shrub biomass is estimated.

Cut the above-ground part of all shrubs in a subplot and calculate the above-ground biomass.

Calculate the mean above-ground biomass in a stratum from measured data.

$$\overline{B}_{A.i,j} = \frac{1}{N_i}\sum_{k}\sum_{j} B_{A,j,k} \quad \textbf{(C23)}$$

where

$\overline{B}_{A,i,j}$	average aboveground biomass of tree for strarum i species j, tonnes d.m. ha^{-1}
$B_{A,j,p}$	aboveground biomass of tree for plot k species j, tonnes d.m. ha^{-1}

N_i number of plot within strarum i, count

Calculate the above and below-ground carbon stock of shrubs in a stratum.

$$C_{A,tree,i} = A_i \cdot \sum_j (\overline{B}_{A,i,j} \cdot CF_j) \quad \textbf{(C24)}$$

$$C_{B,tree,i} = A_i \cdot \sum_j (\overline{B}_{A,i,j} \cdot R_j \cdot CF_j) \quad \textbf{(C25)}$$

Where

$C_{A,tree,i}$ carbon stock in aboveground tree biomass for stratum i, tonnes C

$C_{B,tree,i}$ carbon stock in below-ground tree biomass for stratum i, tonnes C

CF_j carbon fraction of dry biomass in tree species j, tonnes C (tonne d.m.)$^{-1}$

R_j root to shoot ratio for species j, dimensionless.

Calculate the carbon stock in shrub biomass of a stratum.

$$C_{tree,i} = C_{A,tree,i} + C_{B,tree,i} \quad \textbf{(C26)}$$

Where

$C_{tree,i}$ carbon stock in tree living biomass for stratum i, tonnes C

Step 5

Estimate the decrease of CO_2 in a biomass pool associated with the inside and outside of the plantation site.

$$E_{biomassloss} = \sum_i C_{non-tree,i} \cdot 44/12 + \sum_i C_{tree,i} \cdot 44/12 \quad \textbf{(C27)}$$

Where

44/12 ratio of molecular weights of carbon and CO_2, dimensionless

N_2O emissions from nitrogen fertilisation practices

Calculate the GHG emissions by fertilisation at the time of planting.

Step 1
Monitor the amount of synthetic and organic fertilizer used in the project boundary.

Step 2
Calculate N_2O emissions.

$$N_2O_{direct-N_{fertilizer}} = [(F_{SN} + F_{ON}) \cdot EF_N] \cdot 44/28 \cdot 310 \quad \textbf{(C28)}$$

$$F_{SN} = N_{SN-fert} \cdot (1 - Frac_{GASS}) \quad \textbf{(C29)}$$

$$F_{ON} = N_{ON-fert} \cdot (1 - Frac_{GASO}) \quad \textbf{(C30)}$$

where

$N_2O_{direct-N_{fertilizer}}$ direct emissions of N_2O from forest fertilisation within the project boundary, tonnes CO_2-e yr^{-1}
F_{SN} annual amount of synthetic fertiliser nitrogen applied to forest soils adjusted for volatilisation as NH_3 and NO_x, tonnes N yr^{-1}
F_{ON} annual amount of organic fertiliser nitrogen applied to forest soils adjusted for volatilisation as NH_3 and NO_x, tonnes N yr^{-1}
EF_N emission factor for N_2O emissions from N inputs, tonnes N_2O -N (tonnes N input)$^{-1}$
44/28 ratio of molecular weight of N_2O and nitrogen, dimensionless
311 Global Warming Potential for N_2O
$N_{SN-fert}$ total use of synthetic fertiliser nitrogen, tonnes N yr^{-1}
$N_{ON-fert}$ total use of organic fertiliser nitrogen, tonnes N yr^{-1}
$Frac_{GASS}$ fraction of total synthetic fertiliser nitrogen that is emitted as NH_3 and NO_x, dimensionless
$Frac_{GASO}$ fraction of total organic fertiliser nitrogen that is emitted as NH_3 and NO_x, dimensionless

C.4.2. As appropriate, relevant data necessary for determining the ex-post baseline net GHG removals by sinks and how such data will be collected and archived, if required:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	**Source of data**	**Data unit**	**Measured (m), calculated (c) or estimated (e)**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**

C.4.2.1. Description of formulae and/or models used to monitor the estimation of the ex-post baseline net GHG removals by sinks (for each carbon pool, in units of CO_2 equivalent), if required:

>>
The change of the baseline carbon pool is nil.

C.5. Treatment of leakage in the monitoring plan:

>>

- Monitor the GHG emissions from fossil fuel resulting from vehicle and machinery use for the project activity outside the boundary.
- Monitor the amount of fertilisation outside of the boundary.
- Monitor the electric consumption in related facilities outside the boundary.

C.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 *(Please use numbers to ease cross-referencing to D.3)*	Data variable	**Source of data**	**Data unit**	**Measured (m), calculated (c) or estimated (e)**	**Recording frequency**	**Proportion of data to be monitored**	**How will the data be archived? (electronic/ paper)**	**Comment**
5.1.01	Number of each vehicle type used	Monitoring of project activity	number		annually	100%	Electronic and paper	Monitoring number of each vehicle type used
5.1.02	Emission factors for road transportation	GPG 2000, IPCC Guidelines, national inventory	kg CO_2-e l^{-1}	e	annually	100%	Electronic and paper	National or local value has the priority
5.1.03	Fuel consumption	Monitoring of project activity	litre	m	annually	100%	Electronic and paper	Monitoring fuel consumed
5.1.04	Electricity consumption	Monitoring of project activity	kw h^{-1}	m	annually	100%	Electronic and paper	Monitoring electricity consumed

5.1.05	Emission factors for electricity	National inventory	kg CO_2 (kw h^{-1}) $^{-1}$	e	annually	100%	Electronic and paper	National or local value has the priority
5.1.06	Nitrogen fertilization applied	Monitoring of project activity	kg	m	annually	100%	Electronic and paper	Monitoring Nitrogen fertilizer used
5.1.07	Leakage	Calculated	t CO2-e yr^{-1}	c	annually	100%	Electronic and paper	Calculated via 5.1.02, 5.1.07

C.5.2. Description of formulae and/or models used to estimate leakage (for each GHG, source, carbon pool, in units of CO_2 equivalent:

>>

$$LK = E_{fuelburn} + E_{electricity} + N_2O_{direct\_N_{fertilizer}} \quad \textbf{(C31)}$$

where

LK total GHG emissions due to project activities outside the project boundary, tonnes CO_2-e yr^{-1}
$E_{FuelBurn}$ CO_2 emissions from the combustion of fossil fuels outside the project boundary, tonnes CO_2-e yr^{-1}
$E_{electricity}$ CO_2 emissions equivalent to electricity consumption outside the boundary, tonnes CO_2-e yr^{-1}
$N_2O_{direct-Nfertilizer}$ N_2O emission as a result of direct nitrogen application outside the project boundary, tonnes CO_2-e yr^{-1}

Step 1
Determine $E_{FuelBurn}$, $N_2O_{direct-Nfertilizer}$ occurred outside the boundary applying the same method in B.2.2.2.

