FY 2009 CDM/JI Feasibility Study (FS) Programme Report

Executive Summary

Title of the Feasibility Study

Environmentally Friendly Development by Multiple Use of Jatropha curcas in Indonesia

Name of the Company Conducting the Study

Mitsubishi UFJ Securities Co., Ltd.

Study Implementation Framework

Japan Appropriate Technology Institute（JATI）: Conduct a technological survey of the FS Study and provide local study support

Asian People's Exchange（APEX）: Implement project planning as a project proponent and overall management of the Project. Collaborate with JATI to collect required local information and data in the FS Study.

Yayasan Dian Desa（YDD）: Implement the Project as APEX' counterpart in Indonesia. Support local information and data collection for the FS Study.

1. Project Outline

The Project involves multiple uses of Jatropha (*Jatropha curcas*), whose seeds contain fatty oil that can be collected and cultivated, in degraded land in Sikka Regency, Nusa Tenggara Timur Province, Flores, Indonesia. The Project involves the comprehensive implementation of reforestation of unused degraded lands, replacement of diesel oil by production and utilization of renewable energy for electricity generation, gasification of the waste generated in the Jatropha oil production process for electricity generation as well as desalination of seawater using waste heat generated by electricity generation. APEX（Asian People's Exchange）, the project proponent will collaborate with the local Indonesian NGO partner, YDD (Yayasan Dian Desa) to implement the Project with the proactive participation of local residents for the objective of promoting regional development.

In the Project, Jatropha oil will not go through the esterification process after pressing and purification, but will be mixed with diesel oil to be used for electricity generation. 200 ha of land are expected to be planted with Jatropha, producing 400 tons of Jatropha oil after three years of project operation. The Project is expected to reduce Greenhouse gas (GHG) emissions by 1,137tCO_2e annually through replacement of diesel oil by 400 tons of Jatropha oil produced in the Project and through gasification of biomass waste for electricity generation. The multiple use of Jatropha will not only improve the financial feasibility of the

Project but also fertilize the land through the planting of Jatropha, contribute to the sustainable production of biomass and mitigate water shortage. The Project aims to create a model that, while preserving the environment, also increases the income and improves the quality of life of the local population.

Applicable Methodologies

In this study, both revision and application of AMS-I.A., "Electricity generation by the user" are considered and reference is made to AMS-III.T., "Plant oil production and use for transport applications".

2. Study Contents

(1) Study Subjects

1. Technology for Jatropha oil production

In the Project, Jatropha will be cultivated for the objective of reforestation of land degraded by the slash-and-burn farming method and other factors, while electricity will be generated using oil collected from Jatropha seeds and biomass waste generated in the oil production process. Therefore, it is important to ensure proper cultivation of the Jatropha seeds, which is the raw material of the oil, oil pressing and purification in order for continuous implementation of all facets of the Project. In Indonesia, although Jatropha has been attracting much attention as a bio fuel, the success stories are rare. The Study clarifies the following issues and scrutinizes the project plan.

a) Planting of Jatropha

Technical information ranging from breeding to harvesting and issues in project implementation

b) Pressing and purification of Jatropha oil

Pressing and purification technology and issues in project implementation

c) Usage of Jatropha oil

The Jatropha oil produced in the Project will be used as it is without being esterified. The usage of Jatropha oil and its technical information will be studied.

2. Applicability of the methodologies

Methodology applicability is studied for each of the three components of the CDM Project comprising 1) electricity generation using Jatropha oil, 2) Gasified electricity generation using Jatropha shells and 3) Desalination of seawater using waste heat generated from the process of gasified electricity generation.

3. Project boundary

The Project aims to construct a consistent system starting from the reforestation stage all the way to the utilization of Jatropha oil. The project boundary as a CDM project needs to be clarified in accordance with the methodologies.

4. Determination of the baseline scenario

In the absence of the Project, fossil fuel will be used for electricity generation and desalination of seawater. The justification of the baseline scenario is studied through information collection in the project area. The data required for the calculation of baseline emissions are also to be collected.

5. Project emissions

Types of emission sources to be considered for project emissions depend on the project boundary. Project emissions also depend on whether or not to mix with diesel when using the Jatropha oil produced in the Project. The Study analyzes the methodologies and clarifies the emission sources to be considered while collecting the data required for project emission calculation during the field study.

6. Monitoring plan

It is necessary to clarify monitoring items according to the methodologies for each component of the Project including electricity generation using Jatropha oil and biomass waste as well as using waste heat for desalination of seawater. At the same time, monitoring methods and the monitoring operation structure are to be decided through consultation with APEX and YDD.

7. Financial plan and financial feasibility of the Project

The Project has obtained financial assistance from the Japanese Ministry of Foreign Affairs' Grant Assistance for Japanese NGOs that funds up to 80~90% of the initial cost covering construction of Jatropha oil pressing and purification facilities, seedling production and initial operating cost. The remaining costs will be met by APEX and YDD. A financial plan that enables sustainable project operation and financial feasibility of the Project, taking into account the income from CER sales, is to be studied.

