Summary

for

Rubber Tree Afforestation in Mondul Kiri Province, Cambodia

March 2004

Marubeni Corporation

Chapter 1 Purpose of Study, Schedule of Work, and Outline of Project

1.1 Purpose, Region and Group of Study, and Schedule of Work

1) Purpose of Study

We shall implement a rubber tree plantation project in order to change a steppe that has repeatedly been pastured and burnt for years to a magnificent carbon sink. To sustainablely manage forest by a private entity, we shall aim to make this project a CDM project to profit from carbon credits and by-products (rubber resin [tap] and lignocellulosic biomass) sales.

2) Country/Region of Study: Cambodia/MondulKiri Province

3) Group of Study

- Domestic Working Group: Marubeni Corporation, Kansai Environmental Engineering Center Co., LTD. (KANSO), Taisei Corporation, Oji paper Co., Ltd.
- Overseas Counterpart: the Cambodian government/ Ministry of Agriculture, Forestry, and Fishing, Ministry of Environment, Development Committee etc.

4) Progress of Study and Work Schedule

- July 2003: Prior consultation with local counterparts
- July to December 2003: Feasibility study on plantation
- September 2003: First local investigation
- November 2003: Second local investigation
- December 2003: Presentation of mid-term report
- September 2003 to February 2004: Implementation of feasibility study on CDM

5) Items of Study

a. Natural/socioeconomic environment of project site and its surroundings
b. Technology and costs of rubber tree plantation
c. Effects and evaluation of CDM project

1.2 Outline of Project

1) Outline of Project

In order to change a steppe that has repeatedly been pastured and burnt for years to a magnificent carbon sink, we shall implement a rubber tree plantation project around Saen Monourom in MondulKiri province. To sustainablely manage forest by a private entity, we shall aim to make this project a CDM project to profit from carbon credits and by-products (rubber resin [tap] and lignocellulosic biomass) sales.

2) Guidelines of Project

At first, the target area of the plantation had been 10,000ha. As a result of the analysis of the candidate site provided from the local counterpart, however, the possible plantation area

was found to be 7,600ha. Hence, 7,600had shall be applied in this feasibility study. The plantation schedule is as follows: 100ha in the first year; 500ha in the second; and 1,000ha from third to ninth years. The area spreads from the first to third years, and the total area is 7,600ha. Seven years after the plantation of rubber trees, the collection of rubber resin as by-product will resume and continue up to the 35th year when the rubber resin is to reduce. We shall cut down the 35-year-old rubber trees, and transplant/incubate new ones to sustainably run the rubber tree plantation. The woods generated at the time of felling shall be carbonized or reused as the furniture etc to promote a variety of local industries.

As to the rubber tree plantation technology, we shall introduce the most state-of-the-art technology for highlands (seedling growing, land readjustment, plantation, manure, harmful insects management, weeding, resin collection, deforestation) to contribute to the development of rubber tree plantation project in the host country. As the area is underdeveloped, and the infrastructure is not fully improved, this project also contributes to its construction as well as educational infrastructure. Further, since forests spread in the lower part of the highlands as well as there are a wildlife protection zone and natural sightseeing resources, the development shall be environmentally friendly in harmony with them.

3) Location of Project Candidate Site

The most part of 7,600ha is located in the area of Ou Reang, and the rest in Saen Monourom.

4) Advantages of Project

- Advantages for Cambodia
  - Tax revenue, Employment opportunity in the local community, Development of local industry
  - Continuous development, Technology transfer, Efficient land use, Soil protection
- Advantages for Japan
  - Profits from project, Carbon credit, Regional development activity

5) Project Boundary

The Project Boundary is equal to the plantation concession site.

The plantation concession area is supposed to be approximately 11,231ha; in this area, however, riverside forests, villages, and secondary forests used by villagers are included; thus, the plantation area will be 7,600ha taking the above into consideration. In other words, the Project Boundary encompasses seedling fields, natural forests and villages as well as the actual plantation. The operation boundary covers rubber tree plantation project, collection of rubber tree resin, and sales of the resin. Any project to process rubber tree resin is not to be taken in this project.