Step 2
Measure the electric consumption in the related facilities.

Step 3
Calculate CO_2 emissions resulting from electric consumption.

$$E_{electricity} = U_{electricity} \cdot EF_{electricity} \quad \textbf{(C32)}$$

where

$U_{electricity}$ Electric consumption, kw h^{-1}
$EF_{electricity}$ Coefficient of CO_2 per electric consumption, kg CO_2 (kw h^{-1}) $^{-1}$

C.5.3. Please specify the procedures for the periodic review of implementation of activities and measures to minimize leakage:

>>

The subject of leakage must be included in this project. To minimize leakage, energy consumption will be reduced by dealing with the same amount of work, but with less GHG emissions. Thorough instruction for this concept will be provided to all relevant personnel at the time of education/training.

C.6. Description of formulae and/or models used to estimate ex-post net anthropogenic GHG removals by sinks for the proposed A/R CDM project activity (for each GHG, carbon pool, in units of CO_2 equivalent):

>>

$$C_{AR\_CDM} = C_{ACT} - C_{BSL} - LK \qquad \textbf{(C33)}$$

where

C_{AR_CDM} net anthropogenic GHG removals by sinks, , tonnes CO_2-e yr^{-1}

C_{ACT} actual net GHG removals by sinks, , tonnes CO_2-e yr^{-1}

C_{BSL} baseline net GHG removals by sinks = 0, tonnes CO_2-e yr^{-1}

LK total GHG emissions due to project activities outside the project boundary, tonnes CO_2-e yr^{-1}

C.7. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored:

Data ***(Indicate table and ID number e.g. 3.-1.; 3.2.)***	Uncertainty level of data (High/Medium/Low)	**Explain QA/QC procedures planned for these data, or why such procedures are not necessary.**
4.1.1.06 Plot location	low	Random plot verification using GPS to ensure the consistent measuring and monitoring of the carbon stock change over time
4.1.1.07 Tree species	low	Random Verification over the project area to ensure the area of each tree species is correctly measured
4.1.1.08 Age of plantation	low	Random Verification over the project area to ensure the area in terms of plantation age is correctly measured
4.1.1.09 Number of trees	low	Random plot verification
4.1.1.10 Diameter at breast height (DBH)	low	Random plot verification

4.1.1.12 Tree height	low	Random plot verification
4.1.1.14 Merchantable volume	low	All equations used to calculate this data shall be verified
4.1.1.15 Wood density	low	Data that divert significantly from IPCC default value shall be verified
4.1.1.16 Biomass expansion factor (BEF)	low	Data that divert significantly from IPCC default value shall be verified
4.1.1.17 Carbon fraction	low	Data that divert significantly from IPCC default value shall be verified
4.1.1.18 Root-shoot ratio	low	Data that divert significantly from IPCC default value shall be verified
4.1.2.09 Direct N2O emission of N input	low	Data that divert significantly from IPCC default value shall be verified

C.8. 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:

>>
LPFL, as the project entity, is responsible for any relevant acts including labour, management, monitoring and dealing of credits.
The company will disclose all records and evaluations of monitoring to relevant organizations inside and outside of the country, including local inhabitants.
External experts will be employed to investigate and evaluate the technical means of monitoring.

C.9. Name of person/entity determining the monitoring methodology:

>>
Oji Paper Co., Ltd.

SECTION D. Estimation of net anthropogenic GHG removals by sinks:

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

>>

The actual net GHG removals by sinks that the project activities generate are estimated from the carbon stock changes caused by the growth of planted trees and logging, and GHG emissions by the project operation.

Annual carbon stock change in aboveground and belowground biomass

First, we compared the growth models of other countries and adopted the one for Portugal, which is conservatively similar to the subject area. Then, the timber volume each year is calculated applying the growth model formulae (Formula D1 to D3) of Portugal (Tomé et al., 1995). As for the measured value, 2.5 years old Eucalyptus Camaldurensis in the subject area was measured for the values of the formulae.

$$H_{est} = a1 \cdot \left(H_m / a1 \right)^{Age_m^{a2} / Age_{est}^{a2}} \quad \text{(D1)}$$

$$BA_{est} = b1 \Big/ \left[1 - \left(1 - b1 / BA_m \right) \cdot \left(Age_m / Age_{est} \right)^{b2} \right] \quad \text{(D2)}$$

$$V_{est} = c1 \cdot BA_{est}^{c2} \cdot H_{est}^{c3} \quad \text{(D3)}$$

where

H_{est}	estimated tree height, m
H_m	measured tree height, 8.60, m
Age_{est}	tree age when estimated, year
Age_m	tree age when measured, 2.5, year
a1	coefficient = 36.9292
a2	coefficient＝0.621
BA_{est}	estimated DBH area total, m^2 ha^{-1}
BA_m	measured DBH area total, 5.69, m^2 ha^{-1}
b1	coefficient = 42.8372
b2	coefficient = 1.0922
V_{est}	estimated timber volume total, m^3 ha^{-1}
c1	coefficient = 0.7331
c2	coefficient = 1.0263
c3	coefficient = 0.7682

The annual carbon stock change was estimated using the timber volume obtained, coefficients in the table D-1 and formulae C11' and C5 to C7. The table Dshows the result.

Table D-1 coefficients used to estimate the annual carbon stock change

Coefficient	Value	Source
wood density, D	0.495	Field measurement in project area
Biomass Expansion Factor, BEF	1.442	Field measurement in project area
Carbon Factor, CF	0.50	Field measurement in project area
root-shoot ratio, R	0.35	Field measurement in project area

GHG emissions by sources
The formula C20 calculates the $E_{fuelBurn}$. It represents the CO_2 generated by fossil fuels used by vehicles used for forest road construction, transport of seedlings, and logging. The amounts estimated for fossil fuels are taken from actual values from the industrial plantations, which the project entity is operating in other countries (Table D-2). $E_{biomassloss}$ represents the lost biomass caused by removal of existing vegetation for site preparation that has been estimated by the formulae C21-27. The amounts of grass and shrubs biomass per unit area were measured by the project entity (Table D-2).
In this project, the area is fertilized three times - when the seedlings are planted and twice at later stages. Agrichemical N12.5kg ha-1/ha is given to the plantation area each time. The GHG emission was estimated by the formulae C28-30.
The estimated annual GHG emission was obtained by the formula C19 as in table 8.

