Summary

FS Project Title

CDM Feasibility Study for Power Generation using Waste Banana in the Philippines

Implementer

EJ Business Partners Co., Ltd.

Members of this study

In Japan

- EJ Business Partners Co., Ltd. , Main member
- Eight-Japan Engineering Consultants Inc. , Technical support

In Philippines

- Celebrate Life Agriventure Philippines Inc. , Local partner
- Foundation for Agrarian Reform Cooperatives in Mindanao, Inc. , Local partner
- Falck Exp Inc. , Site investigation assistance
- Pasig Agricultural Development & Industrial Supply Corporation. , Plant Research

1. Outline of the project

This Feasibility Study aims to evaluate the feasibility and economic profitability of power generation using waste banana stalks instead of the existing fossil fuel. The Foundation for Agrarian Reform Cooperatives in Mindanao Inc. (FARMCOOP) is composed of banana farmers in Davao del Norte, Southeast Mindanao. The banana stalks, after harvesting the fruits are discarded from the packing houses of farms which are members of FARMCOOP. The stalks are dumped at open disposal sites in the farms. In this project, banana stalks will be used as methane fermentation materials and the methane gas produced will be used for power generation. The power generation capacity is about one (1) MW.

When this project will be carried out, Celebrate Life Agriventure Philippines Inc. (CLAVI), FARMCOOP, and EJ Business Partners will establish a special-purpose company (SPC) as a Philippines corporation.

The baseline scenario of the project are generation of methane gas by the decay of open dumped banana stalks and alternative public grid power consumption by supplying electric power from this project. In the project scenario, the methane generation by the decay of banana stalks going into the atmosphere is avoided. By using methane as power generation materials to supply electric power to the local grid, the amount of the fossil fuel used in the grid is reduced. The greenhouse gas emission will be reduced on the average over a period of 10 years (2012 – 2021) by 9,044 t-CO_2/year with the implementation of this project.

This project is a power generation project using banana stalks from agricultural waste. Implementation of the project contributes to sanitary improvement, pollution control of groundwater, reduction of the amount of waste and antipollution measures, such as bad smell prevention by decay.

2. The contents of this study

(1) The points of this study

1) The conditions of approval of the CDM host country (the Philippines)

- The conditions for approval (days required for approval, similar projects, etc.)
- Governmental development plan

2) The present condition of banana farms

- Selection of banana farms
- The shipment of banana (days of operation and hours worked at packing house, etc.)
- The situation of banana stalks (production, the transport method to disposal sites, the present condition of disposal sites, etc.)
- Use of power supply (fossil fuels' use etc.)

3) Analysis of the biomass power generation system

- Investigation of the collectable quantity of the object biomass (waste banana stalks)
- Investigation on the quality of the target biomass
- The conceptual design of the power generation system

4) Application of baseline methodology

- Selection of the methodology
- Definition of the project boundary
- Identification of the baseline scenario
- Calculation of the greenhouse gas emission reduction
- Planning of the monitoring methodology and the monitoring plan

5) Evaluation of an environmental impact

-Study of the system for environment impact assessment in the Philippines
- Study of the environmental impact by the project implementation
- Other indirect influences

6) Analysis of the project business potential

- Estimated cost of the construction of the plant
- Estimated expenses for the operation and maintenance of the plant
- Estimated income of the project
- Determination of the benchmark for evaluation of the business potential

- Demonstration of additionality
- Financing plan

7) The meeting for project promotion
- Project implementation structure
- Duration of the project activity/crediting period
- Project implementation schedule

8) The method and index-izing which realize the co-beneficial counter measures against global warming and against environmental pollution

(2) The contents of the study

1) CDM Project Policy in the Philippines

The Department of Environment and Natural Resources (DENR) of the Philippines has been selected as the CDM designated national authority (DNA). Information from DENR and the survey of DENR's website, the period required for approval of the CDM project in the Philippines, organization and procedure of CDM approval were investigated (Fig.1 and 2).

According to the latest project list approved by the Philippines government gathered from DENR for this study, the letters of approval for the host country were published for 63 projects, 40 of these projects have also obtained approval from the CDM executive board (as of end of December, 2009). About 80 percent of these projects are classified into waste management.

Since none of this kind, using banana as biomass for power generation project has been registered yet, this innovative idea has a pioneering spirit which would be given merit by the DENR.