Chapter 2 Outline of Natural and Socio-economic Environments around the Project Site

2.1 Natural Environment around Project Site

MondolKiri province is the hills, which lies northeast 390 km far from Phnom Penh, the capital of Cambodia, at 600-800m above sea level with the area of 1,468,200 ha. The climate is tropical monsoon that rainy season is June to October and dry season is November to May. Annual rainfall is 2,268mm, and annual mean temperature is 23.7 degree C. Although the annual rainfall is enough for plant growth, the drought of 7 months shall be a certain severe condition for some plant species. Strong wind is the big issue in the province, particularly the northeasterly stronger wind during the dry season.

There is neither large lake nor large river running across the province. Residents generally establish settlements near streams or irrigation channels, and the residents in a remote highland use small ponds or traditional well. The dominant vegetation in the province is forests with the total area of 1,122,200ha, or 76.4% from the total province land. Tropical deciduous-monsoon forest distributes over a large area, and tropical semi-evergreen forest that sheds leaves in a short period during the dry season is scattered. Tropical evergreen forest is concentrated in the southern hills along the boundary of Vietnam, however the forest has been drastically deforested due to the civil wars and insufficient management. Seven areas are designated as forest conservation zone or wildlife sanctuary.

Soils in the province are classified into 4 kinds of tropical laterite that commonly distribute in Southeast Asian countries. Those soils are physically inferior and clayey, soil fertility is somewhat low, and pH is low at around 3.9, but the land is arable keeping the holding capacity of nutrients.

2.2 Socioeconomic Situation around Project Site

Administrative district consists of 5 districts that cover 21 communes and 90 villages. The provincial governor and every supervisor in the district are appointed by Ministry of Home Affairs under the approval of the federal government. The district committee has authority to make the plan of development and implement.

Population of MondolKiri province is the least in Cambodia with totally 36,300 people in the Year 1999 and 2.5 persons/km^2 of population density. The total population rose at 12% as much as the previous year, which exceeded the national average rate of 2.4%. It was caused by the increase of immigrant. There are 11 ethnic groups in the province, of which Phnong people is the largest one with 62.6% from the total followed by Khmer people with 26.5%. The total of both groups account for nearly 90%. Official language is Khmer, but every ethnic group has own language. Improvement in the education in MondolKiri province is an urgent

issue because its level is under the national average number of schools and pupils.

There is no big industry such as factory, handicraft manufacturing, power generation, etc. Three oversea companies had made plans to invest to some projects, however no project succeeded. In forestry sector, the logging concessions had been authorized to some companies, but the federal government prohibited the tree harvest and canceled the concessions with stressing environmental conservation and sustainable development. There are only a few of plantation forests.

Paddy fields distribute over only the northern region, but scatter in the districts of Ou Reang and Sean Monourom in the southern region. Conversely, grasslands distribute widely over the latter districts where our plantation project is recommended to establish. Many of local people are peasants with the small agricultural land of 1-2ha. Rubber plantation had been performed, but only a few projects were continued. Fruit orchards involving various species with a few trees were recently commenced by some immigrants. Vegetables and seasonal crops are usually produced for home consumption, and their markets depend on the import from Vietnam. All lands fundamentally belong to the federal government, however, the ownership and possession right of land are rather complicated by the traditional rights of the minorities.

In tourism sector, the tourists who are attracted in nature and local people's tradition gradually increase in the number. In transportation network, the national road extends from Phnom Penh to MondolKiri, but there is no asphalt road in the province. This poor access of road network is one of the reasons for the difficulty in market development.

2.3 Government Policies and Measures against Global Warming

Cambodian government ratified the United Nations Framework Convention on Climate Change in December 1995. Subsequently, the government started implementation of the UNDP/GEF-sponsored Climate Change Enabling Activity Project in 1999, and ratified the Kyoto Protocol in August 2002. Ministry of Environment (MoE) officially established a Climate Change Office followed by the interim Designated National Authority (DNA) in 2003. Cambodia has been focusing on the economical development involving environmental conservation and poverty reduction, and has an attitude to positively accept CDM. However, the legal systems are not yet completed and still under improvement. The government institutions related to global warming are MoE, Ministry of Agriculture, Forestry and Fisheries (MAFF), Ministry of Water Resources and Meteorology and Ministry of Land Use management, and Urban Planning and Construction. The national plans related to sustainable development are The Second Five-year Socioeconomic Plan 2001-2005, Interim Poverty

Reduction Strategy Paper in 2000, and National Environmental Action Plan in 1998-2002.