Table D-2 variables and coefficients used for calculation of GHG emissions by sources

variables/coefficients	Values	Source
Diesel consumption, litter/ha/year		
Transport of seedlings	2.3	Other project
Road construction	8.6	Other project
Construction	12.9	Other project
Collection	4.0	Other project
Lost biomass by site preparation, d.m. tones/ ha		
Shrub land	37.6	Field measurement
Grassland	10.5	Field measurement
Emission coefficient		
Diesel, EF_{diesel}	2.64	IPCC

D.2. Estimated ex-ante baseline net GHG removals by sinks:

>>
The change of the baseline carbon pool is set to nil as mentioned previously.

D.3. Estimated ex-ante leakage:

>>
The sources of leakage can be; transport of timbers, chip processing, fossil fuels used to transport chips, electricity for shipping, and fertilisation for planting seedlings.

As for the estimated consumption of fossil fuels and electricity, the actual measured values in the other countries were applied to the formulae C20 and C32. (Table D-2)
The amount of fertilisation to raise seedlings was set to 1.1kg/ha/year and applied to the formulae C28 to 30.
The annual leakage was calculated by formula C31. (Table D-3)

Table D-3 Variables and coefficients used for annual leakage calculation

variables/coefficient	Value	Scource
Diesel consumption, litter/ha/year		
Transport of raw wood	333.4	Other project
Chip process	51.0	Other project
Transport of chips	835.0	Other project
Shipping of chips	25.5	Other project
Electricity consumption, kWh/ha/year		
Chip process	108	Other project
Shipping of chips	54	Other project
Emission coefficient		
Diesel, EF_{diesel}	2.64	Other project
Electricity, $E_{electricity}$	0.36	Other project

D.4. The sum of D.1 minus D.2 minus D.3 representing the ex-ante net anthropogenic GHG removals by sinks of the proposed A/R CDM project activity:

>>
As shown in tabled.D-4

D.5. Table providing values obtained when applying formulae above:

>>
TableD-4 The planned area of plantation and estimated annual net anthropogenic GHG removals by sinks.

Year	Area (ha)			Annual carbon stock change (tCO_2 yr^{-1})	Annual GHG emission (tCO_2-e yr^{-1})	Annual leakage (tCO_2-e yr^{-1})	Annual net anthropogenic GHG removals by sinks (tCO_2-e yr^{-1})
	planted	harvested	remained				
2007	4,150	0	4,150	29,299	-183,262	-3	-153,966
2008	4,150	0	8,300	119,421	-183,291	-3	-63,872
2009	4,150	0	12,450	235,297	-183,291	-3	52,004
2010	4,150	0	16,600	360,020	-183,291	-3	176,727
2011	4,150	0	20,750	485,838	-183,291	-3	302,545
2012	4,150	0	24,900	608,946	-183,291	-3	425,653
2013	4,150	0	29,050	727,462	-183,291	-3	544,168
2014	4,150	4,150	29,050	0	-154	-6,935	-7,089
2015	4,150	4,150	29,050	0	-154	-6,935	-7,089
2016	4,150	4,150	29,050	0	-154	-6,935	-7,089
2017	4,150	4,150	29,050	0	-154	-6,935	-7,089
2018	4,150	4,150	29,050	0	-154	-6,935	-7,089
2019	4,150	4,150	29,050	0	-154	-6,935	-7,089
2020	4,150	4,150	29,050	0	-154	-6,935	-7,089
2021	4,150	4,150	29,050	0	-154	-6,935	-7,089
2022	4,150	4,150	29,050	0	-154	-6,935	-7,089
2023	4,150	4,150	29,050	0	-154	-6,935	-7,089
2024	4,150	4,150	29,050	0	-154	-6,935	-7,089

2025	4,150	4,150	29,050	0	-154	-6,935	-7,089
2026	4,150	4,150	29,050	0	-154	-6,935	-7,089
2027	4,150	4,150	29,050	0	-154	-6,935	-7,089
2028	4,150	4,150	29,050	0	-154	-6,935	-7,089
2029	4,150	4,150	29,050	0	-154	-6,935	-7,089
2030	4,150	4,150	29,050	0	-154	-6,935	-7,089
2031	4,150	4,150	29,050	0	-154	-6,935	-7,089
2032	4,150	4,150	29,050	0	-154	-6,935	-7,089
2033	4,150	4,150	29,050	0	-154	-6,935	-7,089
2034	4,150	4,150	29,050	0	-154	-6,935	-7,089
2035	4,150	4,150	29,050	0	-154	-6,935	-7,089
2036	4,150	4,150	29,050	0	-154	-6,935	-7,089
total	-	-	-	2,566,283	-1,286,554	-159,519	1,120,209

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

E.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:

>>

Hydrospheric / Regospheric impacts

The plantations are scattered over a large area, considering native ecosystem and distribution of local employment. No impact on the Mekong watersheds is expected as it is planned for the downstream sites of two National Protected Areas, that is NPA, Khammouane Limestone and Nam Kading, located in the lowland side of the upper Mekong.

However, the Laotian government is planning and operating large-scale developments, such as construction of a dam upstream of the plantation area. Such plans, other than this project, can cause a severe impact.

Not only the direct hydrospheric impact on the river basin outside of the boundary, but also the indirect impacts on the ecosystem and local farming and fishing must be considered and monitored.

Aquatic pollution

This project might cause the incursion of sands and aquatic degradation by the large-scale development in the upper area and around the project boundary. The plantations are scattered and adjacent to the local farms, communes, Mekong banks and/or swamps. The project entity, LPFL, has environmental guidelines and operation and management manuals for the appropriate use of fertilisers and agrichemicals and will give sufficient consideration to the impact on the natural habitats of aquatic species and prevent the pollution of household water, agricultural water, river and groundwater.

Soil structure/fertility

Inside and outside of the boundary there is a problem of soil fertility degradation and land deterioration due to the conversion of forest to farm by the conventional slash-and-burn shift farming and illegal logging. Topsoil erosion by rainfalls in lowlands and slope lands has caused severe damage and the lands cannot be used for farming and plantations.

Biodiversity

This project keeps a strict environmental guideline: 1) giving first priority to the ecosystem on selection of plantation sites, then select the site from deteriorated lands, 2) keeping impacts least on the ecosystem during site preparation, forest road construction, fertilisation/pesticide, and logging. Therefore, negative impacts on the ecosystem (i.e., native in habitats and vegetation) is not expected by the project operation such as plantations and loggings.
Illegal logging and slush-and-burn farming is still popular amongst the local inhabitants within the project boundary where not delineated yet or outside of the delineated area. The native vegetation is being lost in such areas and sustainable forest management and its consequence has to be spread into the local people through the employment and technology transfer during this project.

