Fiscal 2006 Project Consigned by the Ministry of Environment

Fiscal 2006 CDM/JI Project Study

CDM Project Formulation Study for Jatropha Biodiesel Development in Tanzania

PROJECT DESIGN DOCUMENT

March 2007

Construction Project Consultants, Inc.

CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
Version 03 - in effect as of: 28 July 2006

CONTENTS

SECTION A. General description of project activity

A.1 Title of the project activity:

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- *The title of the project activity*
  Jatropha Methyl Ester – Biodiesel Fuel (JME-BDF) production and use for transportation in Tanzania

- *The version number of the document*
  Version 1

- *The date of the document*
  9/1/2007

A.2. Description of the project activity:

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- *the purpose of the project activity*

The purpose of the Project is to produce Jatropha Methyl Ester – biodiesel fuel (JME-BDF) from Crude Jatropha Oil (CJO) and blend it with petroleum diesel to produce an alternative fuel to petroleum diesel for transportation use in Tanzania. The reduction of greenhouse gas (GHG) emissions will occur through the substitution of petroleum diesel with JME-BDF, which is a biomass-based fuel. Biomass-based fuels are renewable and emissions from these fuels are deemed as "carbon neutral*".

The Project envisages the construction of a JME-BDF production plant to be located in the suburb of Dar es Salaam in principal and adjacent to the Port of Dar es Salaam. The produced JME-BDF will be blended with petroleum diesel to be used as an alternative to petroleum diesel for use of diesel vehicles in Dar es Salaam. The JME-BDF plant will have a production capacity of 100 tons per day and JME-BDF produced will be blended with petroleum diesel at a rate of up to 20%. The raw material to produce JME-BDF is the seed of Jatropha Curcus. Jatropha seed is planned to be cultivated in and around Arusha province. The Jatropha seed collected is processed into Crude Jatropha Oil (CJO) by Jatropha Crude Oil mill located in Moshi or Arusha, then, CJO is planned to be transported by tank lorries to BDF plant located in Dar es Salaam.

* Although CO_2 will be emitted by combusting biodiesel, this emission is defined as "carbon neutral" under IPCC guidelines. Because this CO_2 is deemed to be absorbed and sequestered by plants during its growth, the net CO_2 emission can be counted as zero when it is burned in the atmosphere.

- *the view of the project participants of the contribution of the project activity to sustainable development.*

The project activity will contribute in many aspects to sustainable development in Tanzania as described in detail below.

- **Reduce the dependency on imported energy such as crude oil, and promote the use of alternative energy**

Tanzania does not produce its own petroleum oil and all requirements are met by imports, and the import amounts are up to 266,544 tones and 652,548 tones for petroleum products and diesel oil respectively in 2004. (Liquid Biofuels for Transportation in Tanzania, the German Technical Cooperation (GTZ), 2005) With the current trend of continuously rising oil prices, the Tanzania government is very much concerned with reducing the country's dependence on imported energy as well as in the aspect of energy security. Implementing the proposed project, i.e. producing and using JME-BDF as a local renewable energy source will help reduce the dependence on imported energy and stabilize the supply of energy in Tanzania.

- Poverty reductions through ensuring steady or increase income of farmers in rural area

Constant purchase of CJO by the project activity will stabilize the domestic Jatropha oil market and it will contribute to farmers in the area to ensure a steady income and/or creation of new income source. And the project activity will not only enhance the increase of Jatropha oil production in the area, but also it will contribute to increase the income of farmers through the development of by-products out from the production of CJO such as biomass energy product as well as organic fertilizer.

- Increasing employment opportunities to the community

The project activity leads to the creation of employment opportunities through the process from the raw material production to the final product, i.e. Jatropha cultivation, Jatropha oil production and JME-BDF production.

- Improve the air quality in Dar Es Salaam

Bio-diesel fuels such as JME-BDF is known that bio-diesel blended fuel is possible to reduce effectively not only tailpipe PM but also hydrocarbon (HC), as well as carbon monoxide (CO) emissions as stated in 2004 Biodiesel Handling and Use Guidelines (U.S. Department of Energy). Therefore it is effective to improve the air quality of Dar es Salaam especially when such bio-diesel is used by diesel vehicles operating in Dar es Salaam, and thereby alleviate the adverse health effects to the residents.

The following items are "Sustainable development criteria for Tanzania" adopted by the Vice President's Office Division of Environment, Tanzania. These criteria are based on "Tanzania Vision 2025". The proposed project activity will comply with these criteria.

- Focus on rural development; improve the life and the livelihoods of the poor and those who are marginalized.
- Be environmentally and socio-economically friendly;
- Create employment opportunities to the community;
- Enhance poverty reduction.
- Improve infrastructure;
- LULUCF activities in CDM be primarily undertaken in the arid and semi arid areas of Tanzania where afforestation and reforestation is most needed.
- Be sustainable and cost effective;
- Really provided financial and environmental additionality;
- Be accepted by the local community: hence rely more on local manpower.

- Transfer the technology and enhance capacity of stakeholders.
- Ensure participation of the benefiting communities and stakeholders in development and implementation.
- Enable Tanzania to leapfrog to new sustainable and affordable technologies.

A.3. Project participants:

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Name of party involved	Private and/or public entity(ies) Project participants (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Tanzania	To be specified	No
Japan	To be specified	No

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

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A.4.1.1. Host Party(ies):

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United Republic of Tanzania

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

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Jatropha Cultivation : Moshi or Arusha
CJO Production : Moshi or Arusha
JME-BDF Production : Dar es Salaam
JME-BDF Use : Dar es Salaam

A.4.1.3. City/Town/Community etc:

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Jatropha Cultivation : Moshi or Arusha
CJO Production : Moshi or Arusha
JME-BDF Production : Dar es Salaam
JME-BDF Use : Dar es Salaam

A.4.1.4. Detail of physical location, including information allowing the unique identification of this project activity (maximum one page):

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In the project activity, JME-BDF will be produced in a JME-BDF production plant near Dar es Salaam and will be blended with petroleum diesel up to 20% level and distributed to filling stations or depots. JME-BDF blended diesel will mostly be used as an alternative fuel to petroleum diesel by buses and trucks in Dar es Salaam.

The raw material to produce JME-BDF is the seed of Jatropha Curcus. Jatropha seed is planned to be cultivated in and around Arusha province. The Jatropha seed collected is processed into Crude Jatropha Oil (CJO) by Jatropha Crude Oil mill located in Moshi or Arusha, then, CJO is planned to be transported by tank lorries to BDF plant located in Dar es Salaam.