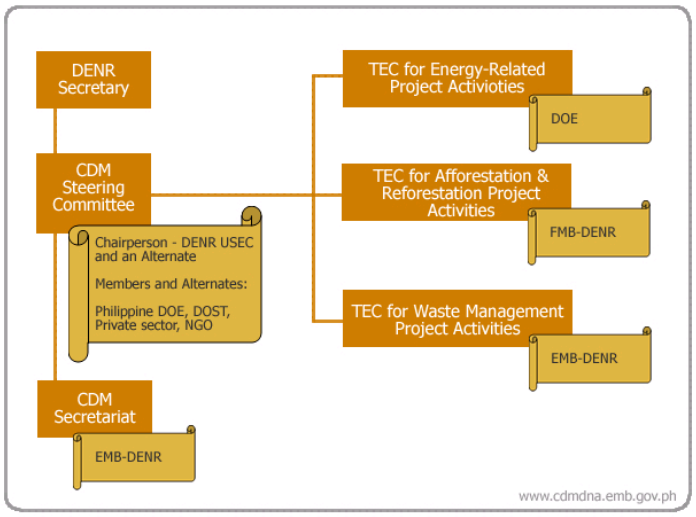

Fig.1 DNA organizational structure in the Philippines
(From website of Clean Development Mechanism - Philippines)

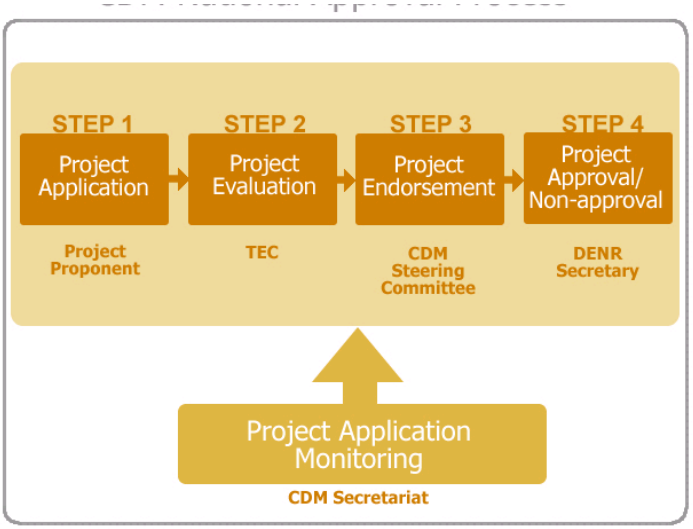

Fig.2 CDM national approval process in the Philippines
(From website of Clean Development Mechanism - Philippines)

2) The present condition of banana farms

Based on the result of two site investigations in this study, ten farms which can cooperate in the collection of banana stalks were selected. These farms are members of FARMCOOP which is a participant in this project, and have promised to supply banana stalks generated from the packing houses for this project. The total area of these farms is about 4,300 hectares (Table 1).

Table 1 Outline of affiliation farms of FARMCOOP

No.	Farm name	Area (ha)	Shipment of banana fruits (t/year)
1	Darbmupco	907.60	57,848
2	Darbco	1,042.40	59,522
3	Marbmco	188.94	9,383
4	Sfarbemco	107.57	4,806
5	Amskarbemco	161.52	8,411
6	Hearbco	600.00	32,414
7	Hearbco 1	442.00	23,882
8	Hearbco 2	278.41	12,542
9	Tcbc	476.66	17,685
10	Cfarbempco	113.00	6,777
	Total	4,318.10	233,267

The banana fruits for export and waste are sorted out at the packing houses in these farms. The shipment of export banana fruits is 233,000 t/year and they are mainly exported to Japan. The waste mainly consists of the substandard banana fruits and banana stalks. In site investigations, it is confirmed that banana stalk which would the main materials in this power generation project are not used and are dumped in the

open (Photo. 1 and 2). On the other hand, it is common that the substandard banana fruits are cheaply sold off for feed and banana chip production. And it is confirmed that the banana skin is also dumped in the farms (photographs 3 and 4).

Photo. 1 Disposal site in the Marbmco farm

Photo. 2 Transport to the disposal site of waste banana stalk

Photo. 3 Open dumping of banana skin (1)

Photo. 4 Open dumping of banana skin (2)

3) The study of the power generation system

(a) Investigation of production of target biomass

The total quantity of banana stalks generated from packing houses in selected banana farms is estimated at 27,990 t/year (93.1 t/day), based on the records of the banana shipment for the past three years (Table 2).

Table 2 Production of banana stalks

No.	Farm name	Shipment of banana fruits (t/year)	Stalk / fruits ratio	Production of stalks (t/year)	Days of operation (day/year)	Production of stalks (t/day)
1	Darbmupco	57,848	0.12	6,943	312	22.25
2	Darbco	59,522	0.12	7,142	312	22.89
3	Marbmco	9,383	0.12	1,126	312	3.61
4	Sfarbemco	4,806	0.12	577	260	2.22
5	Amskarbemco	8,411	0.12	1,009	260	3.88
6	Hearbco	32,414	0.12	3,889	312	12.46
7	Hearbco 1	23,882	0.12	2,865	312	9.18
8	Hearbco 2	12,542	0.12	1,505	260	5.79
9	Tcbc	17,685	0.12	2,121	260	8.16
10	Cfarbempco	6,777	0.12	813	312	2.61
Total		233,267		27,990	2,912	93.1

(b) Quality investigation of banana stalk

In this study, the direct combustion type and the methane fermentation type were studied as a power generation system. In order to get the underlying data of the system, the samples of waste banana stalk and substandard banana fruits were picked up by site investigations and quality analysis of calorific value, etc. was carried out (Table 3).