(2) Study Contents

In addition to two field studies, the required local information was collected in the Study through collaboration with JATI and APEX for obtaining the current status of the project site and information regarding the applicable technologies. Also, in accordance with the project plan, consideration for methodology applicability, data collection needed for GHG emission reduction calculation as well as collection of other information required for the PDD, such as an environmental impact assessment and stakeholder comments have been carried out to produce a draft PDD. The outcome of the study conducted for topics listed in Section 2 (1) is described in the following paragraphs.

1. Jatropha oil production technology

The technologies related to Jatropha oil production were studied through interviews with local experts on Jatropha projects with regards to technical and policy aspects in addition to literature research and trials implemented by APEX. As a result, it has been made clear that although there are no difficult issues in terms of technical aspects, such as Jatropha cultivation, pressing of oil and its purification, the economic feasibility is not adequate at the current Jatropha harvest target volume, which is 6 tons/ha per year, in

order to implement a commercial project. Other points raised as reasons for difficulty in continuing the Project are the absence in the current business model of training local farmers in maintenance methods, despite attempting to develop the Project by providing farmers with seedlings, fertilizers and other incentives, as well as the lack of land ownership by the farmers.

Moreover, it has been pointed out that on the policy front, the price of Jatropha oil will compete with that of crude oil. Currently, the Indonesian government provides a subsidy for crude oil while also promoting the use of bio fuel, making it impossible for Jatropha oil to compete with crude oil at the subsidized price.

The Project is not a commercial project that pursues maximum economic feasibility. Instead, its objective is for farmers to operate in a small-scale and sustainable manner, therefore the experts commented that the amount of harvest should not be a problem. At the same time, harvested seeds will be purchased at a certain price which is to be agreed with farmers through negotiation prior to the purchase so as to provide an incentive for farmers to continue the operation. In addition, Jatropha oil will be used in a regional power plant as an alternative fuel to diesel oil. As the diesel oil used in the power plant is traded at higher than normal price without subsidy, the diesel subsidy will not compete with the Jatropha sales price. It has been agreed by the regional power plant operators that will use the Jatropha oil produced in the Project that the price of the Jatropha oil shall be established to benefit both parties, based on negotiation.

2. Methodology applicability

For 1) Electricity generation using Jatropha oil and 2) Gasified electricity generation using Jatropha fruit shells, AMS-I.A., Ver.13, "Electricity generation by the user", is considered to be applied with revision. AMS-III.T., Ver.1, "Plant oil production and use for transport applications", is used as a reference in order to demonstrate that the Jatropha oil is renewable biomass energy. For 3) Desalination of seawater using waste heat generated through gasified electricity generation, AMS-III.Q., Ver.3, "Waste Energy Recovery (gas/heat/pressure) Projects", was being considered for application, however, the methodology cannot be applied to green-field facilities when the results of the 22nd Small-Scale CDM Working Group (held September, 2009) is taken into account.

3. Project boundary

The project boundary is determined in accordance with AMS-I.A. and AMS-III.T. The boundary includes the Jatropha plantation, the Jatropha oil production process and the power plants using the Jatropha oil.

4. Identification of the baseline scenario

The baseline scenario of the Project is the continuation of electricity generation using diesel oil at project power plants in the absence of the Project. Baseline emissions are emissions emitted from the combustion of diesel oil that are to be replaced by Jatropha oil in the Project. When diesel oil is replaced by 400 tons of Jatropha oil, baseline emissions are calculated as 1,178.78 tCO_2e.

5. Project emissions

AMS-I.A. does not specify any project emissions, however, AMS-III.T. lists cultivation of seeds and

emissions related to plant oil production as emission sources. The Project does not entail any emissions from cultivation of seeds, however, involves emissions accompanying electricity consumption during the production process of Jatropha oil. Although a part of the electricity required for Jatropha oil production will be supplied by gasified electricity generation using Jatropha shells, it will also be co-fired with diesel which results in project emissions from the combustion of diesel oil. Project emissions are estimated at 41.49 tCO_2e per year for 400 tons of Jatropha oil produced.

6. Monitoring plan

The monitoring plan of the Project has been studied in accordance with AMS-I.A. and AMS-III.T. Based on these methodologies, it is necessary to monitor the amount of electricity generated at power plants using Jatropha oil, the amount of Jatropha oil produced and consumed, the amount of Jatropha seeds harvested as well as the amount of diesel oil consumed at power plants and the Jatropha oil production facility.