Chapter 3 Natural and Socio-economic Environments in Project Site

3.1 Natural Environment in Project Site

Regarding soil characteristics, we took samples at 4 points in the project site and its vicinity, and analyzed physically and chemically them. The mother rock is a basalt, and the soil is predicted as Rhodic Ferralsols. The soil is well drained, moderately or severely acid, small in the exchange capacity of cation, and moderately low in fertility. But, the nutrient condition is available to be improved if pH value is raised. The soil has good physical properties, well developed the structure with a good infiltration, and is tolerant against erosion. Water shortage during dry season shall not be serious problem. Those soil characteristics suggested the high possibility of rubber tree growth, and fertilizer shall be effective on the trees in the low fertility. Meanwhile, since the altitude limit of rubber tree growth is mentioned as almost 800m, the growth is probably restricted and not so high.

Although the original vegetation in the site is predicted as tropical evergreen forest or tropical semi-evergreen forest, the present vegetation is identified into 4 types; a) complete grassland, b) open shrub (a few shrub trees on grassland), c) close shrub (more dense shrub trees on grassland), and d) tall-close forest (remained along the streams and near the villages). The satellite image with the false color of Aster image was analyzed for estimating the land area feasible for plantation. The land area feasible for plantation is predicted at 7,616ha, or 66.8% of the total concession area.

3.2 Situation of Local Community in Project Site

The project site covers the major part of Ou Reang District and a part of Sean Monourom District where 6 communes and 21 villages are consisted. The local community consists of the minorities who make their living by the slash-and-burn cultivation and grazing. The minorities are Phnong, Khmer, Tompoun, and Charay, etc. There are around 1,500 families and 10,000 people in two districts. A village consists of 20-80 families, and the people have settled at the same location for several generations.

We had an interview with local people of 5 families in 4 villages. A family consists of 6-10 persons. They usually produce dry-land rice and vegetables for home consumption, but the production is liable to be in short supply. They keep some domestic animals, and feed cattle on grazing by burning grassland for flushing. Since the family usually work in agriculture and seldom gain money by wage labor outside the village, their cash income is very low. They cultivate rice at one place for 1-3 years, then abandon the place, and move to find another

place within a few kilometers apart from the village. Their house fuel is only wood which is collected from the forest near the village. Water for living use comes from rain tank, well and stream. There is no use of electricity. As the isolated forest is commonly left near the village, they utilize some forest products like timber, fuel wood, resin, rattan, wild animals, etc. Their living custom is different from the ethnic groups. The religions are animism in major, and Buddhism, Christianity, and Islam. The elder people have authority to decide some new issues as the need arises.

3.3 Comments of Stakeholders on Plantation Project

We made an interview with local community, local government and federal government.

The local peasants generally did not oppose the project, and showed the expectation of their living rise by getting opportunity to earn cash in the project. But, some of them mentioned the need of land for slush-and-burn cultivation and grazing, so it needs a careful process for establishing the project land. Meanwhile, many of them called also the needs of infrastructure like roads, water and electricity, and education and medical treatment. It needs some concrete measures of coexistence with the local community for aiming at the rise of their income and welfare.

We met with the primary vice governor, director of Department of Agriculture, forestry and fisheries and the other authorities concerned of the province. The officials expressed a high interest in the project with welcoming the new investment. They recognized the high priority to this project as coinciding with the national plan of poverty reduction. They expected the project to contribute to the infrastructure building like roads and electricity, and the rise of human resource, subsequently to encourage the whole development of the province.

MAFF of the federal government mentioned the following 4 advantages of the project for Cambodia; a) tax income of rubber export, b) job opportunity in local region, c) highly development of whole industry through agricultural product industry, and d) conservation of soil erosion in grassland. MoE pointed out some issues on the project as follows; a) the sustainable management of the plantation project, b) the sustainability of balance in local people living, c) the needs of some concrete measures, d) the way of carbon credit share, and e) the consideration of environmental impact assessment (EIA).