A.4.2. Category(ies) of project activity:

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Transport

A.4.3. Technology to be employed by the project activity:

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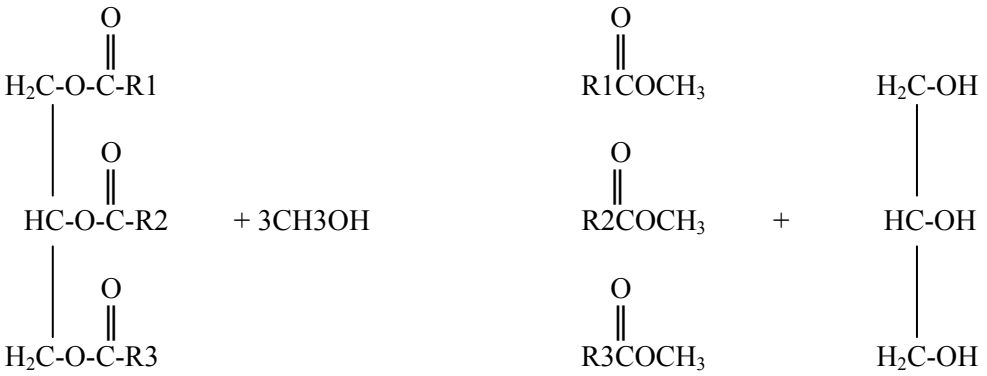
The core technology of the Project is to produce JME-BDF based on Crude Jatropha Oil as an alternative fuel to petroleum diesel. The chemical reaction during the trans-esterification process is illustrated below.



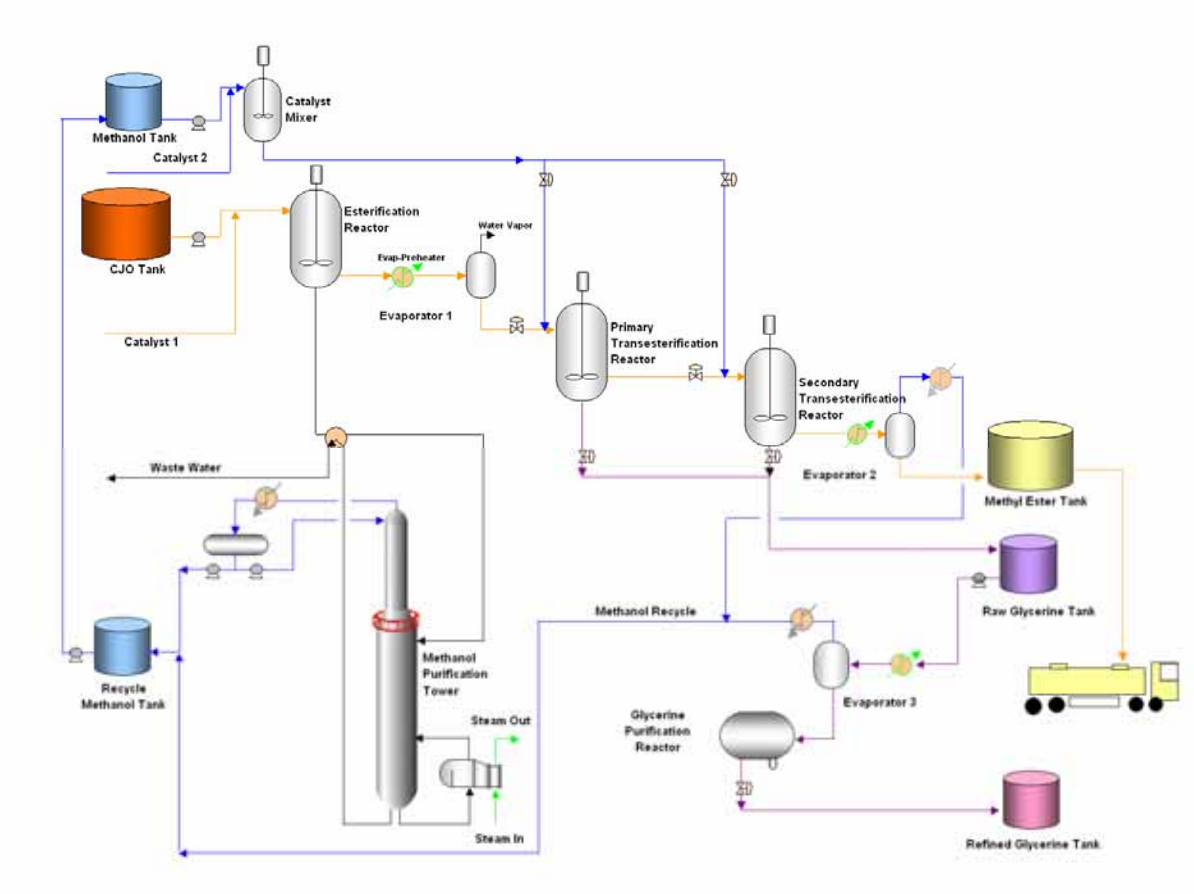
Vegetable Oil (Triglyceride) | Methanol | Methyl-ester | Glycerol

Process outline

CJO is pre-esterified to get rid of free fatty acids. Free fatty acids are esterified in acid-catalyzed conditions with a methanol at a level of 60ºC. The reaction is carried until the acid value of the mixture becomes 0.5. The pre-esterified CJO is transferred to the trans-esterification reactor. The basic catalyst and the methanol are added into the reactor to effect trans-esterification. The reactor is kept at reflux condition until the total glycerin level meets the specification.

Upon reaching the desired total glycerin level in the biodiesel, the residual methanol is distilled. Agitation is stopped to allow JME phase to separate from the glycerol phase. The glycerol phase is drained into another vessel. JME is washed with hot water to remove free glycerol and soap. The water is subsequently drained into the wastewater stream for treatment.

The methyl ester is dehydrated under a vacuum at 90ºC to meet the specification for moisture. The filter aid and the activated carbon are added into the dehydrated methyl ester. The mixture is agitated while being cooled to 40ºC. The biodiesel is filtered through a plate and frame filter and stored in a quarantine vessel. After quality assurance, the biodiesel is transferred into finished good tanks.