7. Financial plan and financial feasibility of the Project

Approximately 90% of the project costs including initial costs required for production facility construction and seedling purchase, as well as a part of the operation cost until 2011, is expected to be provided by the Japanese Ministry of Foreign Affairs' Grant Assistance for Japanese NGOs. Other costs will be met by APEX, JATI and YDD through their own financing. If Jatropha oil and compost produced by the Project make steady sales, the sales will not only cover costs but also make profit. Nevertheless, the financial feasibility of the Project will be greatly influenced by the Jatropha oil sales price. The sales price, in turn, will be affected by fluctuations in the diesel oil price. It is hoped that income from CER sales that can be obtained by implementing the Project as CDM will improve the financial feasibility of the Project as well as mitigate the impact of the fluctuation of the Jatropha oil price on the Project's financial feasibility.

3. Outcome of the Study Aimed towards CDM Project Implementation

(1) Determination of the baseline scenario and project boundary

AMS-I.A., Ver.13, "Electricity generation by the user", is applicable to electricity generation projects below 15MW capacity using renewable energy sources. At the same time, the 21st Small-scale CDM Working Group (held June 2009) has confirmed through response to Clarification SSC_302 regarding the methodology application to projects using plant oil that "Plant oil produced in sustainable plantations that comply with the definition of renewable biomass set forth by the Executive Board may be used in a Type 1 activity". As such, revision and application of AMS-I.A. to the Project is considered.

Also, according to the response by the Small-scale CDM Working Group to Clarification SSC_302, whether the plant oil is indeed of renewable biomass origin is to be demonstrated using the procedures set forth in AMS-III.T., "Plant oil production and use for transport applications". As such, the baseline scenario and project boundary are to be determined in accordance with AMS-I.A and AMS-III.T.

With regards to using Jatropha oil in electricity generation, the project boundary is not clearly defined by AMS-I.A., Ver.13. Nevertheless, AMS-III.T. states: "the area where cultivation of crop, production and processing of plant oil takes place need to be included in the project boundary". For the purpose of the study, cultivation of crops and production and processing of plant oil are included in the project boundary. Using waste heat generated from gasification of Jatropha shells for desalination of seawater is not included in the project boundary as there is no applicable approved methodology for green-field projects. The project boundary of the CDM Project is described in Figure 1.

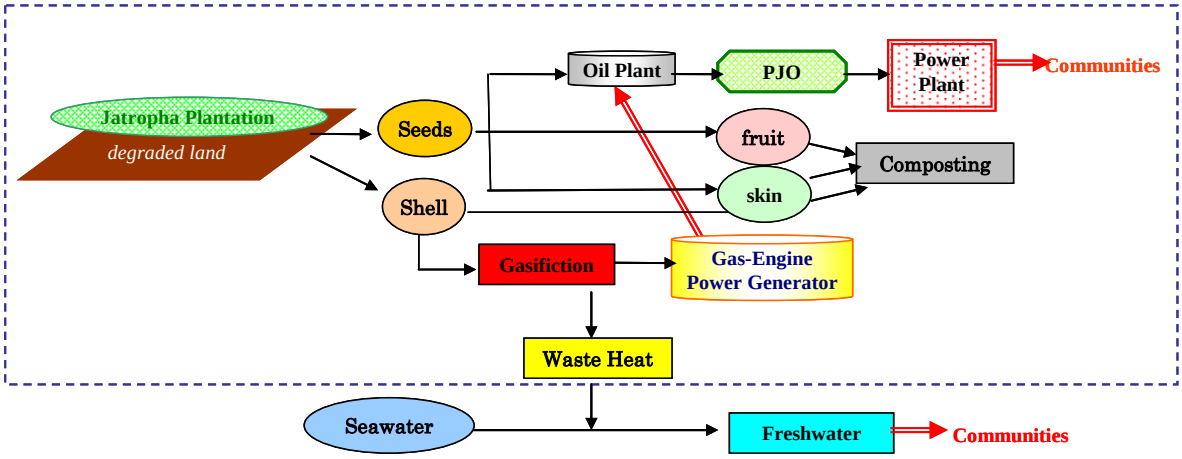

Figure 1. Project Boundary

Baseline emissions are calculated according to AMS-I.A. AMS-I.A. states that the energy baseline is the amount of fuel consumed by the existing technology or technology that would have been used in the absence of the project activity to generate the same amount of energy as the project activity. In the baseline scenario of the Project, diesel oil would be consumed in the absence of the project activity.