We held the CDM seminar for enhancing the understanding of our project scheme and CDM concept for the administrative official at Phnom Penh twice in September and November 2003.

Chapter 4 Consideration to Technology and Costs of Rubber Tree Plantation

4.1 Development of Rubber Plantation

4.1.1 Scion Garden

Scion garden is to be developed with cuttings of superior clone to collect scion for grafting. In order to produce appropriate scion for grafting, an appropriate scion garden shall be developed 1 or 2 years before the actual plantation. 10,000 of cuttings shall be made in 1ha with a plantation space of 1x1m. In 1ha of scion garden, scion for approximately 2ha of seedling field can be collected. In Cambodia, four representative clones, namely GT1, RPIM600, PB260, and IRCA18 are used for scion garden.

4.1.2 Seedling Field

Seedling field is where grafting seedling grafted with scion collected from scion garden is performed. The condition for seedling field is 1) Fertile soil and water detention 2) Being close to a riverhead for the irrigation reason.

4.1.3 Planting

At the time of planting, the site is to be adjusted beforehand: bush and weeding as land preparations, and tilling under some circumstances, are to be performed. These works should be done during the dry season before the rainy season begins when plantation shall commence. Plantation is performed during the rainy season from the middle of May to the end of July. Plantation is performed by seedling with twigs cut off and roots cut in order. Replantation is supposed to take place at least in 2 to 3 weeks after plantation, however, it is desirable that replantation continues for two years after that with the same kind and age of clone seedling still left in seedling field.

4.1.4 Incubation

Immediately after plantation, surface of soil is apt to be impoverished by exposure to the sun, and flow-out of surface soil to take place. At the same time, as weeds sprout and absorb nourishment, weeding shall be paid special attention. Fertilization is as significant as weeding. Proper fertilization to foster the initial growth makes possible resin collection in the early stage, which will lead to improve project profits.

Although it depends on weather and clone, 5 to 6 years is required for the incubation period.

4.1.5 Costs of Plantation and Incubation

The expected unit price of plantation and incubation of rubber trees from 0 to 6 years is US$2,460/ha; therefore, the expected total costs is US$18,696,000 in case of 7,600ha of

plantation.

4.2 Collection of Rubber Resin

4.2.1 Necessary Condition to Grow Rubber Trees in a plantation

As mentioned above, it takes 5 to 6 years until rubber tree are planted and grow up. Although it depends on the nature of clone, the way of incubation, and the conditions of environment (soil and weather) etc., the first time of tapping comes in 4 to 5 years at the earliest and 7 years in usual cases. Usually, one worker can tap 250 to 300 trees. If the landform is not in good condition or the tapping panel is located quite high, however, s/he may do approximately 150 to 180 trees only.

4.2.2 Tapping

The quasi-spiral (1/2S) tap shall continuously be made with a gradient of 30 degrees against the horizon from up left to down right.

4.2.3 Results

Clone is the core factor to determine on productivity. In order to acquire high productivity, clone ought to be determined in consideration of a. High quality of DRC (Dry Rubber Content) to maintain high productivity; b. Resistance against disease/s, wind hazard, harmful insect/s, and leaf disease/s; c. Resistance against dry weather, infertile soil, and highlands.

4.2.4 Frequency of Tapping

The frequency of tapping affects bark damage and span (to generate rubber resin). Today, a variety of frequency of tapping (every day; every two days; once in three days; and once in four days) is adopted.

Recently, the frequency of tapping coupled with uses of stimulant and fertilizer are decreasing so as to avoid damage and dry of tree and to diminish burden of labor. In rubber companies in Cambodia, S/2d/3 (e.g. once two quasi-spiral cuts in three days) is adopted.

4.2.5 Time Frame of Tapping

Given that rubber resin flows out to the maximum early in the morning, the tapping shall be performed under the first sunshine in the morning. The tapping shall be performed only to trees with dry trunks. In this case, wet trees are not appropriate because rubber resin is lost from dropping from the tapping as well as there is a possibility that the disease would spread.