Methanol Tank
Catalyst 2
Catalyst Mixer
CJO Tank
Esterification Reactor
Water Vapor
Evap-Preheater
Evaporator 1
Catalyst 1
Primary Transesterification Reactor
Secondary Transesterification Reactor
Evaporator 2
Methyl Ester Tank
Waste Water
Raw Glycerine Tank
Methanol Recycle
Recycle Methanol Tank
Methanol Purification Tower
Steam Out
Steam In
Evaporator 3
Glycerine Purification Reactor
Refined Glycerine Tank

A.4.4 Estimated amount of emission reductions over the chosen crediting period:

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Years	Annual estimation of emission reductions in tonnes of CO_2e
Year 1	75,217
Year 2	75,217
Year 3	75,217
Year 4	75,217
Year 5	75,217
Year 6	75,217
Year 7	75,217
Year 8	75,217
Year 9	75,217
Year 10	75,217
Total estimated reductions (tons of CO_2e)	752,170
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tons of CO_2e)	75,217

A.4.5. Public funding of the project activity:

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No public funding will be used in this project for the establishment of JME-BDF production plant.

SECTION B. Application of a baseline and monitoring methodology

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

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Since to date, there is no baseline methodology approved by the CDM EB which is applicable to the project activity. However, the proposed methodology NM0108-rev can be applied to the project activity.

The title of the new methodology is:

"Production of biodiesel from perennial non-edible oil crops for use as fuel"

B.2 Justification of the choice of the methodology and why it is applicable to the project activity:

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The proposed project activity is to produce JME-BDF (Jatropha Methyl Ester - Biodiesel Fuel) and using them in transportation, thus this methodology is chosen.

The proposed project activity meets the following applicability conditions specified in the baseline methodology.

1. Biodiesel plant:

a) The project activity involves construction and operation of a biodiesel plant for (trans-) esterification1 of biogenic oils and fats, using methanol as the alcohol feedstock.

b) The biodiesel plant includes an expeller2 for extraction of oils from seeds, and / or it processes oils expelled elsewhere.

c) Storage and treatment of feedstock and products of the plant do not result in any methane emissions. In particular, seed cake produced at the plant is either treated aerobically (e.g. returned to field directly, or after composting), or the methane resulting from anaerobic treatment is completely captured and combusted (e.g. in a biodigester for energy generation).

2. Consumers:

a) The biodiesel is supplied to identified consumers, and / or to identified retailers for on-sale to unidentified consumers.

b) The baseline fuel is petrodiesel. Volumes of biodiesel not meeting this condition are discounted in the calculation of emission reductions.

c) For biodiesel supplied to unidentified consumers via retailers, the following conditions apply:

- *The biodiesel is supplied as a blend with petrodiesel, and the blending proportion is low enough to ensure that the price and technical performance characteristics of the blend do not differ significantly from those of pure petroleum diesel. The default value for the maximum allowable blending proportion for this purpose is 20% by volume (B20).*
- *Blending is done by the producer or a third party who is contractually bound to the producer (e.g., the retailer), to ensure that blending proportions can be verified.*

d) For biodiesel supplied to identified consumers, the following conditions apply:

- *The biodiesel is consumed as transport fuel or for stationary combustion;*
- *The biodiesel is consumed either pure (B100) or as a blend with petrodiesel (e.g. B5, B10, B20, etc.);*

- *If the biodiesel is consumed pure or in blends higher than B20, petrodiesel is established as the baseline fuel through scenario analysis.*

e) Export of the biodiesel to other countries is prevented, or accounted for:

- *The identified consumers operate in the host country, and are contractually obliged to consume the biodiesel in the host country;*
- *Retailers are contractually obliged to sell the biodiesel blend in the host country;*
- *Any biodiesel volumes exported abroad by the producer are clearly identified and discounted in the calculation of emission reductions.*

3. Feedstock:

a) The plant processes mainly oils and seeds from non-edible, perennial crops such as Pongamia pinnata and Jatropha curcas.

b) The geographical origin and original suppliers of the processed crops are identified.

c) The oil seeds are either picked from pre-existing oil trees (whether naturally occurring or from man-made plantations), or produced in dedicated plantations that are induced by the project activity.

d) If picked from pre-existing trees, the oil seeds are available in surplus, preventing displacement of existing uses.

e) Dedicated plantations are restricted to waste land, severely degraded land, and marginal land along railroads, field boundaries, etc.

f) Nitrogen (N) inputs into plantations of each processed oil crop can either be monitored, or there is sufficient information available to determine in a conservative way whether the average total amount of nitrogen (N) input into the plantations of all oil crops is likely to exceed 120 kg N per metric tonne of oil produced in the region where the biodiesel plant procures its feedstock.

g) Any crops processed by the project activity which do not meet the above conditions are discounted in the calculation of emission reductions. For example, annual and edible crops, such as sun flower and soybean, as well as waste oils and fats from industrial processes may be processed, but will not generate CERs.

h) Volumes of biodiesel produced with alcohols other than methanol (for example, ethanol) are discounted in the calculation of emission reductions.

4. CER Ownership:

a) Project participants claim CERs only for the direct CO2 emissions from fossil fuels displaced by the biodiesel. They do not claim CERs for the following: (i) Biodiesel consumed for non-energy purposes; (ii) Reductions in life-cycle emissions associated with the production of the displaced fossil fuels; and (ii) Utilization of the by-products of biodiesel production, such as glycerol and de-oiled seed cake.

b) Project participants have contractually arranged with their identified biodiesel consumers and retailers that the latter will not claim CERs for the displaced fossil fuels.

c) This methodology does not prejudice the ability of project participants or other parties to claim removals by sinks associated with plantations of perennial oil seed crops, using an approved methodology for afforestation/reforestation. Likewise, it does not prejudice the ability of biogenic methanol producers to claim CERs for the carbon incorporated in the biodiesel, using a separate, approved methodology (carbon from biogenic methanol is treated as fossil by this methodology).

B.3. Description of the sources and gases included in the project boundary

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The spatial extent of the project boundary includes
a) The biodiesel production plant site comprising the trans-esterification unit.
b) Upstream expeller plants supplying oil to the biodiesel production plant.
c) Vehicles where the biodiesel is consumed.

Relevant emission sources within this boundary include (see table below for details):
- Fuel and electricity consumed at the biodiesel plant;
- Electricity consumed by upstream expellers;
- Emissions from combustion of the biodiesel.

Emissions associated with the cultivation of the oil crops are excluded for the project boundary, but accounted for as leakage. The same applies for the production of methanol, and for transports of oil crops.

Based on the methodology, the following processes are excluded from the project boundary:
- Transports biodiesel to consumers / retailers;
- Emissions from preparation of other inputs for the biodiesel plant (e.g., emissions from production of methanol);
- Treatment of by-products of the biodiesel plant (Glycerol, seed cake).

