Title of the feasibility study:
CDM Feasibility Study for Biodiesel Fuel (BDF) production from organic oils of Jatropha and usage for transportation vehicles in Vietnam

Name of the Company Conducting the Study:
Mitsubishi UFJ Research & Consulting Co., Ltd.

1 Basic information

1.1 Project outline

The proposed project is located in Bac Ai District, Ninh Thuan Province in Vietnam. It intends to reduce GHG emissions by replacing fossil fuel with Biodiesel Fuel (BDF) for a captive fleet of vehicles.

The project owner, RIN Vietnam (RIN) located in Ninh Thuan Province, will developt the project with a technical supprt of Revo International INC (Revo) who has experiences in DBF production in Japan.

The project participants have a plan to cultivate Jatropha in degraded lands in Ninh Thuan Province. Local people will be employed to cultivate and harvest the oilseeds of Jatropha. Pilot plantation of Jatropha has just started in 2010.

The BDF production plant is also planned to locate in Ninh Thuan Province. The production capacity is to be 30,000 ℓ/day. Revo will provide plant technology and engage in plant design. Plant operation technology will be transferred from Revo to RIN trough this project. The local people will engage in the production of BDF.

The estimated CO2 emission reduction is 2,259 tCO2 for the first year and 8,407 tCO2 for the second year or later.

The following co-benefits can be anticipated through this project;

- CO2 emission reduction
- Employment opprtunities to local people
- Mitigation of air pollution

2 Contents of the study

2.1 Study conducting entities

Mitsubishi UFJ Research & Consulting Co., Ltd. has conducted this feasibility study with a support from the following project participants;

① RIN Vietnam (Vietnam)
[Role] Arrangement of studies in Vietnam, Preparation and implementation of the stakeholder consultation, Provision of project related local information
② Revo International INC (Japan)

[Role] Provision of project related information especially in technological issues

2.2 Study tasks

2.2.1 Tasks recognized at the beginning of study

[Tasks in relation to CDM]

a) The reasons why not so many CDM projects in Vietnam are registered at the EB
b) Demonstration of additionality
c) Demonstration of "degrade lands"

[Tasks in relation to the project]

d) Reliable data about yields of Jatropha oilseeds

2.2.2 Tasks recognized after conducting the study

[Tasks in relation to CDM]

e) Quantification PM (Particulate Matter) emissions from BDF consumption

[Tasks in relation to the project]

f) The reasons why the previous Jatropha BDF project has not been succeeded in Vietnam

2.3 Study contents

2.3.1 Approved CDM methodologies

AMS-III.A.K "Biodiesel production and use for transport applications (Version 1)" can be applicable to the project.

2.3.2 Scenario analysis for baseline and additionality

The plausible baseline options as follows; (see section 3.1.2 for more details)

- status quo
- implementation of the project
- production and consumption of biofuel from other plants, fats or waste oils

2.3.3 Host country

- CDM procedures in Vietnam

2.3.4 Site visit and stakeholder consultations

Hearings with the DNA of Vietnam, ministries in relation to the project and local governments have been conducted from 11th October 2010 to 15th October 2010. Stakeholder consultation has also been held in Bac Ai District, Ninh Thuan Province.

2.3.5 Study results on the tasks

a) Emission factor of grid electricity in Vietnam

The emission factor of grid electricity officially published has been obtained from the DNA.

b) Demonstration of "degrade lands"

Certification of specific degraded lands can be published from the local People's Committee of Ninh Thuan Province when the project participants can provide appropriate information.

c) Other specific data

Feasibility study report of the previous Jatropha BDF project promoted by the Ministry of Agriculture and Rural Development has been obtained from the ministry.

d) Detailed cost data in relation to the project

Operational costs have been obtained from the field study.

e) Current status of BDF utilization

Bioethanol is already in Vietnamese market but biodiesel is not at all.

f) Quantification of co-benefits

SOx emission is considered to be zero based on a report published by the Ministry of Agriculture and Rural Development, Vietnam. Since local data of PM emission was not found via internet search, research results in other countries such as in Japan are used for co-benefits quantification.