Waste management
This project operates plantation over the swidden areas and leftovers of shrubs by site preparation and wood debris by logging are generated. They will be reused as biomass energy for power generation by this project instead of conventional disposal by burning.

E.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 impacts have been identified.

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

>>
No significant negative impacts have been identified. However, environmental monitoring plan and remedial measures for any risks will be implemented.

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

>>

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

>>
Land tenure
LPFL has formulated written criteria for site selection survey and land lease procedures which indicates the project implementation with good consideration for environmental impacts on soils and ecosystems and social benefits such as employment opportunity and land use.
At any time of the project such as delineatation as well as planting and logging, land tenure can generate conflicts. It is necessary to let the local people, not only heads of the communes, have opportunity to express their opinions and to join briefings for amicable operation while protecting the locals land rights.

Livelihood & Food security 生計・NTFP

In the project area with concession of 150,000ha, the local people have a low level of living. They live on hunting, products by NTFP, and rice cropping. Some sells rattan and bamboo works, wood and bamboo materials, NTFP and tobacco but basically they live on subsistence basis.

The project entity shall respect to the local people's current life styles deeply involved with and enjoying various benefits from the forests and nature. The entity will provide employment opportunities and profit but also shall maintain the natural and forestry resources for the locals in and out of the plantation *areas*

Employment(quality and quantity)
In the subject area, there is no established industry and the employment opportunities, which the project provides will contribute greatly to the local communities and economy. The quality of employment is valuable as the project fosters the development of technicians and experts for IT (e.g., GIS operation), trucks and machinery operations, and plantation management and the skills necessary.

Social-infrastructure
The local interviews conducted in eight villages in 2005 (Ecolao, 2005) show that the villagers desire schools, roads, and medical facilities, such as a hospital.
The Laotian government requires the project entity to contribute USD50.00/ha of plantation area and will provide social investments, such as medical facilities, schools and roads, in response to the locals' wishes.

Technology transfer
The major industries in Laos are agriculture, engineering and forestry. The proposed project is expected to foster and transfer management skills, methods of growing seedlings, seedling breeding skills necessary for industrial plantations for paper materials, the demand for which is rising throughout Asia.

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

>>
No significant negative impacts have been identified as of today.

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

>>
No significant negative impacts have been identified. However, a socio-economic monitoring plan and remedial measures for any risks will be implemented.

SECTION G. Stakeholders' comments:

>>

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

>>
We conducted face-to-face interviews with members of environment and forestry government staff, as well as with an environmental NGO. The answers to the questionnaire were collected from the eight local villages and face-to-face interviews were conducted in two interviews.

G.2. Summary of the comments received:

>>
The Laotian government recognises the forestry regeneration as an issue of the highest importance and favours plantations as its efficient solution, which can also attract foreign funds. Despite of the

government's favour, the operator should refrain from operation on the authority, neglecting the local people.
Having collected information of the past environmental issues and met the environment and forestry government agency and a NGO, we found that there was criticism by an environmental NGO against mass afforestation of Eucalyptus in the past. However, each meeting revealed that it is commonly acceptable these days if forestry management is sustainable and considering environmental and social impacts.
In the interviews to the local people in two villages where plantations have started already, they gave positive responses and anticipation for the plantations. The counterpart commented that they hear misgivings in the villages where plantation has not been launched yet. It means that the explicit explanation to the inhabitants and the operation is necessary based upon the guidelines considering environmental and social factors.
In the research of environmental and social impacts by the assigned environmental consultant, eight villages in the project area were interviewed. We heard many complaints and negative comments on the project, for which incurred before we took over. The environmental consultant concluded in their analysis and advice as follows: "As impacts evaluation, there are significant amount of negative impacts generated by this project. It mainly derived from lack of awareness for management policy and staff education. Now Oji Paper has taken over the project and they are establishing the precise environmental guidelines by a new socio-environmental department to solve the past problems. Their appropriate staff education will spread the management policy, environmental guidelines, and operation procedures over the organisation, most of the current problems will be settled."
We take this research result of environmental and social impacts into consideration and reflect it in the reform measures and organising the framework.

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

>>
We will immediately prepare the appropriate organisations and systems for countermeasure based upon the results of this survey of environmental and social impacts.
The environmental guidelines and an expert department of socio-environmental impact measurements were already established. We are in the stage of improving the guidelines to for practical use, creating operation manuals, thorough education, organising the framework so that the management policy, the guidelines and operational procedure can be spread throughout the organisation.

Annex 1

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

Organization:	**Oji Lao Plantation Forest Co., Ltd.**
Street/P.O.Box:	Nokeokoummane Street, P.O.Box 8832
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Represented by:	
Title:	General Director
Salutation:	Mr.
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Middle Name:	
First Name:	Seiro
Department:	
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Direct FAX:	
Direct tel:	
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funds are expected.

Annex 3

BASELINE INFORMATION

In the grasslands, there are a few areas that might change to shrubs but the majority of the area will stay as grassland due to poor nutrients. In the shrubland, the locals who have no way to secure food other than by slash-and-burn farming, though this is illegal, the increased shrub biomass will be set off. With regard to the total area, the total amount of the biomass will not change.
For this study, the residents of the eight villages in the subject area for plantations were interviewed. One out of three households acquired new land to cultivate by burning fields in 2005 and the average swidden area was 1ha per household.. The fallow period is between 3 and 7 years with an average of 4.4 years.
There are 10,000 households in the subject area for the plantation. Our rough estimate is that there were more than 3,000 ha swidden during 2005, and the total area of burned fields was 15,000 ha.

Annex 4

MONITORING PLAN

3. Monitoring of the baseline
   It will not be necessary to monitor the baseline.

4. Monitoring of the project activity
   (a) Monitoring schedule
   The plots will be measured every five years beginning in 2012. The measurements in the year of logging need not to be bound by calendar years, but are to be conducted on the date nearest the logging period. The first measurements in 2012 will be done over all substrata where two years or more have passed after planting. Monitoring from the satellite will be done along with the plot measurements. In and after 2012, satellite image data will be obtained for analysis each year with the plot measurements.
   All area within the boundary will be analysed in the Verification year.

   The monitoring will be conducted by the method described in C.3.2.1.

   (b) Determination of numbers of sample plots
   The sample plots will be determined by the equations C1-C3.
   The first sampling will adopt the results of the 10 plots preliminary allocated in the testing plantation site. The standard deviation was calculated from the equation C2. Allowable errors were limited to 10% and a t-value was set to a 95% confidence level. The growth of trees and the cost of selecting a sample plot are assumed to make no difference, whether consisting

shrubs or not, among the strata. 10% of the numbers calculated from equation C1 were added to the actual plot numbers. The number of total plots are allocated according to the area of each substratum.