	Source	Gas	Included?	Explanation
Baseline	Vehicles consuming biodiesel	CO_2	Yes	Main source of baseline emissions
		CH_4	No	Small emissions source, and no systematic difference to project activity
		N_2O	No	Small emissions source, and no systematic difference to project activity
Project Activity	Biodiesel plant energy consumption	CO_2	Yes	On-site fuel consumption plus production of grid electricity
		CH_4	No	Only negligible emissions associated with on-site fuel consumption and grid electricity
		N_2O	No	Only negligible emissions associated with on-site fuel consumption and grid electricity
	Upstream expeller	CO_2	Yes	Electricity consumption included, using default value
		CH_4	No	Negligible
		N_2O	No	Negligible
	Vehicles consuming biodiesel	CO_2	Yes	Fossil carbon contained in alcohols used for esterification. Other biodiesel carbon is climate-neutral (renewable biomass).
		CH_4	No	Small emissions source, and no systematic difference to baseline scenario
		N_2O	No	Small emissions source, and no systematic difference to baseline scenario

B.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

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The methodology is applied to the proposed project activity in following five main steps.

Step I : Checking the applicability conditions
Step II : Description of the project boundary
Step III : Determination of baseline scenario
Step IV : Assessment of additionality
Step V : Calculation of emission reduction

This section determines the baseline scenario stepwise following "Section II., 2. Procedure for selection of the most plausible baseline scenario" of the methodology.

Step I is already elaborated in B.1.1. Steps II, IV, and V are elaborated in sections B.4., B.3., and E., respectively.

In the methodology, the most likely baseline scenario in the absence of the CDM project activity should be established separately for (i) the biodiesel production plant ("Producer"), and (ii) each identified consumer of the biodiesel ("Consumers"). The baseline scenario is determined for "Producer" and "Consumers" among possible alternative scenarios as outline in the table below.

No.	Producer Scenario Description	Explanations
P1	Project activity undertaken without CDM	Analyzed in detail in Section B.3.
P2	Biodiesel plant operates on alternative feedstock (e.g. waste oils or residues of edible crops)	There is no other feedstock, which can be the raw material of biodiesel, in the area planned to cultivate Jatropha Curcus. And even no edible oil is available to produce biodiesel. Therefore this scenario is not realistic.
P3	Biodiesel plant built with other size	As analyzed in Section B.3., project activity will not be undertaken without CDM. And if the size of the plant will be smaller, the viability of the project will be much lower, therefore this scenario is not realistic.
P4	Biodiesel plant not built	As P1 to P3 are not realistic, this scenario will be the most possible baseline scenario.

No.	Consumer Scenario Description	Explanations
C1	Project activity undertaken without CDM	Analyzed in detail in Section B.3.
C2	Alternative biodiesel supply	The situation of biodiesel production using trans-esterification technology in Tanzania is in the research and development, or field test, stage. Therefore, there is still no supply for commercial purposes and the Tanzania government needs technical or financial assistance from foreign countries to promote biodiesel. Therefore this scenario is not realistic.
C3	Consumer continues to use current fuel	The consumers are currently using petroleum diesel. As another fuel for transportation, e.g. CNG or LPG, is currently not available and there is no detailed plan to construct infrastructures to distribute them in Tanzania, the consumer will continue to use petroleum diesel fuel. This scenario will be the most possible baseline scenario.

C4	Consumer switches to other fuel	As another fuel for transportation, e.g. CNG or LPG, is currently not available and there is no detailed plan to construct infrastructures to distribute them in Tanzania, the consumer will continue to use petroleum diesel fuel.
C5	Consumer partly or fully discontinues transport operations	The consumers will continue the transport operations. Even when the units of vehicles will be reduced in the future, the amount of petroleum diesel consumed will as much enough to be replaced by JME.

Thus, the baseline scenario is determined as P4 and C3 for producer and consumer stages respectively.
P4: Biodiesel plant not built
C3: Consumer continues to use current fuel, petroleum diesel

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity (assessment and demonstration of additionality): >>

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The baseline methodology applied for the project activity proposed to demonstrate the additionality using the latest version of the consolidated tool agreed by the Executive Board. The consolidated tool on additionality is a step by step approach which is applied to the project activity as follows.

Step 1: Identification of lawful alternatives to the project

The project activity has three alternatives that are realistic and credible, as given below.

a) The proposed project activity not undertaken as a CDM project activity;
b) Continuation of petroleum diesel consumption;
c) Petroleum diesel substitution with CNG, LNG or LPG.

All the alternatives defined above are in compliance with applicable laws and regulations in Tanzania.

And as detailed in the previous section (B.2), the appropriate baseline scenario that represents the GHG emissions in the absence of the project activity is the continuation using petroleum diesel and the proposed project activity is not the only alternative. Hence, the project passes this step to the next step.

Step 3: Barrier Analysis

The consolidated additionality tool provides for selection of either Step 2: Investment Analysis or Step 3: Barrier Analysis. Project proponents selected Step 3: Barrier Analysis for the proposed project activity, since, the project is first of its kind in Tanzania facing several barriers. This step has two sub-steps as given below.

The following barriers are identified for the proposed project activity.

Investment barriers;

In realizing biodiesel projects, there exist some implementation risks. The project is first of its kind in Tanzania, and the situation of biodiesel production using trans-esterification technology is in the research and development, or field test stage. There are some hand-made biodiesel in Arusha area, however because of the lack of experience on producing and using biodiesel there is still no supply for commercial purposes and the technology to produce biodiesel is quite new in Tanzania. Due to the risks associated with such a new technology in Tanzania, convincing investors to invest in biodiesel projects is very difficult.

Technological Barriers;

As already written above, the project is first of its kind in Tanzania, therefore experiences on producing and using biodiesel are lacking. And skilled labors and training to operate and maintain the biodiesel plant are also needed.

Barriers due to prevailing practice;

Due to the technological concerns noted above, there is lack of will to switch to biodiesel from petroleum diesel. One apprehension is that the biodiesel may affect vehicular performance anticipating poor quality biodiesel due to lack of proper experience in biodiesel technology. Hence, most vehicle owners prefer to continue using petroleum diesel instead of switching over to biodiesel.

The baseline scenario is to continue the current practice (i.e. consumption of petroleum diesel). Therefore, the above-mentioned barriers do not pose as obstacles to its promotion. Hence, the proposed project activity passes this step to the next step.

Step 4: Common practice analysis

As described earlier, there are no similar project activities in Tanzania. The project will be the first of its kind (evidences are to be prepared at the final PDD).