3 Outcome of the study

3.1 Baseline scenario and the project boundary

3.1.1 Applied methodology

AMS-III.A.K "Biodiesel production and use for transport applications (Version 1)"

3.1.2 Baseline scenario

Identification of the various alternatives available to the project proponent that deliver comparable level of service including the proposed project activity undertaken without being registered as a CDM project activity.

1. Continuation of current practices with no investment in jatropha plantation and biodiesel production capacity
2. The project activity implemented without the CDM
3. Investment in any other alternative oilseed plantation/waste oil recycling and alternative fuel replacing partially or totally the diesel fuel

It has been concluded that the only plausible baseline scenario is 1 Continuation of current practice with barrier analysis.

3.1.3 The project boundary

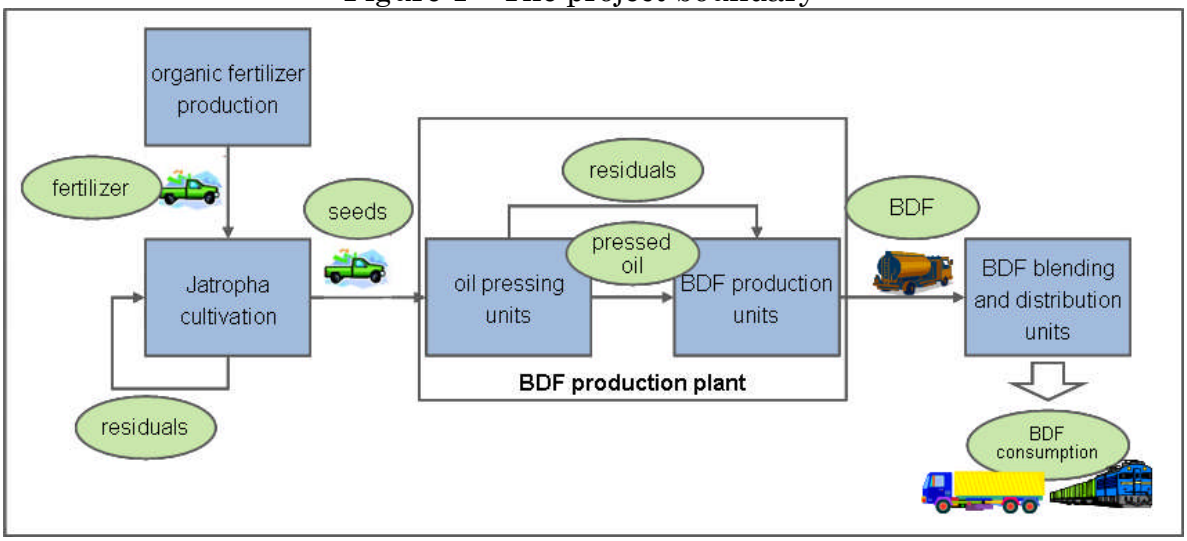
The project boundary encompasses the following areas;

- The plantation lands of Jatropha curcas
- The organic fertilizer production

- The oil pressing units
- The BDF production units
- The BDF blending and distribution units
- Trucks and trains where BDF is consumed
- Transportation of fertilizer, jatropha seeds, residuals, jatropha oil, and BDF

Although the production of methanol used for the trans-esterification process, GHG emissions due to the use of methanol from fossil origin are included in the project boundary.