The amount of Jatropha oil produced is expected to be 50 tons in first year, 300 tons in second year and 400 tons in third and subsequent years. All Jatropha oil produced is to be consumed in the project power plants and the baseline emissions are deemed to be emissions from the combustion of the same amount of diesel oil as the Jatropha oil produced. Baseline emissions when 400 tons of Jatropha oil replaces diesel oil are calculated according to equation (1).

$$\begin{aligned} BE_y &= \sum FC_{j,y} \times NCV_j \times EF_{CO2,j} \\ &= \sum FC_{k,y} \times NCV_k \times EF_{CO2,j} \\ &= 400 \times 39.77 \times 0.0741 = 1{,}178.78 \end{aligned} \qquad (1)$$

Where:

BE_y	=	Emissions in the baseline (tCO_2e)
$FC_{j,y}$	=	Amount of fuel consumption of fuel type j mass or volume unit in year y (tons)
NCV_j	=	Net calorific value of fuel type j (GJ/ton)

$EF_{CO2,j}$	=	CO_2 emission factor of fuel type j （tCO_2e/GJ）：0.0741（IPCC data）
$FC_{k,y}$	=	Amount of fuel consumption of fuel type k mass or volume unit in year y (tons)
NCV_k	=	Net calorific value of fuel type k （GJ/ton）：39.77
j	=	Existing fuel replaced by the Project (diesel oil)
k	=	Fuel type of the Project (Jatropha oil)

As such, yearly baseline emissions, in accordance with the production volume of Jatropha oil, are demonstrated in Table 1.

Table 1. Baseline emissions

	Amount of Jatropha oil produced （tons）	**Baseline emissions** （tCO_2e）
Year 1	50	147.34
Year 2	300	884.08
Year 3 onwards	400	1,178.78

(2) Project emissions

AMS-I.A. does not specify any project emissions. According to AMS-III.T., project emissions include emissions from seed cultivation and plant oil production. For each project emission source, a) emissions from energy used in the plan oil production process and b) N_2O emissions from fertilizer application and from nitrogen in crop residues are calculated in accordance with "General guidance on leakage in biomass project activities". In the Project, there are no N_2O emissions that correspond with b). Project emissions for a) are calculated by equation 2).

$$PE_{OFP,k,y} = EC_{OFP,k,y} \times EF_{CO2,ELEC} + \sum_i (FC_{OFP,j,k,y} \times NCV_j \times EF_{CO2,j}) \quad (2)$$

Where:

$PE_{OFP,k,y}$	=	Project emissions from energy use for oil-seed processing (e.g. pressing and filtering) of crop "k" in year "y（tCO_2e）
$EC_{OFP,k,y}$	=	Electricity consumption in processing (e.g. pressing and filtering) for crop "k" in year "y"（MWh）
$EF_{CO2,ELEC}$	=	Emissions factor for grid electricity supplied to the project plant (tCO_2e/MWh)
$FC_{OFP,j,k,y}$	=	Consumption of fossil diesel oil for filtering and pressing for crop "k" in year "y" (tons)
NCV_j	=	Net calorific value of diesel oil（GJ/ton）：43.0（IPCC data）
$EF_{CO2,j}$	=	Emission factor of fossil fuel i（tCO_2e/GJ）：0.0741（IPCC data）

In the Project, no electricity will be consumed from the grid in the oil pressing and purification process. All electricity demand is expected to be met by in-house electricity. For production of 400 tons of Jatropha oil, 110,250kWh of electricity is required. The electricity will be supplied by gasified electricity generation using Jatropha shells. The output of the gasified electricity generation through fixed floor-gasification is expected to be 60～140kW. It is estimated to take approximately two hours to reach normal operation from operation start when co-fired with diesel oil. Therefore, electricity will be supplied for 5 out of 7 hours of operation by gasified electricity generation. At the same time, gas and diesel oil will be co-fired at a ratio of 7:3. In other words, 50%（5/7×0.7＝0.5） of the electricity consumption will be replaced by gas. As the amount of diesel oil consumed for the production of 400 tons of Jatropha oil is 13.02 tons, project emissions are calculated in the following manner:

$$PE_{OFP,k,y} = EC_{OFP,k,y} \times EF_{CO2,ELEC} + \sum_i (FC_{OFP,j,k,y} \times NCV_j \times EF_{CO2,j})$$
$$= 0 + (13.02 \times 43.0 \times 0.0741)$$
$$= 41.49$$

Annual CO_2 emissions from energy consumption by Jatropha oil production is described in Table 2.

Table 2. Emissions from energy usage in the plant oil production process

	$PE_{OFP,k,y}$ (tCO_2e)
Year 1	10.38
Year 2	31.12
Year 3~	41.49

AMS-I.A. states that leakage is to be considered when the power plant used in the Project is transferred from another activity or if the existing equipment is transferred to another activity. Since this is not the case in the Project, leakage is zero. Leakage in relation to cultivation of Jatropha is to be considered in accordance with the "General guidance on leakage in biomass project activities". As a result of analysis of leakage based on this Guidance, there is no leakage in this project activity.

(3) Monitoring plan

Monitoring for electricity generation using biomass fuel has been planned in accordance with AMS-I.A. At the same time, although it is not mentioned in AMS-I.A., items that may require monitoring for production and utilization of plant oil has been studied based on AMS-III.T. The resulting items deemed to require monitoring are listed in Table 3.