(c) Locating sample plots
Each plot size will be set to 15 m × 15 m. The seedlings are planted at interval of 3 m ×2 m in the project activity (i.e., 5 lines every 3 m and 7 lines every 2 m total 35 trees).
The plots are to be set at random, as described in section C.3.

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CLEAN DEVELOPMENT MECHANISM
SIMPLIFIED PROJECT DESIGN DOCUMENT
FOR SMALL-SCALE PROJECT ACTIVITIES (SSC-CDM-PDD)
Version 02

CONTENTS

SECTION A. General description of the small-scale project activity

A.1. Title of the small-scale project activity:

>>

Electrical power generation of woody biomass in Laos

A.2. Description of the small-scale project activity:

>>

The project intends to supply electrical power to the unelectrificated areas, for which there are no future plans for electrification, by building a power plant that will be fueled by recycled woody biomass.

Oji Lao Plantation Forest Co., Ltd.(LPFL, hereafter) has a concession for an area of 150,000 ha in Khammouane Province and Borikhamxay Province in Laos and 7,000ha plantations have been undergoing every year. Shrubs are currently burned to clear the land for plantations and we plan to build a power plant so that the unused biomass, such as the shrubs and post-harvested debris, can be recycled to provide electrical power to the unelectrificated areas.

The capacity of the woody-biomass-fueled power plant will be 30kW and it will run from 10:00 a.m. until 10:00 p.m. as an independent power supply. It will distribute power to houses, medical clinics, schools, street lights in the villages, as well as to pumps for wells and irrigation.

A.3. Project participants:

>>

Host: Lao People's Democratic Republic
Project entity: Oji Lao Plantation Forest Co., Ltd. (Abbr. LPFL)

A.4. Technical description of the small-scale project activity:

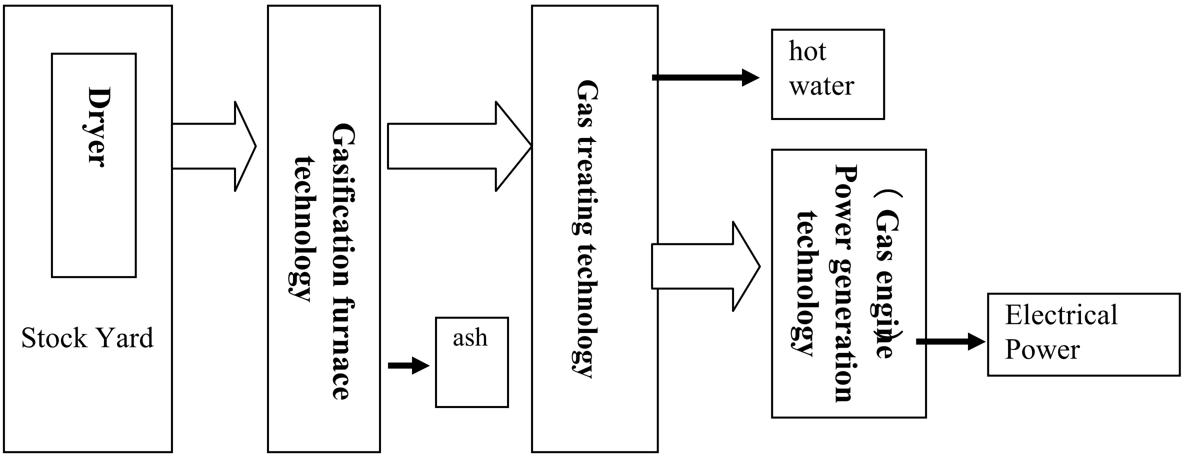
>>

Two types of power generation are available: direct combustion incineration and gasification incineration. The former may not be economically efficient because the generating efficiency is less than 10% when the plant size is less than 1,000kW.

On the other hand, current experiments show that gasification generating efficiency can be 20% when the plant size is less than 100kW. Because the power plant planned for this project will have a capacity of 30kW, the woody biomass gasification technology is considered to be appropriate.

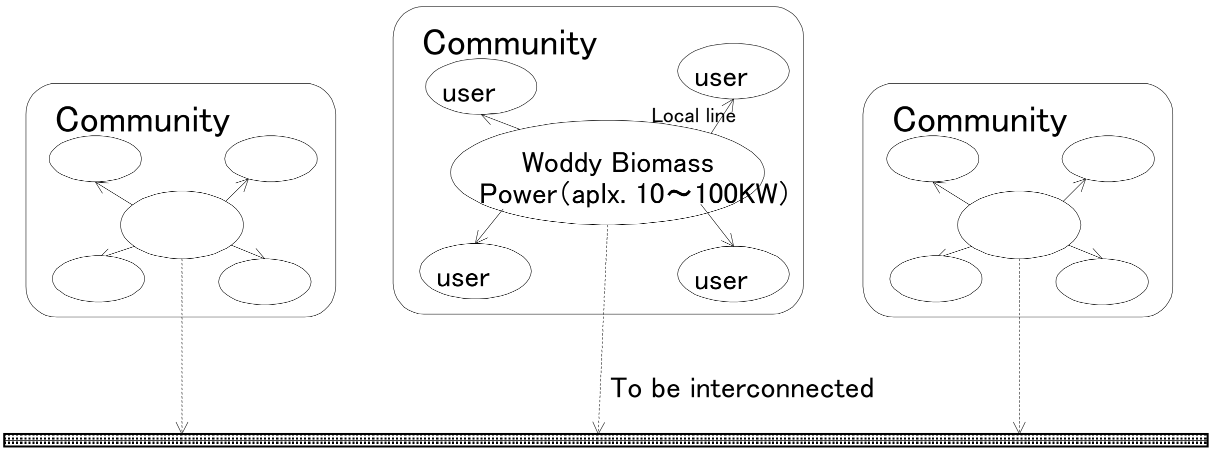
Woody biomass gasification generation involves gasification furnace, gas treating, and power generation (gas engine) technologies. Improvement of gas treating technology is being studied in experimental plants as an extension of existing technology and the improved technology is expected to be available soon.

To maintain the installed plant, it will be necessary to change the engine oil, clean the sawdust filters and change the paper filters. Such maintenance can be managed by the locals adequately. Xang Village, where the plant will be installed, is currently using diesel powered electricity and the operation of a woody biomass fuelled power plant will not cause any negative effects.