4.2.6 Period to Collect Rubber Resin

Rubber resin stops flowing out three to four hours after the tapping. The moment the tapping stops, we shall collect resin as soon as possible. In the case where the collected rubber resin show a sign of solidification, it is necessary to use coagulant on the spot. To avoid early solidification, rubber resin must be transported to factory after collection in no time. The collected rubber resin is to be put into tank and pulled.

4.2.7 Necessary Infrastructure and Facilities to Develop/Incubate/Run Rubber Plantation

The necessary infrastructure, vehicles, and facilities are as follows:

- Personnel Housing, Well (for living), School, Health Management Center, Power Facilities (for living), Use of Renewable Energy Such as Wind Power, Photovoltaic Power, Biomass etc., Office, Warehouse/Laboratory, Bulldozer, Tractor, Truck, Mini Truck, Pickup Cabin, Excavator, Forklift, Tank etc.

4.3 Sales Profits of Rubber Resin

4.3.1 Outline of Cambodian Rubber Industry

1) CSR (Cambodian Specified Rubber)

1. Composition of Grade

The natural rubber product in Cambodia is called CSR (Cambodian Specified Rubber). Rubber resin solidified with acid is processed into CSR3L, CSRL, or CSR5. CSR10 or CSR20 are used for ordinary products.

2) Marketing with Regard to NR (Natural Rubber) Products

40,000ton of Cambodian rubber block, recently also known as rubber resin crepe rubber, are annually produced, and almost all of them are exported to Malaysia, Singapore, Vietnam, etc. The rubber further is processed specially in those countries, and then exported to Europe and America.

The price of rubber block is lower than the international price by 15-20%. This derives from the fact that CSR has not fully been recognized in the international community, though RRIC (Rubber Research Institute for Cambodia) has joined IRRDB (International Rubber Research and Development Board) since January 2002. Nevertheless, the price of CSR is expected to be the same as the products in other countries in the near future.

Incidentally, the international price in 2003 is US$1,300-1,400/ｔ.

4.3.2 Sales Profits of Rubber Resin

1) Definition of Rubber Resin to Be Sold

Generally in Cambodia, rubber is distributed in the form of rubber block; in this feasibility study, the sales profits are calculated on the assumption that the rubber is sold in the form of rubber resin (collected rubber resin material). The rubber resin is to be delivered at the processing factory next to the collection place.

As rubber resin is dealt 30% lower than rubber block, the expected sale price of the rubber resin in this project is US$728/ｔ (International price: US$1,300 x 80% x 70%).

4.3.3 Settlement of Account in Project

1) Precondition

- Project Period: from 2005 to 2039 (35 years)
- Procurement of Funds: Necessary funds to implement this project shall be supplied by private entities and groups.
- Depreciation: 20 years for rubber trees and infrastructure (facilities); and 7 years for the equipment.
- Personnel Expenses: the ratio of regular wage increase for local staff is 3% while that for Japanese workers none.

2) IRR (Internal Rate of Return)

The Equity IRR and Project IRR based on the above precondition is as follows:

- Equity IRR (Period: 35 years): 5.1% (residual value included: 7.8%)
- Project IRR (Period: 35 years): 5.1% (residual value included: 7.0%)

3) Consideration

The total investment amount in this project is US$36million; the surplus in a single year is to resume from 2019 (15 years after the start of this project); and the accumulated deficit is to resume from 2033 (29 years after the start of this project).

As you are aware, the profits from this project is low while the investment amount is quite high and no returns (profits) is not expected for 15 years after the initial investment. If this project is regarded as usual investment one, it is assumed that this project is not to be materialized independently.

4.4 Estimate of Rubber Tree Growth Rate

4.4.1 Method to Measure Growth Rate

We shall assume that growth rate of rubber tree should be calculated with the volume equation reckoned from the analysis of trunk after diameter at breast height and height of tree of sample plot from each stand are measured in the same way as the growth measurement of general woods for construction and kinds of plantation trees for woods for pulp.

Furthermore, provided that growth is considered CO_2 sink, it is necessary that growth of underground as well as that of branches/leaves should be thought over. If possible, we shall measure/analyze the growth rate of both branches/leaves and underground together with trunk analysis.