Table 3. Monitoring items

Monitoring items	**Parameter**	**Unit**
Amount of electricity generated by the Project power	-	kWh/year

plants using Jatropha oil		
Amount of Jatropha oil consumed at the power plants	$FC_{k,y}$	ton/year
Amount of diesel oil consumed at the power plants	-	ton/year
Net calorific value of Jatropha oil	NCV_k	GJ/ton
Jatropha seeds harvested	-	ton/year
Oil content fraction of Jatropha seeds	-	%
Amount of Jatropha oil produced	-	ton/year
Amount of diesel oil consumed at the Jatropha oil production plant	$FC_{OFP,i,k,y}$	ton/year
Area used for Jatropha cultivation	-	ha

In addition to the items listed in Table 3, the following items that the methodologies require will also be monitored and studied:

- *Ex-ante* determination of the specific fuel consumption of diesel and Jatropha oil at the Project power plants;
- Confirmation that there is no external fertilizer input for Jatropha cultivation;
- Confirmation that there is no shift of pre-project activities and competing use of biomass;
- An agreement among APEX, YDD and the power plants that states only APEX and YDD hold rights to the CERs;
- Confirmation that Jatropha oil is not exported.

Monitoring is expected to be conducted based on the structure demonstrated in Figure 2.

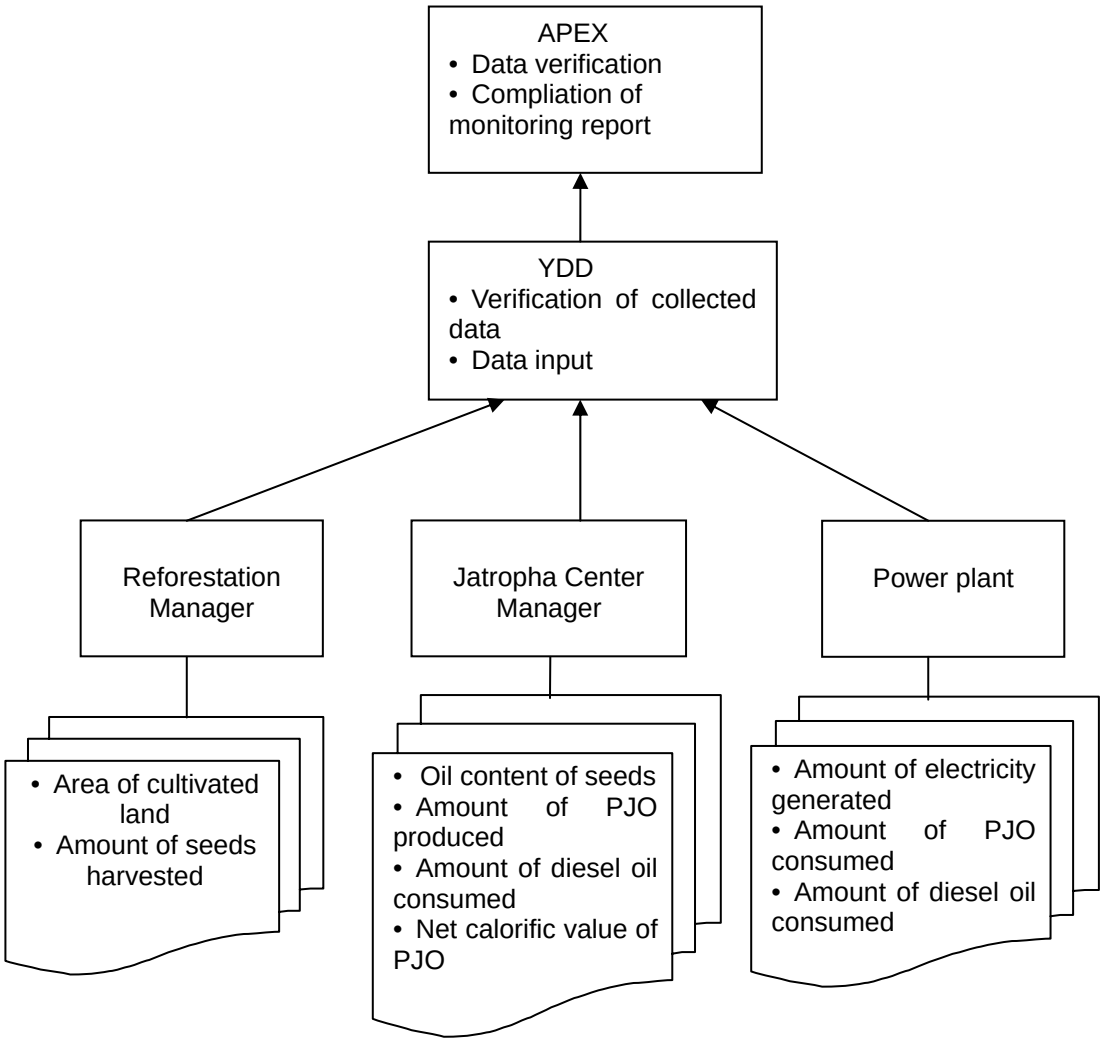

Figure 2. Monitoring structure

(4) Greenhouse gas emissions reduction

The GHG emissions reduction estimated for the Project is demonstrated in Table 4.