Block diagram of woody biomass power generator

This project aims for sustainable development of the unelectrificated areas where there is no access to the national power system. The project entity will provide them with a woody biomass power plant that will supply more constant power throughout the year than will solar or wind power generation. It will be designed to construct a small network within the village by cabling from the plant to each utility user so that the network can be used when it connects to the national power system in the future. Below is a diagram of the woody biomass power plant project development.



National Electric Line (90% of Laos to be electrified by 2020)

A.4.1. Location of the small-scale project activity:

>>

A.4.1.1. Host Party(ies):

>>

Lao People's Democratic Republic

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

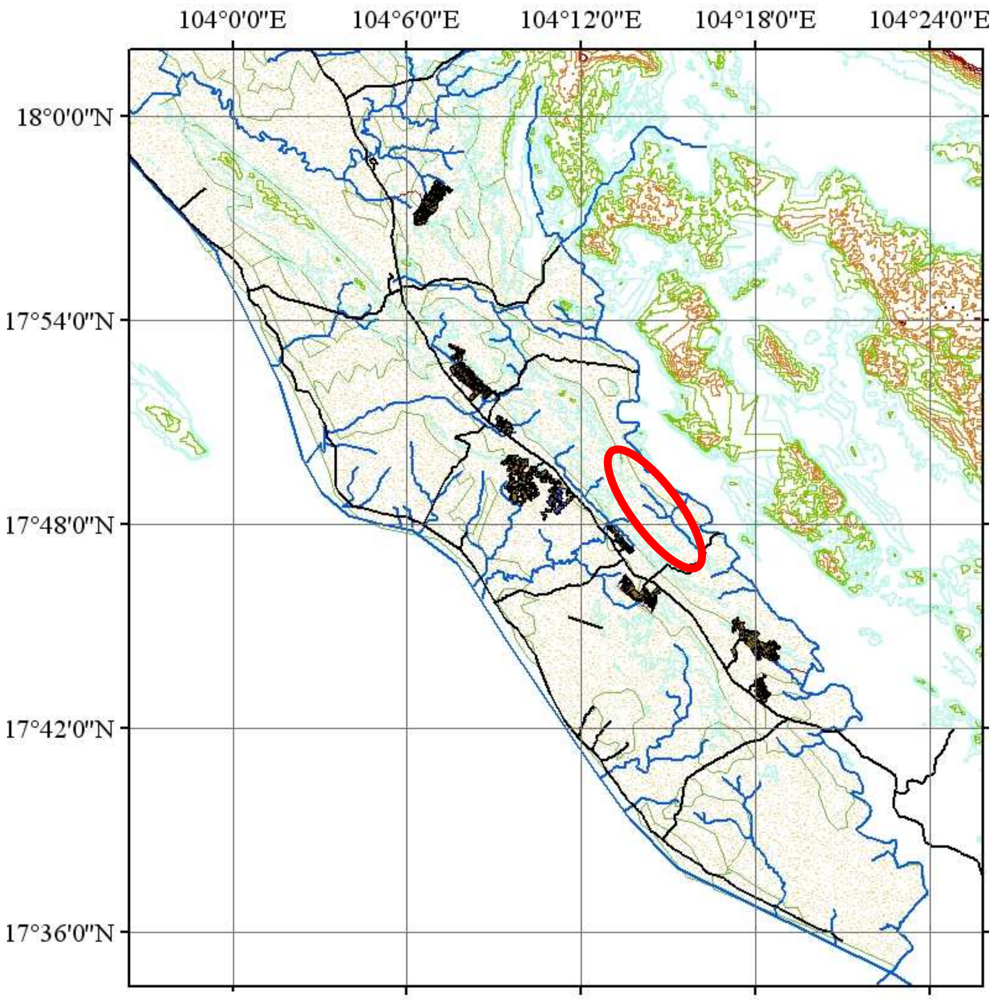
>>
Khammouane Province

A.4.1.3. City/Town/Community etc:

>>
Hinboune District , Xang Village

A.4.1.4. Detail of physical location, including information allowing the unique identification of this small-scale project activity(ies):

>>



A.4.2. Type and category(ies) and technology of the small-scale project activity:

>>

Type Ⅰ.A. (Electricity generation by the user: Renewable energy project)

A.4.3. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed small-scale project activity, including why the emission reductions would not occur in the absence of the proposed small-scale project activity, taking into account national and/or sectoral policies and circumstances:

>>

There is no plan for Xang Village to access the national power system at present and thus this project will install a woody biomass power generator system as an independent power source. The system will be operated days and nights from 10:00 to 22:00 to supply power to houses, medical clinics, schools, and lights in open areas, as well as to pumps for wells and irrigation. Therefore, this project corresponds to Type Ⅰ.A. of CDM Small-scale project activity: Renewable Energy Project (the user/domestic level)

Xang Village uses diesel-powered electricity for some households today. The PV system became popular recently, but it cannot be used during rainy seasons. In the future, more electricity will be required for economic development and the PV system will be replaced by the alternative stable supply systems. Currently, there is no plan to connect Xang Village to the national power system. Financially and traditionally, the village will have to depend on the diesel-powered electricity, if this project does not proceed.

A.4.3.1 Estimated amount of emission reductions over the chosen crediting period:

>>

The crediting period is considered to be 14 years (2x7 years) based upon two main reasons. First, it is expected that the subject area will not have access to the national power system within fourteen years because there is currently no plan for electricity along the tributary areas of the Mekong River. Another reason is that a longer period is more economical in terms of depreciation of machinery. In the fifteenth year or later, it will be decided whether to continue the project or not as a normal power plant business, according to how durable the facility will be and profitability.

The annual CO2 credits which can be obtained from the project will be 54tCO2, and 756tCO2 during a total of 14 years.

A.4.4. Public funding of the small-scale project activity:

>>

No public funds are expected.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a larger project activity:

>>

This project applies to a particular village, Xang Village, but can be extended to other unelectrificated villages such as Vangmone Village, Songkhom Villge, and Parkveng Village if this project succeeds. The total power generation will be approximately 150kW, which is within the small-scale CDM project.

SECTION B. Application of a baseline methodology:

B.1. Title and reference of the approved baseline methodology applied to the small-scale project activity:

>>

Electricity generation by the user (AMS-I.A.)

B.2 Project category applicable to the small-scale project activity:

>>

Category I.A. (Renewable energy project by the user)

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

>>

Xang Village uses diesel-powered electricity for some households today. The PV system became popular recently, but it cannot be used during rainy seasons. In the future, more electricity will be required for economic development and the PV system will be replaced by the stable supply systems. Currently, there is no plan to connect Xang Village to the national power system. Financially and traditionally, the village will have to depend on the diesel-powered electricity, if this project does not proceed.

To calculate the emissions of GHG, 50% of the load factor of diesel power generation will be taken as the emission factor, since the project activity will provide electricity only in the limited time zone, from 10:00 and 20:00.