Step 5: Impact of CDM registration

Approval and registration of the project as a CDM project enable the project promotes to reduce the sale price of the biodiesel in proportion to the benefits received by selling emission reductions. This reduced price enables the biodiesel to penetrate into the market and remove the barriers that exist in respect of market conditions and low motivation to switch over to the biodiesel. Further, CDM status of the project activity will alleviate implementation risks and investment risks.

The logic above from Step 1 to Step 5 can lead to the conclusion that the project activity is additional.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

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Since to date, there is no baseline methodology approved by the CDM EB which is applicable to the project activity. However, the proposed methodology NM0108-rev can be applied to the project activity.

The title of the new methodology is:

"Production of biodiesel from perennial non-edible oil crops for use as fuel"

The proposed monitoring methodology closely relates to the baseline methodology applied to the Project. The applicability of the monitoring methodology is the same as that of the baseline methodology, which is already certified as applicable.

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	EF
Data unit:	t C /t fuel
Description:	Carbon content of heavy oil

Source of data used:	IPCC default values
Value applied:	0.85
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value.
Any comment:	In this case, the data is based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories: Reference Manual, p1.18 and p.21 (Residual Fuel Oil).

Data / Parameter:	Fe_{eler}
Data unit:	t CO_2/MW h
Description:	Emission factor for grid electricity
Source of data used:	Grid supplier data
Value applied:	0.094
Justification of the choice of data or description of measurement methods and procedures actually applied :	The data is gathered and recorded by the local power generation company according to their procedure stipulated by the associated regulation.
Any comment:	In this case, the data is calculated for using total electricity production and GHG emission from power generation.

Data / Parameter:	EF_{MeOH}
Data unit:	t C/t
Description:	Fossil carbon content of methanol
Source of data used:	Theoretical data
Value applied:	12/32
Justification of the choice of data or description of measurement methods and procedures actually applied :	Theoretical data.
Any comment:	Default value.

Data / Parameter:	$EF_{MeOH\ PC}$
Data unit:	(t CO2 /t methanol)
Description:	Precombustion emission factor for methanol production
Source of data used:	Specific primary energy consumption in methanol plants is assumed as 30GJ/t MeOH (Source:http://edj.net/sinor/SFR4-99art7.html; modern plants reach 29 GJ/t MeOH). CO_2 emission factor is assumed as 65kgCO_2/GJ (average of IPCC emission factors for natural gas and diesel oil).
Value applied:	2.0

Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value in the methodology.
Any comment:	

Data / Parameter:	NCV_{PD}
Data unit:	kcal/ kg
Description:	Net calorific value of petrodiesel
Source of data used:	Based on J. B. Kandpal dan Mira Madan(1994), Jatropha Curcus: a renewable source of energy for meeting future energy needs(Diesel Oil)
Value applied:	10,170
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default value.
Any comment:	

Data / Parameter:	EF_{PD}
Data unit:	t C/t
Description:	Carbon content of petrodiesel
Source of data used:	IPCC default values
Value applied:	0.87
Justification of the choice of data or description of measurement methods and procedures actually applied :	IPCC default value.
Any comment:	In this case, the data is based on 2006 IPCC guidelines for National Greenhouse Gas Inventories: Reference Manual, p1.18 and p1.21.

B.6.3 Ex-ante calculation of emission reductions:

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- The project activity emissions are calculated as,

Following the methodology, project activity emissions are calculated for each process below.

- *Combustion of fuels in the biodiesel plant*
- *Electricity consumption in the biodiesel plant*
- *Combustion of fossil carbon contained in methanol*

1. *Combustion of fuels in the biodiesel plant*

$$E_{P\_fuel\_y} = \left(M_{P\_fuel\_expel\_y} \times \frac{M_{Oil\_ester\_y}}{M_{Oil\_expel\_y}} + M_{P\_fuel\_other\_y} \right) \times EF \times 44/12$$

where:

$M_{P\_fuel\_expel\_y}$: *Heavy Oil consumed on-site for expeller (t)*
$M_{Oil\_ester\_y}$: *Total amount of oil processed (esterified) on-site (t)*
$M_{Oil\_expel\_y}$: *Amount of oil expelled on-site (t)*
$M_{P\_fuel\_other\_y}$: *Heavy Oil consumed on-site other than for expeller (t)*
EF : *Carbon content of heavy oil (t C/t)*

Parameters	Value	References or how the values are to be selected
$M_{P\_fuel\_expel\_y}$: *Heavy oil consumed on-site for expeller (t)*	141	Estimated for ex-ante calculation (to be studied further) : =427(kg/day) x 330(day) /1000
$M_{Oil\_ester\_y}$: *Total amount of oil processed (esterified) on-site (t)*	1.0	Assumed as 1.0
$M_{Oil\_expel\_y}$: *Amount of oil expelled on-site (t)*	1.0	Assumed as 1.0
$M_{P\_fuel\_other\_y}$: *Heavy oil consumed on-site other than for expeller (t)*	0	Assumed as 0
EF : *Carbon content of heavy oil (t C/t)*	0.85	Based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories : Reference Manual, p1.18 and p1.21(Residual Fuel Oil)
$E_{P\_fuel\_y}$: *Emissions from combustion of heavy oil in the biodiesel plant (t CO_2)*	439	Calculated : =141 x 0.85 x 44/12

2. *Electricity consumption in the biodiesel plant*

$$E_{P\_elec\_y} = (Q_{P\_elec\_expel\_y} \times \frac{M_{Oil\_ester\_y}}{M_{Oil\_expel\_y}} + Q_{P\_elec\_other\_y}) \times EF_{Elec}$$

where:

$Q_{P\_elec\_expel\_y}$: *Electricity consumed on-site for expeller (MWh)*
$Q_{P\_elec\_other\_y}$: *Electricity consumed on-site other than for expeller (MWh)*
EF_{Elec} : *Emission factor for electricity (kg CO_2/MWh)*

Parameters	Value	References or how the values are to be selected
$Q_{P\_elec\_expel\_y}$: *Electricity consumed on-site for expeller (MWh)*	350	Estimated for ex-ante calculation (to be studied further) : =1,060(kWh/day) x 330(day)
$Q_{P\_elec\_other\_y}$: *Electricity consumed on-site other than for expeller (MWh)*	0	Assumed as 0
$M_{Oil\_ester\_y}$: *Total amount of oil processed (esterified) on-site (t)*	1.0	Assumed as 1.0
$M_{Oil\_expel\_y}$: *Amount of oil expelled on-site (t)*	1.0	Assumed as 1.0