Table 4. GHG emissions reduction

Year	**Baseline emissions** BE_y	**Project emissions** PE_y	**Leakage** LE_y	**Emissions reduction** ER_y
2010	147.34	10.38	0	136.96
2011	884.08	31.12	0	852.96
2012	1,178.78	41.49	0	1,137.29
2013	1,178.78	41.49	0	1,137.29
2014	1,178.78	41.49	0	1,137.29
2015	1,178.78	41.49	0	1,137.29

2016	1,178.78	41.49	0	1,137.29
2017	1,178.78	41.49	0	1,137.29
2018	1,178.78	41.49	0	1,137.29
2019	1,178.78	41.49	0	1,137.29
Total	**10,461.66**	**373.42**	**0**	**10,088.24**

(5) Project operation period and crediting period

For the Project, an agreement was signed on 7 October 2009 regarding the construction of the oil pressing and purification plant. As such, this date has been chosen as the project start date. The start date is deemed to have no problem as the CDM feasibility study was implemented before the project start date with CDM as a pre-requisite. The project proponent, APEX has also signed a CDM consulting service agreement with Mitsubishi UFJ Securities Co., Ltd; therefore, again, the project start date is not a problem. In addition, a "Prior Consideration of the CDM Form" has already been submitted to the UNFCCC and Indonesian DNA. The crediting period of the Project is expected to be 10 years from 2010 to 2019.

(6) Environmental impact and other indirect impacts

In Indonesia, the environmental impact assessment system (AMDAL) is prescribed by law. According to the rules of AMDAL, the Project does not need to conduct an AMDAL due to its small size, however, simpler forms of assessment, UKL (Upaya Pengelolaan Lingkungan Hidup: Environmental Management) and UPL (Upaya Pemantauan Lingkungan Hidup: Environmental Monitoring) are required. UKL and UPL will be the basis for the license issuance that enables the Project to start operation. The processes required for UKL and UPL are set forth by Environment Minister's Ordinance Number 86 of 2002. It is required to demonstrate the following items to receive approval:

- Information on the project developer and/or project owner
- Outline of the project plan
- Environmental impacts of the project
- Environmental management and environmental monitoring plans
- Signature and seal

Additionally, environmental standards regarding air quality, water quality and odor as well as exhaust standards in Indonesia are prescribed by either government ordinances or ministerial decree. The environmental impacts of the Project dealt with by each standard are elaborated as follows:

○Air pollution

The Project does not involve any exhaust gas except for the exhaust from the diesel power plant. Therefore, it is deemed there will not be any significant problem with regards to air quality.

○Water pollution

The Project involves the generation of wastewater from the oil pressing and purification plant. Wastewater will be separated into oil and water and biologically treated before infiltration into soil. As the amount of wastewater is small and will be soil infiltrated, it is deemed not to pose any negative environmental impact.

○Noise, vibration, odor

In the Project, there is no noise or vibration issue deemed problematic. However, the odor and impact from the production of compost, from the waste derived from the oil pressing process, needs to be carefully watched.

(7) Stakeholders' comments

Collection of stakeholders' comments was conducted in the Sikka Regency where the Project will take place through meetings with public officials, residents and power companies. All stakeholders expressed support and hope for the Project. Comments and questions raised by the residents and the response by APEX are shown below:

○**Comments and questions raised by the residents and the response by APEX**

(Resident) We want to be paid for labor in the plantation and cutting weeds if there is money involved in the Project.

(APEX) As a principle, we want the residents to engage voluntarily in cultivation, growing and harvesting. APEX ensures that all seeds harvested will be purchased.

(Resident) The Project should not replace crops, such as corn, currently being harvested.

(APEX) The Project will be located in unused degraded land; therefore, will not replace any existing crop.

(Resident) Want the purchasing price for Jatropha seeds to be set high so residents have more motivation and the local economy will improve.

(APEX) Wants to seek a suitable price for both parties as the purchasing price is important. It should be balanced with the price of diesel.

(Resident) We basically support the Project and want to actively participate.

(Resident) A small reservoir should be made to be used for watering during dry seasons to prevent Jatropha from drying excessively.

(APEX) We will consider it if necessary. Labor and water tanks will be required to store water. We will wait for the rainy season before deciding.

(Resident) Security posts should be placed in each plantation so residents in each area can inspect and ensure the proper growth of Jatropha.

(APEX) Inspections are already being carried out.