Diesel power system's emission factors by three types of load factors

(kgCO2equiv./kWh)

Case	Mini-grid in 24 hours operation	i)Mini-grid in limited time (4-6 hours) ii) Productive application iii) Water pump	Mini-grid condenser
Load factor (%)	25%	50%	100%
3-12kW	2.4	1.4	1.2
15-30kW	1.9	1.3	1.1
35-100kW	1.3	1.0	1.0
135-200kW	0.9	0.8	0.8
>200kW	0.8	0.8	0.8

Source) UNFCC/CCNUCC Version07: 28 November 2005

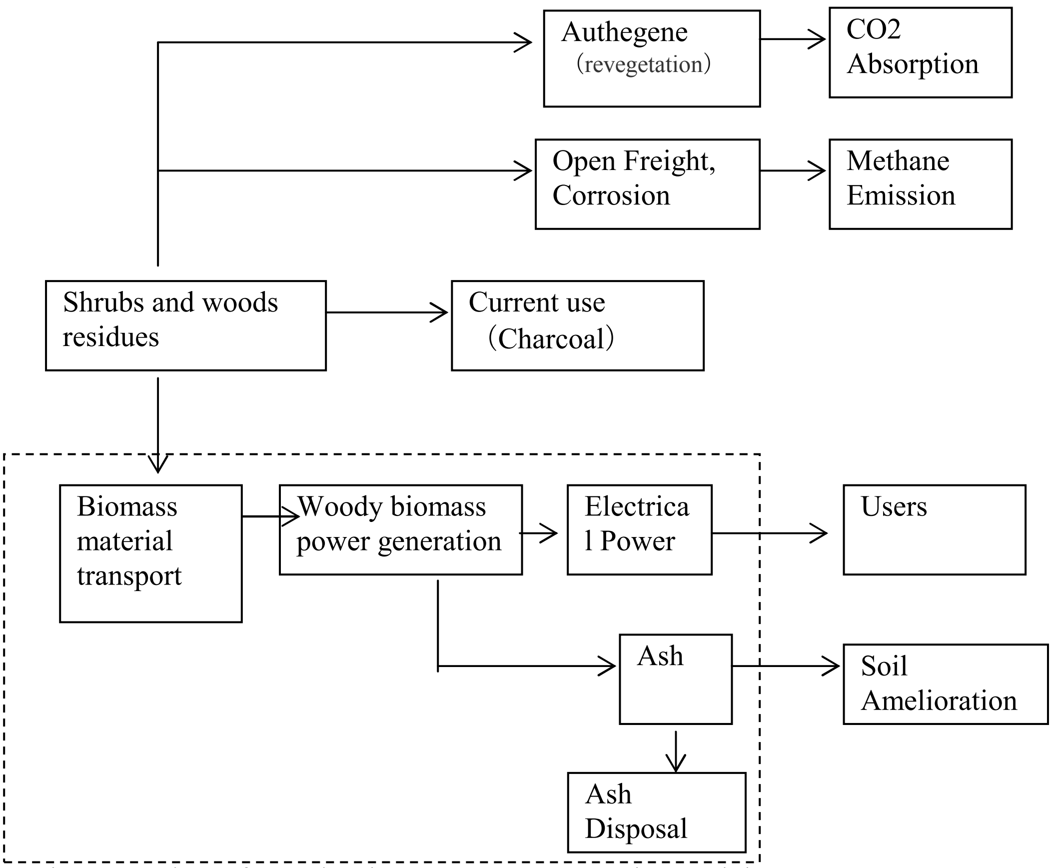
B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the small-scale project activity:

>>

The project boundary of this activity (woody biomass power generation) is described below:

To specify leakage issues of the biomass power generation, it is necessary to consider whether the biomass was used only for transport of the biomass and chip mill machinery.

Direct emission within the boundary	No emission from biomass energy
Direct emission outside of the boundary	Emission for transport to the boundary
Indirect emission within the boundary	N/A
Indirect emission outside of the boundary	Leakage issues (to be described later)



Project Boundary of Woody Biomass Power Generation Activity

B.5. Details of the baseline and its development:

>>

Electric power consumption can be derived as follows by applying Option 1 which is described in Category I.A for a small-scale CDM project activity.

Option 1:

$$\mathbf{E_B = \Sigma_i(N_i{*}C_i)/(1-L)}$$

Where

E_B = annual energy baseline in kWh per year

Σ_i = the sum of the group of "i" renewable energy technologies (e.g., residential, rural health center, rural school, mills, water pump for irrigation, etc.) implemented as part of the project.

N_i = number of consumers supplied by installations of the renewable energy technology belonging to the group of "i" renewable energy technologies during the year.

C_i = estimate of the average annual individual consumption (in kWh per year) observed in the closest grid of electricity systems among rural grid-connected-consumers belonging to the same group of "i" renewable energy technologies. If energy consumption is metered, C_i is the average energy consumed by consumers belonging to the group of "i" renewable energy technologies.

L = the average technical distribution losses that would have been observed in diesel powered mini-grids installed by public programmes or distribution companies in isolated areas, expressed as a fraction.

The electricity required by the subject facilities, both indoor and outdoor, of this project is calculated as below. The calculation includes a medical clinic that is not in the village today and an unattended clinic that will be built along with this project.

Electric Quantity and Using Time of Indoor facilities to be electrified

Facilities	Quantity	Wattage per building	Total wattage	Time
Medical clinic	1	10W×5	0.1kW	17:00～22:00
		40L(30W)×1	0.06kW	24h
School	1	20W×10	0.4kW	10:00～20:00
		45W×5	0.45kW	11:00～16:00
House	46	10W×2	0.92kW	17:00～22:00
		60W×1	2.76kW	17:00～22:00
Light	1	20W×10	0.2kW	17:00～22:00

Electric Quantity and Using Time of Outdoor facilities to be electrified

Facilities	Quantity	Wattage per facility	Total wattage	Time
Well pump	1	750W×1	0.75kW	③ 10:00～14:00
	1	750W×1	0.75kW	④ 14:00～18:00
Irrigation pump	2	6kW×1	12.0kW	③ 10:00～16:00
	2	6kW×1	12.0kW	④ 12:00～18:00

The total wattages per day for the subject facilities to be electrified are 178kWh; the annual total comes to 41,294kWh.