Figure 1　The project boundary



3.1.4 Baseline emissions

Baseline emissions are calculated with the following equation provided by AMS-III.AK.

$$BE_y = BD_y \times NCV_{BD,y} \times EF_{CO2,PD,y}$$

with

$$BD_y = \min[(P_{BD,y} - P_{BD,on\text{-}site,y} - P_{BD,other,y}), (f_{PJ,y} \times f_{PD,y} \times C_{BBD,y} - P_{BD,other,y})]$$

Where:

$NCV_{BD,y}$	Net calorific value of BDF produced for the year y (GJ/tonne)
$EF_{CO2,PD,y}$	Carbon dioxide emissions factor for petrodiesel (tCO2/GJ)
$P_{BD,y}$	Production of BDF in the project plant in year y (tonnes)
$P_{BD,on\text{-}site,y}$	Quantity of BDF consumed at the project BDF production plant in year y (tonnes)
$P_{BD,other,y}$	Quantity of BDF that is either produced with other alcohols than methanol from fossil origin or that is produced using other oil seeds or waste oil(s)/fat(s) than those eligible under this methodology according to the applicability conditions
$f_{PJ,y}$	Fraction of blending in year y (volume ratio)
$f_{PD,y}$	1.0 if pure petrodiesel is used for blending otherwise use the fraction of petrodiesel in the fuel used for blending (blending

rate shall be established volume by volume)

$C_{BBD,y}$ Consumption of (blended) BDF from the project plant by the captive consumer(s) in year y (tonnes)

BE_y was estimated with an assumption that BDF production volume is equal to BDF consumption volume, since all the DBF produced would be consumed by the transportation companies based on a contract.

Estimated BE_y is 6,685tCO2 for the first year and 24,874tCO2 for the second year or later.

3.2 Project emissions

The following sources of project emissions shall be considered based on the methodology:

(a) Emissions associated with the cultivation of land to produce the oil seeds used for production of biodiesel/plant oil;
(b) Emissions due to transportation of feedstock sources from their originating sites to the biodiesel production facility;
(c) Emissions from energy use for biodiesel production;
(d) Emissions from fossil fuel carbon in the biodiesel due to the use of methanol from fossil origin in the trans-esterification process;
(e) Where applicable CH4 emissions due to stockpiling, land filling of solid waste generated by the project or from the waste water generated in the biodiesel production facility.

3.2.1 Emissions associated with the cultivation of Jatropha

Project participants may choose among two options to calculate this emission source based on the methodology:

· Option A provides a simplified approach, using conservative default values for the emissions associated with the cultivation of lands, taking into account different geographical regions where the crop is grown. This approach can only be used for oil seeds from palm or jatropha;
· Option B calculates the emissions based on actual data from the cultivation process and is more accurate than option A but requires additional data collection efforts.

However option A is planned to use for this project, the project participants will also consider applying option B once the details of project is decided.

[Option A]

Since 4,000ha of plantation is planned, project emissions associated with the cultivation of Jatropha can be estimated with a default value set in the methodology as follows:

$PE_{CC,k,y} = 4,000 \times 1.76 = 7,040$ tCO2e

3.2.2 Emissions due to transportation of feedstock sources

Emissions due to transportation of feedstock sources from from their originating sites to the biodiesel production facility shall be taken into account. Emission due to the following items shall also be considered for estimation.

j=1; organic fertilizers
j=2; Jatropha oilseeds
j=3; residuals of Jatropha
j=4; pressed oil
j=5; BDF

j=1; organic fertilizers

Estimations are 0.9 tCO_2 for year 1 and 3.3 tCO_2 for year2 or later.

j=2; Jatropha oilseeds

Estimations are 13.2 tCO_2 for year 1 and 49.1 tCO_2 for year2 or later.

j=3; residuals of Jatropha

Since transportation of residuals of Jatropha is not planned for this project, GHG emissions will be zero.

j=4; pressed oil

Since pressed oil will be transported manually or produced BDF will be consumed for such transportation, GHG emissions will be zero.

j=5; BDF

Estimations are 1.3 tCO_2 for year 1 and 6.5 tCO_2 for year2 or later.

3.2.3 Emissions from BDF production

3.2.3-1 Emissions from oil pressing

Estimations are 1,634 tCO_2 for year 1 and 6,078 tCO_2 for year2 or later.