4.4.2 Estimate of Growth Rate

At the time of the local investigation on November 2003, we measured the diameter at breast height and the height of 6-, 9-, and 43-year-old rubber tree at a rubber plantation in Snoul on the way to MondolKiri from Phnom Penh. Subsequently, we compare the collected date with the one (weight of root, trunk, branch, and leaf of rubber tree) reported in the study report 1) by Rubber Research Institute of Malaysia for reference.

Since we judged that it is too conservative to use only the volume of trunk as growth above the ground, in this report we shall set the trunk weight ratio to branches and trunks under the ground in each category of age of stand, based on the study report of Rubber Research Institute of Malaysia. Incidentally, we set it conservatively in full consideration of difference of weathers etc. and measurement errors.

Secondly, regarding growth curve, we couldn't find that of rubber tree no matter where we try to. Although we could have assumed a growth curve based on the study data of Rubber Research Institute of Malaysia mentioned above, we presupposed that the data is quite excessive and the conditions such as location etc. are significantly different. Thus, we presumed a growth cure based on the study data in Snoul, which holds only three ages of stand, since Snoul is conditionally close to MondolKiri.

As it is not practical to draw a similar figure from the data of only three years, we presumably filled the times between the three years to make them compose a smooth S-shape curve. In reference with the data filling, we presumed that CAI increases up to 10-year-old tree; it goes even from 11- to 20-year-old ones; and it decreases after 21-year-old ones. Afterwards, we calculated the growth rate including that of branch/leave/root in consideration of the weight ratio of the volume of single isolated tree (trunk) in each year.

The altitude of the project site is more than 600m, and the weather is considered to be around the lower limit of the right temperature for rubber tree. Further, it is presupposed that the growth in the site will decline in comparison with a right area for rubber plantation since the nourishment of the site has been leaching for the reason that it has been grassland in the long term. Consequently, we set the estimated growth in the project site by reducing it by 30% from the value of the estimated growth based on the investigation result in Snoul.

The polynomial expression of the growth curve in this graph is as follows:

One to eleven years old: $y = 0.1457x^3 - 1.1615x^2 + 3.6977x - 2.6483$

After eleven years old1: $y = -0.008(x-9)^3 + 0.0614(x-9)^2 + 20.919(x-9) + 41.184$

*y = Growth (including branches/roots), x = Years after plantation

Chapter 5 Effect and evaluation of CDM project

5.1 Project Period, Credit Acquisition and Additionality

The period of project implementation is 70 years by twice 35-year rotation of planting-cutting-replanting. The period of credit acquisition is 30 years in maximum without renewal. The credit is Temporary CER (t-CER).

In the earning evaluation of the plantation project, IRR without credit income is calculated at only 5.1% in 35 years after the start of project. It shall not satisfy the standard of invest incentive expected at 15%. As this low value of IRR becomes one of the barriers against the invest initiation to the project, the plantation project shall not be realized in business as usual. This low IRR is probably identified as the additionality of CDM project initiative.

5.2 Baseline of Rubber Plantation

Land-use change similar to our project may not happened because there is no similar plan of rubber plantation near the region, and both of the federal and provincial governments have no plantation program of rubber and other species. It is predicted that the current land use of slash-and-burn cultivation and grazing shall be continued in the future as same as before.

We estimated the biomass of grass and shrubs and their growth increment. The biomass of grass was estimated by harvesting method. The shrub biomass was estimated by applying the real diameters at the breast height and heights into the allometric equations led by Ogawa,H. et al. (1965) who had studied the monsoon forest in the northwest of Thailand. The biomass of the open shrub was calculated at 7.46t-dw/ha, and the close shrub was calculated at 13.66t-dw/ha. The grass was considered as zero in the growth increment, and as complete decay due to annual death. The growth increment of shrub was estimated by applying 1.6% of an average annual growth rate to the initial biomass led by Kira,T. et al. (1967) as same study as Ogawa,H. et al. (1965). Consequently, the growth increment was calculated at 0.003t-dw/ha.yr in the open shrub, and 0.0994t-dw/ha.yr in the close shrub.