(Resident) Suggest children be taught about the Project in schools so they understand the meaning and objective of the Project and will not harm the seedlings.

(APEX)Agreed.

Perusahaan Listrik Negara (PLN), the regional power company, also gave supportive comments along with government officials and residents. In response to a question by PLN's technical expert about the need for power plant modification, APEX has explained the lack of such need.

(8) Project implementation framework

The implementation framework of the Project is demonstrated in Figure 3.

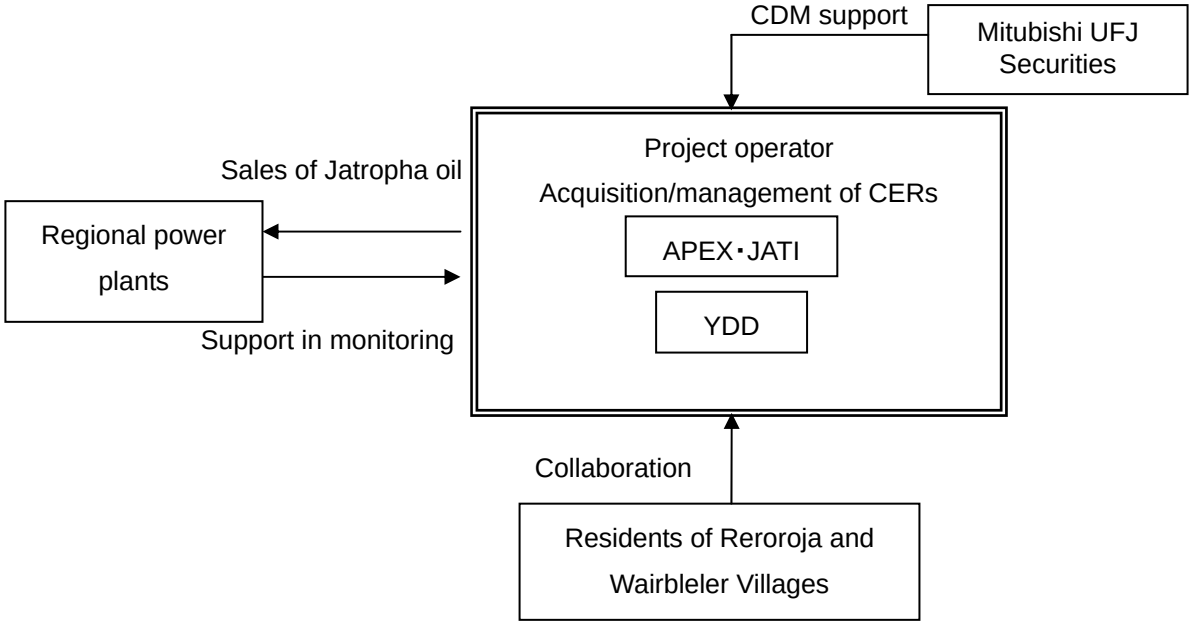

Figure 3. Project implementation structure

(9) Financial plan

The Project requires an initial investment of approximately JPY 53 million for Jatropha seedlings and the oil pressing and purification plant as well as operating costs of approximately JPY 11 million (for 400 tons of Jatropha oil production) for seed purchasing and Jatropha oil production. Of the production plant cost and operating cost up to Year 2011 (excluding the cost for seeds), approximately 90% will be met by the Japanese Ministry of Foreign Affairs' Grants for Japanese NGOs. The remaining 10 % which includes the cost of purchasing seeds from 2010~2011 and APEX, JATI and YDD will disburse their own funding for all operating costs after 2012, The costs to be self-funded by APEX, JATI and YDD will also be met by the revenue from selling purified oil and compost assuming that the sales activity proceeds smoothly.

(10) Financial analysis

The Project does not intend to use CER sales revenue to recover the initial investment cost, but aims to use such revenue for promoting sustainable regional development.

The financial feasibility of the Project is influenced by the sales price of the Jatropha oil produced. In the Project, Jatropha oil will be used to replace diesel oil at power plants in Sikka Regency. Although the

purchasing price of oil by the power plants is yet to be decided, the price will be negotiated taking into account the price of diesel. The price of diesel oil currently used in the power plants is 6,000 Rupiah (approximately JPY 60) per liter. Therefore, it is assumed that the sales price of Jatropha oil will be negotiated in the range of 4,500～5,500 Rupiah (approximately JPY 45～55). In this Report, the financial feasibility of the Project is analyzed with the conservative assumption that the Jatropha oil is purchased at 4,500 Rupiah per liter and 4,000 Rupiah per liter.

Even though the sales revenue of CER is not, in fact, significant, it contributes to improving the financial feasibility of the Project and it is also hoped to mitigate the impact of potential falls in the price of Jatropha oil affected by fluctuations in the price of diesel.

(11) Demonstration of additionality

The additionality of the Project is demonstrated through: 1) investment barriers, 2) technological barriers and 3) barriers due to prevailing practice.