3.2.3-2 Emissions from BDF production

Estimations are 404 tCO_2 for year 1 and 1,504 tCO_2 for year2 or later.

3.2.4 Emissions from methanol

Estimations are 428 tCO_2 for year 1 and 1,593 tCO_2 for year2 or later.

3.2.5 Emissions from solid waste and/or waste water

Solid waste such as residuals of Jatropha oil seeds are to be used as fertilizers, which are directly supplied into the cultivation lands, and fuels for boiler at the BDF production plant.

Waste water is to be treated the same manner as in Japan. Impurities contained in waste water are separated with adsorptive filtration and burnt in a boiler as a fuel.

The above treatment will not lead to a consumption of additional fossil fuels or electricity and formation of CH_4. Therefore, emissions from solid waste and waste

water need not to be considered.

3.2.6 Emissions from BDF blending

Estimations are 52 tCO2 for year 1 and 195 tCO2 for year2 or later.

3.2.7 Leakage

No leakage is indicated from the project.

3.3 Monitoring plan

Monitoring will be carried out in accordance with the monitoring plan and parameters stated in the Table III.AK.2 of AMS-III.A.K.

Any difficulty of monitoring is not assumed, however, contract will be made between the project participants and distributors of BDF to make sure monitoring will be carried out properly.

The followings are the main parameters to be monitored:

Quantity of biodiesel produced and consumed, Net calorific value of BDF, Fraction of blending, Total cultivation area of Jatropha, Quantities of transported items, Electricity consumption, Consumption of fossil fuel, Net calorific value of fossil fuel, Emissions factor of fossil fuel, Amount of glycerin associated with BDF production, etc.

3.4 Emission reductions

Emission reductions can be derived with the following equation;

$ER_y = BE_y - PE_y$

Figure 2 Detailed calculation of the Estimation Reductions

parameter	data unit	year1	year2	year3	year4	year5	year6	year7	Total
ER_y	tCO2	2,259	8,407	8,407	8,410	8,410	8,410	8,410	52,714
BE_y	tCO2	6,685	24,874	24,874	24,874	24,874	24,874	24,874	155,926
PE_y	tCO2	4,425	16,467	16,467	16,463	16,463	16,463	16,463	103,212

3.5 Duration of the project activity / crediting period

3.5.1 Duration of the project activity: 25 years (2011-2035)

Duration of the project activity is expected to be 25 years with a start year of 2011 when purchase order will be made to construct the BDF production plant.

3.5.2 Crediting period: 21 years (2011-2031)

Crediting period will be 21 years starting from 2011 with an assumption which the project will be registered before issuance of purchase order of the BDF production plant.

Prior Consideration has already submitted to the UNFCCC secretariat and accepted in August 2010.

3.6 Environmental impacts / other indirect impacts

The environmental impact assessment (EIA) for this project will be conducted for jatropha plantation and construction of BDF production plant.

As the project is at the planning stage, it has not applied for EIA necessary for a project approval from local authority, People's Committee of Ninh Thuận province. Although it has not received formal EIA approval by the local government, the project participant believes that the project would not lead to environmental impacts for the following reasons:

[Jatropha plantations]

For jatropha oilseeds production, dedicated plantations will be established on degrading and degraded lands to minimize the environmental impacts to the site. The lands planned to be used for the project are mostly un-vegetated lands.

[BDF production plant]

The plant is planned to be constructed in an industrial estate of the province which the local government has established. As construction of the plant takes place in the already established industrial estate, environmental impacts to the construction site are expected to be minimal. The details of the impacts will be analyzed in the EIA when applying for project approval of the local government.

3.7 Stakeholders' comments

Stakeholder consultations were organized to during the period of 10th October and 15th October 2010 with Ministries, local governments, and local people. The following comments were collected.