Power consumption in Xang Village

Facilities	Wattage	Quantity	kWh/day	In-use-Days/year	kWh/year
Clinic	0.970	1	0.970	365	354
School	3.125	1	3.125	365	1,141
House	0.400	46	18.400	365	6,716
Light	1.000	1	1.000	365	365
Well pump	3.000	2	6.000	365	2,190
Irrigation pump	36.000	4	144.000	212	30,528
Total			173.495		41,294

Note: Irrigation pumps are used during dry seasons (November to February) and in summer (March to May)

SECTION C. Duration of the project activity / Crediting period:

C.1. Duration of the small-scale project activity:

>>

14 years

C.1.1. Starting date of the small-scale project activity:

>>

1st of January, 2007

C.1.2. Expected operational lifetime of the small-scale project activity:

>>

14 years

C.2. Choice of crediting period and related information:

>>

Renewable credit

C.2.1. Renewable crediting period:

>>

21 years (7 x 3 years): The power plant durability is 20 years. Whether or not the project is to be continued will be according to the then condition after 14 years of the project.

C.2.1.1. Starting date of the first crediting period:

>>

1st of January, 2007

C.2.1.2. Length of the first crediting period:

>>

7 years

C.2.2. Fixed crediting period:

>>

N/A

C.2.2.1. Starting date:

>>

N/A

C.2.2.2. Length:

>>

N/A

SECTION D. Application of a monitoring methodology and plan:

>>

D.1. Name and reference of approved monitoring methodology applied to the small-scale project activity:

>>

The total wattage produced by the whole system and samples should be monitored as this small-scaled CDM project mainly aims to generate electric power.

D.2. Justification of the choice of the methodology and why it is applicable to the small-scale project activity:

>>

The sole product of this project is electric power and the baseline will be justified by measuring the electric power consumed.

D.3 Data to be monitored:

>>

ID	Data type	Data unit	Value type (measured, , calculated or estimated	Frequency of measurement	Data storage type	Remarks
1	Generated power	kWh	Measured	Daily	Electronically	
2	Transmitted power	kWh	Measured	Daily	Electronically	
3	Power consumption by users	kWh	Measured	Monthly	Electronically	
4	Invoice	kip	Calculated	Monthly	Electronically/hardcopy	
5	Receipt	kip	Calculated	Monthly	Electronically/hardcopy	

D.4. Qualitative explanation of how quality control (QC) and quality assurance (QA) procedures are undertaken:

>>

Although this project involves highly public aspects to support electrification in rural areas, it will be built upon its profitability. In order to maintain the project, power generated and power sold shall be recorded precisely, as well as power consumed in order to collect revenue for electricity consumed by users.

D.5. Please describe briefly the operational and management structure that the project participant(s) will implement in order to monitor emission reductions and any leakage effects generated by the project activity:

>>

An organization commissioned by LPFL in the village will be formed to operate and manage the power plant. The organization will record the power generated and power transmitted, as well as read the meters and collect the payments of the bills.

D.6. Name of person/entity determining the monitoring methodology:

>>

LPFL

SECTION E.: Estimation of GHG emissions by sources:

E.1. Formulae used:

>>

E.1.1 Selected formulae as provided in appendix B:

>>

To calculate the emissions of GHG, 50% of the load factor of diesel power generation (i.e., 1.3kgCO2/kWh) will be taken as the emission factor since the project activity will provide electricity only during the limited period of 10:00 to 20:00.

E.1.2 Description of formulae when not provided in appendix B:

>>

E.1.2.1 Describe the formulae used to estimate anthropogenic emissions by sources of GHGs due to the project activity within the project boundary:

>>

E.1.2.2 Describe the formulae used to estimate leakage due to the project activity, where required, for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities

>>

E.1.2.3 The sum of E.1.2.1 and E.1.2.2 represents the small-scale project activity emissions:

>>

E.1.2.4 Describe the formulae used to estimate the anthropogenic emissions by sources of GHGs in the baseline using the baseline methodology for the applicable project category in appendix B of the simplified modalities and procedures for small-scale CDM project activities:

>>

E.1.2.5 Difference between E.1.2.4 and E.1.2.3 represents the emission reductions due to the project activity during a given period:

>>

E.2 Table providing values obtained when applying formulae above:

>>

Unit: tCO2

Year	Total emission by the baseline	Total emission by this project	Emission cut by this project
Year 1	54	0	54
Year 2	54	0	54
Year 3	54	0	54
Year 4	54	0	54
Year 5	54	0	54
Year 6	54	0	54
Year 7	54	0	54
Year 8	54	0	54
Year 9	54	0	54
Year 10	54	0	54
Year 11	54	0	54
Year 12	54	0	54
Year13	54	0	54
Year 14	54	0	54
合計			756

SECTION F.: Environmental impacts:

F.1. If required by the host party, documentation on the analysis of the environmental impacts of the project activity:

>>

There has been no request for documentation by the host country. It is assumed to be unnecessary for precise environmental impact analysis as this is a small-scale project.

SECTION G. Stakeholders' comments:

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

>>

Interviews of local residents in two villages, including Xang, were conducted to determine their electrical requirements.

G.2. Summary of the comments received:

>>

There is high demand for electricity. 10 households out of 44 are using diesel-powered electricity in Xang: 15 households have television sets. The diesel power is operated from 18:30 to 21:00. 15 households out of 31 rent PV systems and 9 households have television sets. The rental cost of a 20W PV system is 30,000 kips/month, while a 40W system costs 60,000 kips/month. PV systems are not usable during the rainy seasons.

Car batteries are being used in many villages in Laos where there is no access to the national electricity system. Those batteries are brought to the villages, having been electrified with the national system, and must be charged from time to time. . Battery charging is not expensive because 96% of electricity in Laos is generated by large or medium hydro-powered systems and the system does not charge as much as 113 to 765 kips/kWh (1.3-8.6JPY/kWh). Therefore, in comparison to other developing countries/areas where diesel-powered generation is mainly used, electricity is inexpensive in Laos.

However, as there is no way to gain access to the subject area of this project, except by a small boat, batteries can hardly be carried frequently. There is a high, constant demand for electricity from an an independent source in dry and rainy seasons in unelectrificated villagers.

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

>>

During the interviews of the villagers, we mentioned the following comment:

This project matches the national promotion "Renewable-Energy-Based Rural Electrification" in Laos and it will contribute to the sustainable development of the village. However, the operation of the power plant may financially threaten the villagers and its profitability must be planned well in advancet.

Annex 1

CONTACT INFORMATION FOR PARTICIPANTS IN THE PROJECT ACTIVITY

Host : Lao People's Democratic Republic

Project entity : Oji Lao Plantation Forest Co., Ltd.
Oji Lao Vientiane Office
Ban Mixay, Nokeokhoummane Street, P.O. Box 8832, Vientiane Lao PDR
Tel.: 856-21-218301, Fax.: 856-21-219422

Oji Lao Project Office
Soughong Khammouance Province
Tel.: 856-51-620077, Fax.: 856-51-214342

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no plan to use any public funds.

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