1) Investment barrier

As the Project, like other projects centered on low-income communities, is facing difficulties in obtaining loans, it will utilize grants from the Japanese Ministry of Foreign Affairs to cover part of the initial investment cost. Nevertheless, even if the ODA covers most of the initial investment, there is still need for more financing to purchase seeds and to operate and continue the Project. For the Project to continue, it is also absolutely necessary that local residents earn a steady income. The income of the Project will be influenced by the sales price of Jatropha oil. Its link to the price of crude oil has been raised as one of the reasons for limited success in many Indonesian Jatropha projects. It is deemed that the fall in the price of Jatropha oil in response to the fall in the price of crude oil prevents Jatropha projects from continuing operation. The CER sales revenue of the Project will contribute to securing funding for project continuation and mitigating the impact of any fall in the price of crude oil on the Project income.

In order to implement a CDM project using ODA, it is required that the Annex I country confirm that “the funding does not result in the diversion of official development assistance and is separate from and is not counted towards the financial obligation of the Annex I country”. When implementing the Project as CDM, a letter is issued stating that “there is no diversion of official development assistance in the CDM Project”.

2) Technological barrier

Although Jatropha has recently attracted much attention, there are very few Jatropha success stories in Indonesia. The reasons are related to the fact that forming a consistent system of Jatropha cultivation starting from selection of good quality seedlings and their cultivation to planting, maintenance, harvesting, pressing and purification is not easy and the associated technologies are not fully established. There is also virtually no technical training provided to local residents on a continuous basis. The Project cannot be implemented without the continuous technical support, education and training provided by the project

participants, APEX and YDD.

3) Barrier due to prevailing practice

The slash-and-burn method is the typical attempt at increasing yields in Nusa Tenggara Timur Province which includes Reroroja Village, the project location, as most farmers cannot afford to buy fertilizer to compensate for poor soil and the resulting low yields. Although slash-and-burn is illegal in the project areas, the situation is not expected to change. In the absence of the Project, in which APEX and YDD will provide support for the reforestation of degraded land and multiple use of Jatropha with the incentives provided by CDM, the local residents would undoubtedly continue the slash-and-burn practice.

As stated above, it is recognized that the Project faces technological barriers, investment barriers and barriers due to prevailing practice and, therefore, is additional.

(12) Outlook towards project implementation

To date, trials and studies of the Project have proceeded without any technical problems. According to the hearing conducted by authorities during the site visit for this study, there are no serious concerns expected to arise regarding Jatropha cultivation, oil extraction, purification, and utilization of oil. While it is important to set a stable price of Jatropha oil for the continuous operation of the Project, the project owner will aim to set a price which provides long term benefits for both the seller (the project owner) and consumer (the local power company) of Jatropha oil. In addition, the project owner will decide the price of seeds after discussion with local farmers to provide enough incentive for the farmers to continue cultivation of the Jatropha.

In order to implement this project as CDM, a revision of AMS-I.A to be consistent with AMS-III.T in terms of the production of plant oil is necessary.

4. Outcome of the Study on the Project's Contribution to Sustainable Development

The Project is expected to not only reduce GHG emissions, but also contribute to reforestation of degraded land, fertilization of the land, mitigation of water shortage and an increase in the local residents' income. Each expected outcome above and the relevant evaluation method (for those outcomes capable of being evaluated) are described below:

1) Reforestation of degraded land

Degraded and infertile land caused by slash-and-burn farming and logging is pervasive in Reroroja Village where the reforestation for the Project will take place. Through reforestation of such unused degraded land by the planting of Jatropha, the Project is expected to produce various benefits including a) prevention of soil erosion; b) improvement in the watershed protection ability of the soil; c) reduction of slash-and-burn farming and forest fire incidents; and d) improvement of the regional scenery. With regards to c) and d), it is deemed possible to analyze the changes brought about by the Project by

interviewing local residents.

2) Mitigation of water shortage

The Project area, with its dry climate, suffers from chronic water shortage. However, the Project's plan to supply water by desalinating seawater using the waste heat generated from the Project is expected to improve the everyday-life of local residents. As it is possible to measure the amount of desalinated water supplied, it is also possible to quantify the Project's effectiveness.

3) Increasing local residents' income

APEX and YDD will purchase all Jatropha seeds harvested in the Project. After seed trading begins, it is possible to evaluate the Project's contribution to the improvement of residents' income, based on the price data and the amount of seeds purchased.

As stated above, the Project is deemed to contribute to regional sustainable development through environmental preservation of the Project area and improvement of the quality of life of the residents. It is also hoped that through the Project, a regional development model for the multiple use of Jatropha will be established and the Project will expand not only within Flores Island but also to other areas of Nusa Tenggara Timur Province with similar conditions and contribute to continual improvement in the sustainable development of Indonesia.