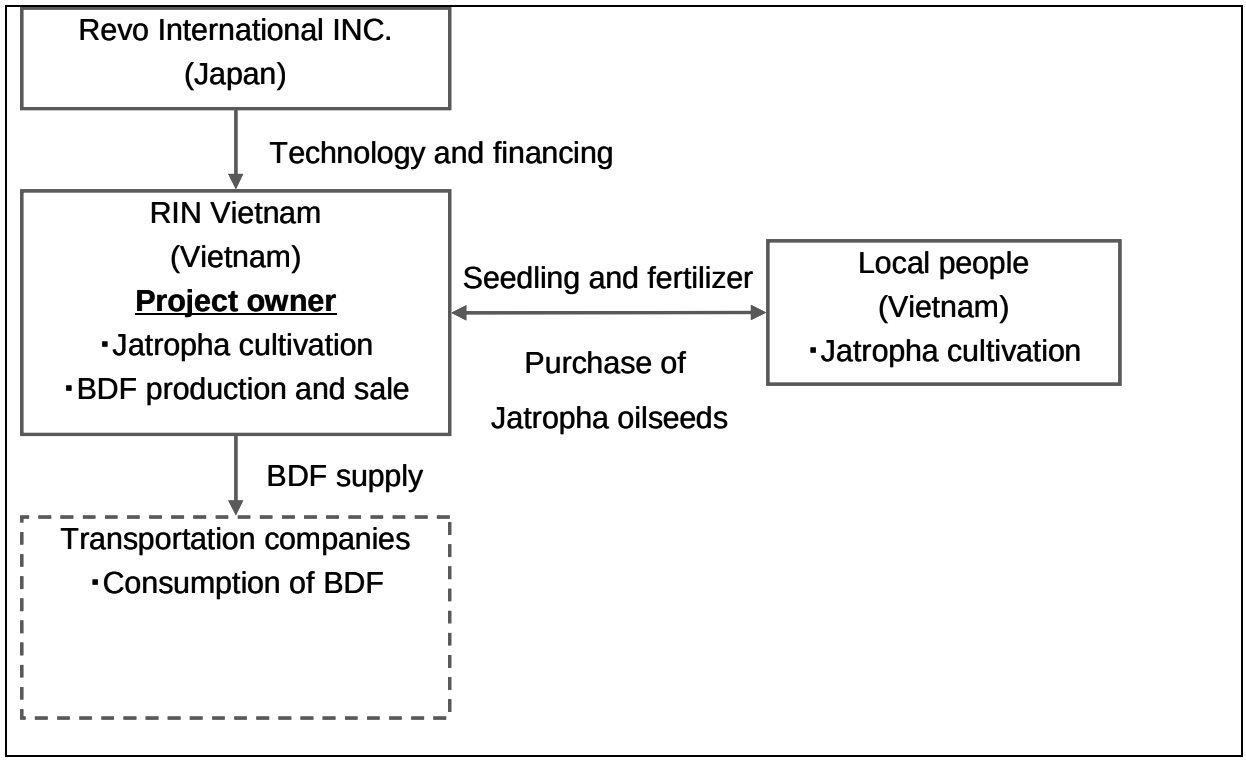
Figure 3 Summary of the comments received

Stakeholders	Comments	Responses from the PP
People's Committee of Ninh Thuan Province	Jatropha shall be cultivated in degraded lands not to compete other crops.	It is planned to cultivate in degraded lands.
	People's Committee will support the project activity since it complies with the energy master plan of Province.	The project participants are encouraged to implement the project.
People's Committee of Bac Ai District	Economical benefits should be demonstrated to the local people compared with other crops.	Jatropha can be cultivated in degraded lands where other crops are difficult to be grown.
Ministry of Natural Resources and Environment	EIA is compulsory for this project.	EIA will be conducted.
	The project activity complies with the government policies in Vietnam and the national criteria of CDM project.	The project participant will apply for the national approval of CDM project as soon as possible.
Ministry of Transport	Quality check of BDF should be suggested.	Quality check of BDF has been planned.
	BDF must meet the Vietnamese	BDF is planned to be produced to