5.3 Estimation of GHG Gas Balance

We estimated the fossil fuel consumption by vehicles and machines in the project as the CO_2 emission. The annual CO_2 emission was calculated at 0.47t-C/ha applied by the CO_2-equivalent standard of fuel consumption by the heavy machines in civil construction in

Japan.

Although it was difficult to calculate the CO_2 amount in leakage, we predict the happenings of some negative and positive leakage events as follows. The negative event shall be that the local peasants perform the slash-and-burn cultivation and grazing in the outside land due to the decrease of the available lands. But, it shall not happen for them to collect their fuel wood from the outside forest because the forests near the villages are excluded from the plantation sites. The positive event shall be that the peasants reduce the frequency of conventional slash-and-burn performance because of obtaining the job opportunity in the project.

The balance of CO_2 gas was calculated in the way that the biomass and growth of the current vegetation and the fuel consumption of heavy machines were deducted from the growth of rubber trees. The CO_2 balance is 2,903,124t-CO_2 during 30 years of the credit period, 3,509,347t-CO_2 in the 35th year as the peak, and negative in the first commitment period of credit, 2008-2012. We shall be able to acquire the credit every 5 years since the 11th year after the project initiation as follows; 39,377t-CO_2 in 2015, 642,051t-CO_2 in 2020, 1,497,500t-CO_2 in 2025, 2,316,274t-CO_2 in 2030, 2,903,124t-CO_2 in 2034.

5.4 Cost Efficiency

The cost of rubber plantation in 7,600ha was calculated at US$18,696,000. As the CO_2 balance was calculated at 2,903,124t-CO_2 in 30 years, the cost efficiency was US$6.44/ t-$CO_2$ during the 30-year credit period.

5.5 Capacity Building

It is necessary to advance a communication with the minorities in the project site for performing a capacity building with the stakeholders. A council or committee is probably significant for performing consensus between administrative parties, local community and the project. Cambodian government has been developing the capacity building of legal institutions as a host country that MoE established Climate Change Office and DNA working in cooperation with Bureau of Planning and Legal, and MAFF has a positive attitude to respond CO_2 sink project. The organization and legal system are still in the process of developing. As the authorities concerned in the host country have a high attraction in the CDM projects, the project party should enhance information exchange with them on various movements of CDM.

5.6 Direct and Indirect Impacts on Environment

Any industrial projects larger than the criteria of legal regulations are charged to implement the EIA. The legal regulations are Law on Environmental Protection and Natural Resource Management in 1996, and Sub-decree on Environmental Impact Assessment Process in 1999. The laws describe the criteria for forest logging concession and agricultural estate, however, do not mention the forest plantation. As they oblige the project of agricultural estate larger than 10,000ha to carry out the EIA, we are under consulting with MoE about the treatment of the large-scale project of rubber plantation.

5.7 Monitoring Method

There is nothing of the approved monitoring method that is successively employed to the plantation project. We are under consideration to perform them in the CO_2 sink project according to forestry general standards as follows; a) to set the permanent plots for monitoring the growth, b) to do a harvesting study for the biomass, c) to do the aboveground biomass once a year, and the underground biomass every 5 years.

5.8 Sustainability of Project

The project dose not involve the short-rotation harvesting of fast-growing trees but the long-term growth of trees which is favorable to carbon sink, as well, the income is expected in the collection of rubber resin during project period. Furthermore, as rubber timbers after the 35-year rotation is possible to be effectively utilized for the various purposes, the project has a potential to encourage many side business.

5.9 Feasibility of Project and Unsolved Issues

Both of federal and provincial governments expect so much the project establishment with sustainable development as well as socio-economic advantages in MondolKiri Province that they are positively looking forward to the CDM project. Positive circumstances in the host country is favorable to the feasibility of the CDM project. However, we deem that the following issues should be solved so as to identify the feasibility of project from the views of business as usual and CDM; a) more reliable prediction of rubber tree growth, b) more precise identification of present vegetation as the baseline, c) more comprehensive understanding of local community's sense, d) more precise identification of costs of plantation and resin collection, e) relation to the development of other industrial sectors, and f) relation to the infrastructure and energy use.

5.10 Documentation of PDD

The draft of PDD was completed.