EF_{Elec} : Emission factor for electricity (kg CO_2 /MWh)	94	Calculated：=229($GgCO_2$) / 2.44 (TWh)
Total Electricity Production(TWh)	2.44	Based on U.S. DOE(2005),Tanzania in the year 2000
GHG emission from Power generation($GgCO_2$)	229	Based on "Option for Greenhouse Gas Mitigation in an Integrated East African Power Development",p25,Tanzania in the year 2000
$E_{P\_elec\_y}$: Emissions from electricity consumption in the biodiesel plant (t CO_2)	33	Calculated : =350 x 94 / 1,000

3. *Combustion of fossil carbon contained in methanol*

$$E_{P\_MeOH\_y} = M_{MeOH\_y} \times EF_{MeOH} \times 44/12$$

where:

M_{MeOH_y} : Amount of methanol consumed in biodiesel plant (t)
EF_{MeOH} : Mass fraction of methanol that is carbon (t C/t). EF_{MeOH} is 12/32.
$E_{P\_MeOH\_y}$: Emissions from combustion of fossil carbon contained in methanol (t CO_2)

Parameters	Value	References or how the values are to be selected
M_{MeOH_y} : Amount of methanol consumed in biodiesel plant (t)	1,650	Estimated for ex-ante calculation（to be studied further）: =5,000(kg/day) x 330(day)
EF_{MeOH} : Mass fraction of methanol that is carbon (t C/t)	12/32	Default Value
$E_{P\_MeOH\_y}$: Emissions from combustion of fossil carbon contained in methanol (t CO_2)	2,269	Calculated : =1,650 x 12/32 x 44/12

4. Total

$$E_{P\_y} = E_{P\_fuel\_y} + E_{P\_elec\_y} + E_{P\_MeOH\_y}$$

where:

E_{P_y} : Project activity emissions in year y (t CO_2)
$E_{P\_fuel\_y}$: Emissions from combustion of fuels in the biodiesel plant (t CO_2)
$E_{P\_elec\_y}$: Emissions from electricity consumption in the biodiesel plant (t CO_2)
$E_{P\_MeOH\_y}$: Emissions from combustion of fossil carbon contained in methanol (t CO_2)

Parameters	Value	References or how the values are to be selected
$E_{P\_fuel\_y}$: Emissions from combustion of fuels in the biodiesel plant (t CO_2)	439	Calculated
$E_{P\_elec\_y}$: Emissions from electricity consumption in the biodiesel plant (t CO_2)	33	Calculated
$E_{P\_MeOH\_y}$: Emissions from combustion of fossil carbon contained in methanol (t CO_2)	2,269	Calculated
E_{P_y} : Project activity emissions in year y (t CO_2)	2,741	Calculated

- Leakage emissions are calculated as,

Following the methodology, leakage emissions are calculated for each process below.
- *Transport of oil seeds (or oil) from suppliers to biodiesel plant*
- *Production of methanol consumed by the biodiesel plant*
- *Production of Jatropha*

1. *Transport of oil seeds (or oil) from suppliers to biodiesel plant*

$$L_{Transport\_y} = E_{BL\_y} \times 0.05$$

where:

E_{BL_y} : *Baseline emissions in year y (t CO_2)*
$L_{Transport\_y}$: *Leakage related to transport of oil seeds (or oil) from suppliers to biodiesel plant (t CO_2e)*

Parameters	Value	References or how the values are to be selected
Default factor for transport emissions(%)	5	Average transport distance oil crops is 500km
E_{BL_y} : *Baseline emissions in year y (t CO_2)*	97,901	Calculated
$L_{Transport\_y}$: *Leakage related to transport of oil seeds (or oil) from suppliers to biodiesel plant (t CO_2e)*	4,895	Calculated: =97,901(tCO_2) x 0.05

2. *Production of methanol consumed by the biodiesel plant*

$$L_{MeOH\_y} = M_{MeOH\_y} \times EF_{MeOH\_PC}$$

where:

M_{MeOH_y} : *Consumption of methanol in the biodiesel plant (t)*
EF_{MeOH_PC} : *Precombustion emission factor for methanol production (t CO_2 /t methanol)*
L_{MeOH_y} : *Leakage from production of methanol consumed by the biodiesel plant (t CO_2e)*

Parameters	Value	References or how the values are to be selected
M_{MeOH_y} *: Consumption of methanol in the biodiesel plant (t)*	1,650	Estimated for ex-ante calculation（to be studied further）: =5,000(kg/day) x 330(day)
EF_{MeOH_PC} *: Precombustion emission factor for methanol production (t CO2 /t methanol)*	2.0	Specific primary energy consumption in methanol plants is assumed as 30GJ/t MeOH(Source:http://edj.net/sinor/SFR4-99art7.html; modern plants reach 29 GJ/t MeOH). CO_2 emission factor is assumed as 65kgCO_2/GJ(average of IPCC emission factors for natural gas and diesel oil).
L_{MeOH_y} *: Leakage from production of methanol consumed by the biodiesel plant (t CO2e)*	3,300	Calculated: =1,650(t) x 2.0 (t CO_2 /t methanol)

3. *Production of oil crops*

$$L_{Crop\_net\_y} = E_{BL\_y} \times 0.12$$

where:

E_{BL_y} : *Baseline emissions in year y (t CO_2)*
$L_{Crop\_net\_y}$: *Net leakage from production of Jatropha (t CO_2e)*

Parameters	Value	References or how the values are to be selected
E_{BL_y} : *Baseline emissions in year y (t CO_2)*	97,901	Calculated
$L_{Crop\_net\_y}$ *: Net leakage from production of Jatropha(t CO_2e)*	11,748	Calculated: =97,901(tCO_2) x 0.12

4. Total

$$L_Y = L_{Transport\_y} + L_{MeOH\_y} + L_{Crop\_net\_y}$$

where:

L_y : *Total leakage from the project activity (t CO_2e)*
$L_{Transport\_y}$: *Leakage related to transport of oil seeds (or oil) from suppliers to biodiesel plant (t CO_2e)*
L_{MeOH_y} : *Leakage from production of methanol consumed by the biodiesel plant (t CO_2e)*
$L_{Crop\_net\_y}$: *Net leakage from production of Jatropha (t CO_2e)*

Parameters	Value	References or how the values are to be selected
$L_{Transport\_y}$: *Leakage related to transport of oil seeds (or oil) from suppliers to biodiesel plant (t CO_2e)*	4,895	Calculated
L_{MeOH_y} *: Leakage from production of methanol consumed by the biodiesel plant (t CO_2e)*	3,300	Calculated
$L_{Crop\_net\_y}$ *: Net leakage from production of Jatropha (t CO_2e)*	11,748	Calculated
L_y *: Total leakage from the project activity (t CO_2e)*	19,943	Calculated