	criteria of emissions.	meet the European standard of quality (EN14214).
	If BDF will be sold to the public, disclosure of information in relation to BDF shall be required.	BDF intends to be consumed only by transportation companies who make contract with the project participant.
Ministry of Industry and Trade	Standards of safety and environment shall be complied to sell BDF.	BDF is planned to be produced to meet the European standard of quality (EN14214) and technology standard of Vietnam.
	Environmental laws shall be respected to construct BDF production plant.	EIA will be conducted.
	It is encouraged to transfer Japanese technologies to Vietnam in energy field.	The project participants are encouraged to implement the project.
Ministry of Agriculture and Rural Development	The government promotes cultivation of Jatropha and BDF production.	The project participants are encouraged to implement the project.
	Jatropha cultivation project has been organized by the forestry department of the Ministry, however, it has been failing to get a good result.	The project participants are willing to share test results from the project.
Local people	In case the cultivation of Jatropha will fail.	Technical experts of RIN will help to cultivate and grow Jatropha not to fail.
	Whether pesticide will be used or not.	Environmental friendly pesticide will be used in case it is necessary.

3.8 Project implementation

Figure 4　Project implementation



3.9 Financial plan

3.9.1 Financing and investment plan

[Jatropha cultivation]

Jatropha curcas for this project will be cultivated on lands owned by local minority people under the contract to plant, manage and harvest the seeds. The oil seeds will be purchased by the project participant. At this stage, costs for jatropha seedling production, obtainment of raw material for organic fertilizer, management of nursery, wage for labor, procurement of oil seeds. The project participant estimates the cost of growing jatropha plants amounts to 35,000 JPY/ha which will be financed by its own account.

[Plant construction]

The project participant will plan to find financing institutions such as trading houses to invest in the project activity and it plans to fulfill the financial needs through dept finance from banks.

3.10 Financial analysis

According to our study result, profitability of the project is as follows:

In Vietnam, prime interest rate for its policy rates is 8%[1] at the time of the study was conducted. IRR for the project during the 20 year project period results in 6.4% without CER income while CER income pushes up the IRR to 8.3% surpassing the benchmark rate of 8%. For the duration of 25 year project period, the result shows the similar trend as the 20 year period.

The detailed figures are shown in the table below

[1] アジア開発銀行ウェブサイト：http://asianbondsonline.adb.org/vietnam.php

Figure 5　Project-IRR

	10 years	15 years	20 years	25 years
Without CERs	-5.6%	3.3%	6.4%	7.7%
With CERs	-2.7%	5.5%	8.3%	9.4%

As the jatropha seed yield will vary according to its variety, land fertility, fertilizer and combination of those variables. To count in those variances, the sensitivity analysis was conducted to reflect the possible changes to the profitability of the project to which the project participant may encounter.

Project-IRR（Without CER）

Yield	10 years	15 years	20 years	25 years
3t/ha	N/A	-7.9%	-3.0%	-0.8%
5t/ha	-12.9%	-2.1%	1.8%	3.6%
9t/ha	-2.2%	5.9%	8.7%	9.8%
12t/ha	3.2%	10.2%	12.5%	13.3%

If the oil seed harvest is below 5t/ha, the project would not be considered as feasible while the plants bear seeds at 9t/ha, the project participant could expect sufficient profitability.

3.11 Demonstration of additionality

The project participant intends to use the approved methodology AMS-III.AK, which permits the use of barrier analysis to demonstrate additionality. On the other hand, many project activities are placed under review by the EB, therefore the project participant prepares financial analysis for demonstration of additionality.

Step 1:

Alternatives considered for this project activity are as follows:

1. Continuation of current practices with no investment in jatropha plantation and biodiesel production capacity;
2. The project activity implemented without the CDM; and
3. Investment in any other alternative oilseed plantation/waste oil recycling and alternative fuel replacing partially or totally the diesel fuel.

Step 2:

Financial analysis

From the financial analysis, the project profitability is expected to be low with out CER. On the other hand, with CER income, the project activity would pass the benchmark set for the project activity.