The project activity emissions are calculated as,

$PE_{total} = E_{P\_y} + L_y = 2{,}741 + 19{,}943 = 22{,}684$ tCO_{2e}/yr

- Baseline emissions are calculated as,

Following the methodology, baseline emissions are calculated for each process below.
- *Efficiency multiplier (mass basis) for JME vs. petrodiesel*
- *Baseline emissions in year y*

1. *Efficiency multiplier (mass basis) for JME vs. petrodiesel*

$$efm\_m = \frac{NCV_{JME}}{NCV_{PD}}$$

where:

NCV_{JME} : *Net calorific value of JME (kcal/kg)*

NCV_{PD} : *Net calorific value of petrodiesel (kcal/kg), determined from national statistics at start of project activity*

Parameters	Value	References or how the values are to be selected
NCV_{JME} : *Net calorific value of JME(kcal/kg)*	9,470	Based on J. B. Kandpal dan Mira Madan (1994), Jatropha Curcus : a renewable source of energy for meeting future energy needs(Jatropha Oil)
NCV_{PD} : *Net calorific value of petrodiesel (kcal/kg)*	10,170	Based on J. B. Kandpal dan Mira Madan (1994), Jatropha Curcus : a renewable source of energy for meeting future energy needs(Diesel Oil)
efm_m : Efficiency multiplier (mass basis) for JME vs. petrodiesel (kg/kg)	0.93	Calculated : =9,470 / 10,170

2. *Baseline emissions in year y*

$$E_{BL\_y} = M_{JME\_y} \times efm\_m \times EF_{PD} \times 44/12$$

where:

E_{BL_y} : *Baseline emissions in year y (t CO_2)*

M_{JME_y} : *Amount of biodiesel (pure, i.e. before blending) produced from Jatropha (t)*

efm_m : Efficiency multiplier (mass basis) for JME vs. petrodiesel (kg/kg)

EF_{PD} : *Carbon content of petrodiesel (t C /t)※*

44/12 : Molar weight ratio to convert tonnes of carbon to tonnes of CO_2

※The carbon contents of the petrodiesel EF_{PD} should be based on either national statistics or IPCC default values.

Parameters	Value	References or how the values are to be selected
M_{BD_y} : *Amount of biodiesel (pure, i.e. before blending) produced from Jatropha (t)*	33,000	Estimated for ex-ante calculation（to be studied further）: =100(t/day) x 330(day)
efm_m : Efficiency multiplier (mass basis) for JME vs. petrodiesel (kg/kg)	0.93	Calculated
EF_{PD} : *Carbon content of petrodiesel (t C /t)*	0.87	Based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories : Reference Manual, p1.18 and p1.21
E_{BL_y} : *Baseline emissions in year y (t CO2)*	97,901	Calculated : =33,000 x 0.93 x 0.87 x 44/12

3. Total

The baseline emissions are calculated as:

E_{BL_y} = 97,901 tCO_{2e}/yr

- Emission reductions (ERs) are calculated as:

$ERs = E_{BL\_y} - PE_{total}$= 97,901 – 22,684= 75,217 tCO_{2e}/yr

B.6.4 Summary of the ex-ante estimation of emission reductions:

>>

Years	Estimate of project activity emissions (tons of CO_2e)	Estimate of baseline emissions (tons of CO_2e)	Estimate of leakage (tons of CO_2e)	Estimate of emission reductions (tons of CO_2e)
Year 1	2,741	97,901	19,943	75,217
Year 2	2,741	97,901	19,943	75,217
Year 3	2,741	97,901	19,943	75,217
Year 4	2,741	97,901	19,943	75,217
Year 5	2,741	97,901	19,943	75,217
Year 6	2,741	97,901	19,943	75,217
Year 7	2,741	97,901	19,943	75,217
Year 8	2,741	97,901	19,943	75,217
Year 9	2,741	97,901	19,943	75,217
Year 10	2,741	97,901	19,943	75,217
Total (tonnes of CO_2e)	27,410	979,010	199,430	752,170

B.7 Application of the monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	$M_{P\ fuel\ expel\ y}$
Data unit:	t
Description:	Heavy oil consumption for on-site expeller
Source of data to be used:	Plant records (purchase data)
Value of data applied for the purpose of calculating expected emission reductions in section B.6	141, estimated for ex-ante calculation.
Description of measurement methods and procedures to be applied:	- The data would be measured. - The recording frequency of the data will be annually. - The data will be archived in electronic format.

QA/QC procedures to be applied:	As per methodology
Any comment:	Fuel purchase data must be adjusted for stock changes. Index i denotes different fuels.

Data / Parameter:	$M_{P\ fuel\ other\ y}$
Data unit:	t
Description:	Heavy oil consumption other than for on-site expeller
Source of data to be used:	Plant records (purchase data)
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Assumed as 0
Description of measurement methods and procedures to be applied:	- The data would be measured. - The recording frequency of the data will be annually. - The data will be archived in electronic format.
QA/QC procedures to be applied:	As per methodology
Any comment:	Fuel purchase data must be adjusted for stock changes. Index i denotes different fuels.

Data / Parameter:	$M_{Oil\ ester\ y}$
Data unit:	t
Description:	Amount of oil esterified
Source of data to be used:	Plant records
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Assumed as 1.0
Description of measurement methods and procedures to be applied:	- The data would be measured or calculated. - The recording frequency of the data will be annually. - The data will be archived in electronic format.
QA/QC procedures to be applied:	As per methodology
Any comment:	This is the sum of oil purchased and oil expelled on site. May be calculated from biodiesel output $M_{BD\ i\ y}$

Data / Parameter:	$M_{Oil\ purchase\ y}$
Data unit:	t
Description:	Amount of oil purchased

Source of data to be used:	Plant records (purchase data)
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Assumed as 1.0
Description of measurement methods and procedures to be applied:	- The data would be measured. - The recording frequency of the data will be annually. - The data will be archived in electronic format.
QA/QC procedures to be applied:	As per methodology
Any comment:	

Data / Parameter:	$Q_{P\ elec\ expel\ y}$
Data unit:	MWh
Description:	Electricity consumption for expeller
Source of data to be used:	Plant records (electricity meter)
Value of data applied for the purpose of calculating expected emission reductions in section B.6	350, estimated for ex-ante calculation.
Description of measurement methods and procedures to be applied:	- The data would be measured. - The recording frequency of the data will be annually. - The data will be archived in electronic format.
QA/QC procedures to be applied:	As per methodology
Any comment:	

Data / Parameter:	$Q_{P\ elec\ other\ y}$
Data unit:	MWh
Description:	Electricity consumption other than for expeller
Source of data to be used:	Plant records (electricity meter)
Value of data applied for the purpose of calculating expected emission reductions in section B.6	Assumed as 0
Description of measurement methods and procedures to be applied:	- The data would be measured. - The recording frequency of the data will be annually. - The data will be archived in electronic format.

QA/QC procedures to be applied:	As per methodology
Any comment:	

Data / Parameter:	$M_{MeOH\ y}$
Data unit:	t
Description:	Methanol consumed
Source of data to be used:	Plant record (purchase data)
Value of data applied for the purpose of calculating expected emission reductions in section B.6	1,650, estimated for ex-ante calculation.
Description of measurement methods and procedures to be applied:	- The data would be measured. - The recording frequency of the data will be annually. - The data will be archived in electronic format.
QA/QC procedures to be applied:	As per methodology
Any comment:	

Data / Parameter:	NCV_{JME}
Data unit:	GJ /t biodiesel
Description:	Net calorific value of biodiesel
Source of data to be used:	Lab analysis
Value of data applied for the purpose of calculating expected emission reductions in section B.6	9,470 In this case, the data is based on J. B. Kandpal dan Mira Madan (1994), Jatropha Curcus: a renewable source of energy for meeting future energy needs(Jatropha Oil).
Description of measurement methods and procedures to be applied:	- The data would be measured. - The recording frequency of the data will be once at project start. - The data will be archived in electronic format.
QA/QC procedures to be applied:	As per methodology
Any comment:	Determined separately for biodiesel from each different oil crop. A sample is representative if the uncertainty of the NCV does not exceed ± 5% at 95% confidence level.

Data / Parameter:	$M_{JME\ y}$
Data unit:	t
Description:	Amount of biodiesel (pure, i.e. before blending) produced from Jatropha
Source of data to be	Plant records (production data)

used:	
Value of data applied for the purpose of calculating expected emission reductions in section B.6	33,000, estimated for ex-ante calculation.
Description of measurement methods and procedures to be applied:	- The data would be measured. - The recording frequency of the data will be annually. - The data will be archived in electronic format.
QA/QC procedures to be applied:	As per methodology
Any comment:	

B.7.2 Description of the monitoring plan:

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To be elaborated.

B.8 Date of completion of the application of the baseline study and monitoring methodology and the name of the responsible person(s)/entity(ies)

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December 2006

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SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

>>
01/01/2010

C.1.2. Expected operational lifetime of the project activity:

>>
20y-0m

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

C.2.1. Renewable crediting period

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

>>

C.2.1.2. Length of the first crediting period:

>>

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>
01/01/2010

C.2.2.2. Length:

>>
10y-0m

SECTION D. Environmental impacts

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D.1. Documentation on the analysis of the environmental impacts, including transboundary impacts:

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To be completed.

D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

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To be completed.

SECTION E. Stakeholders' comments

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

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Attached as Annex 5: Stakeholders comments.

E.2. Summary of the comments received:

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Attached as Annex 5: Stakeholders comments.

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

>>

The proposed activities are still at the preliminary feasibility stage; hence, no actions are applicable.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Mitsubishi Corporation
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Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Rajani Industries Limited
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Represented by:	
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Salutation:	Mr.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No public funding will be used in this project.

Annex 3

BASELINE INFORMATION

Annex 4

MONITORING INFORMATION

Annex 5

STAKEHOLDRS COMMENTS

STAKEHOLDERS CONSULTATION PROCESS

Stakeholders were identified through prior consultation with Embassy of Tanzania in Japan and Tanzania Liaison Office of Mitsubishi Cooperation. The study team found out that relevant ministries, public organizations and four private firms had a keen interest in involvement in the Project in the first field study.

In advance, the Project synopsis was distributed to each stakeholder identified for smooth consultation in the host country (Tanzania). In January 2007, the study team for the second field study consisting of five members was delegated to Tanzania to make presentations on the outline of the Project and the study outcomes based on the result of the first study carried out in September 2006. Comments received during meetings in the second study are encouraged to be reflected on the final study report.

STAKEHOLDERS COMMENTS

<General Comments>

In general, public comments received during meetings with stakeholders are supportive and constructive. No negative comments/objections were received. All stakeholders identified welcomed the implementation of the Project and hoped to see its progress.

<Detailed Comments>

Public agencies:

- Vice President's Office: This is a highly interesting project. Please promote it at the current pace. It is a good idea to invite participation from the TPDC. Of course, private sector participation is also welcome. Please keep us informed on this project.
- Ministry of Planning, Economy and Empowerment: We hope the project will be advanced at the present rate. We feel it is important to maintain the cooperative relationship between the public and private sectors, both inside and outside of Tanzania, in order to realize this project.
- Tanzania Petroleum Development Corporation (TPDC): These are very interesting contents. We will examine our future cooperation in internal discussions. It is necessary to further disseminate the proposed contents. (The willingness of TPDC to participate in the project has been confirmed by e-mail from TPDC that received after returning to Japan from the second field study).
- Ministry of Energy and Minerals: We hope that the project development will be continued at this rate. We consider it the government's role to formulate and advise relative policy. The biodiesel blending ratio could be 20% rather than 10%. We hope to stay in touch in the future.
- Arusha Municipal Council: We are in 100% agreement with the contents. A lot of progress has been made since the survey of last September and we hope the work continues at this pace. We hope to stay in touch on this matter in the future.

Private sector:

- Rajani Industries Ltd.: We would very much like to invest in this project. We also feel the need to conduct research and study into Jatropha. We can also add our personnel who are well-versed BDF matters onto the study team. If any data and so on are required, please let us know. We wish to stay in touch on this matter in the future.
- Diligent Tanzania Ltd.: Concerning Jatropha cultivation, we agree that it is important for farmers to become organized. Depending on the area, since there is a risk of clashes occurring under certain

conditions, it may be necessary to display care when selecting the cultivation sites. We have gained lessons in organizing farmers, and we could offer cooperation.

- Marks Ltd.: We well understand the contents. How may we cooperate as a consultant or partner? Please stay in touch on this matter in the future.
- KAKUTE Ltd.: We can fully understand the contents of the proposal. Now is maybe the time to consider what kind of research will be required in future. Since the timing of harvest and so on differs according to each area, it may be necessary to categorize the features of Jatropha geographically.

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