As such, the most plausible baseline scenario is most likely to be continuation of current practices.

Step 3:

Barrier analysis

As there is no regulations obliging the use of BDF fuel in Vietnam, BDF production has not been commercialized according to interviews conducted by the project to major ministries in the host country. The interviewed ministries are as follows:
Ministry of Transport: Ministry in charge of regulating fuels used in transportation
Ministry of Industry and Trade: Ministry in charge of fuel production
Ministry of Agriculture and Rural Development: Ministry in charge of crops and tree cultivation

Based on above results, the project is considered as a First of its kind project which is a type of barriers recognized as a prohibitive barrier to implementation of the project activity.

As mentioned above, there is no regulation and also no case where BDF was introduced for replacing diesel in transport sector of Vietnam. Current practices for transport sector are to use diesel as BDF is not available in the market. This would lead to alternative with higher emissions.

Step 4:
Common practice analysis
As mentioned above, the project is considered as first of its kind and it would be possible to demonstrate that it is not a common practice.

Based on discussion above, it can be concluded that the project activity is additional.

3.12 Outlook towards project implementation

From the study conducted, the progress towards project implementation was carried out in the aspects mentioned below.

3.12.1 Project implementation

- Nursery construction and seedling cultivation
- Site preparation for planting
- Agreement on planting, harvesting and procurement of oilseeds with the local minority group
- Consideration of plant construction site
- Financing for the project

3.12.2 Project implementation as the CDM

- Prior consideration was prepared
- Consultation with local counter part
- Discussion with local government and DNA

3.13 Study results for issues anticipated before or encountered during the study

3.13.1 Issues anticipated before the study

Before conducting the study, the project participant anticipated the issues a) to d) below and the solution to them were researched during the study.

Figure 6 Issues anticipated before the study and the study results

Issues related to CDM	Study results for the issues
a) Difficulties with projects implemented in Vietnam	• From the interview with the DNA staff, the project participant was informed that there used to be some projects which were not registered as they had difficulties in obtaining grid data for emission factor, however, the data are prepared by the DNA already
b) Detailed data for demonstration of additionality (evidence for investment analysis, BDF production, diffusion and use in Vietnam	• Data necessary for the investment analysis were collected during the study • From the interviews with major ministries and local municipalities, the project participant found out that BDF production and use is not commonly practiced in Vietnam. Data to support this assumption was also obtained during the study. • The project participant assumes that the project is first of its kind and additional based on the facts found during the study
c) Demonstration of degraded land	• Once the project participant designates the area for plantation, local authority can issue a letter of proof on the land type and the letter would be used after sites are secured for the project.
Issues related to project	Study results for the issues
d) Reliable BDF yield data from jatropha	• Report on jatropha production and yield was obtained • The jatropha oilseed production expected in the project stays within the range of the report.

3.13.2 Issues encountered after the study

The issues that the project encountered after conducting the study.

Figure 7 Issues encountered after the study and the study results

Issues related to CDM	Study results for the issues
e) Quantification of co-benefit	• During the study, a report on SOx emission reduction through the use of BDF in comparison with that of diesel was confirmed.

4 Validation

4.1 Validation overview

The project aims to be registered by the EB and for its first step, a desk review was conducted by a DOE, Lloyd's Register Quality Assurance Ltd. (LRQA).

The progress of the validation can be summarized that the project has finished its public comment and PDD desk review. On site visit will be planned in the future.

5 Study result on co-benefits

The study was done on SOx and PM that are contained in exhaust gas of diesel engines and the findings are shown blow:

- SOx emission is almost zero as BDF does not contain sulfur.
- PM emission from BDF fuel will be reduced to a half of the amount emitted by diesel according to report by US EPA
- Based on the abovementioned findings, it is expected that SOx and PM, which are air pollutants and disease causing agents, could be reduced.

6 Study result on contribution to sustainable development

Not applicable