Table 3 The result of quality analysis

Analysis	Unit	Result
Moisture	%wet	94.7
Ash	%wet	0.38
Carbon	%wet	4.92
Gross Calorific Value	kJ/dry-kg	12100
Total Solids	%wet	5.3
Volatile Solids	%dry	92.8

Analysis	Unit	Result
Moisture	%wet	82.6
Ash	%wet	0.99
Carbon	%wet	16.5
Gross Calorific Value	kJ/dry-kg	15600
Total Solids	%wet	17.4
Volatile Solids	%dry	94.3

(Waste banana stalk (left) and substandard banana fruits (right))

(c) Biomass power generation system

In the result of quality analysis, since waste banana stalk and substandard banana fruits have very high moisture content and the calorific value are low, it became clear that such materials are unsuitable for the direct combustion type. For this reason, the methane fermentation type was adopted as the power generation system. And, in order to promote further methane fermentation, substandard banana fruits will also be used for power generation.

The power generation system adopted is shown in the following figure. In the result of consultation with methane fermentation equipment makers, the system consists of receiving and pretreatment facility (receiving, crush, mixing, etc.), methane fermentation tub, gas utilization equipment (power generation, heat use), and residue processing equipment (dehydration composting). The power generation scale is about

1MW. The generated electric power is supplied to packing houses, and is also supplied to the public grid. The generated heat will be used for warming the methane fermentation equipment etc..

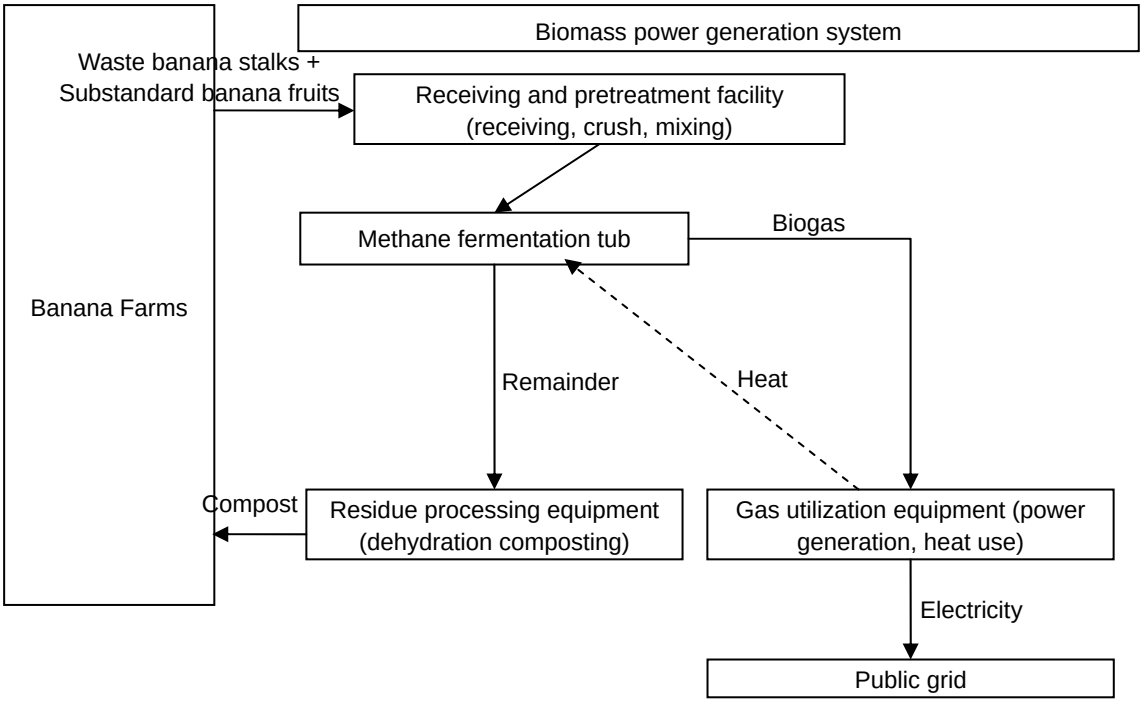

Fig.3 Concept of biomass power generation system of waste banana stalks use

3. Result of the study towards CDM project implementation

(1) Definition of the project boundary and identification of baseline

1) Application of baseline methodology

In this project, the banana stalks that are used to be dumped in the open will be effectively fermented to produce methane gas for power generation to be supplied to public grid. The AMS-I.D. (Grid connected renewable electricity generation) and the AMS-III.E. (Avoidance of methane production from decay of biomass through controlled combustion and gasification or mechanical/thermal treatment) will be applied in this project activity. The object of the AMS-I.D. is renewable energy technology that supplies electricity to homes and other users as an alternative of fossil fuel. Moreover, AMS-III.E. is a methodology which avoids the methane generation from the decay of biomass through controlled combustion etc.

Since the quantity of emission reduction of this project is less than annual 60,000 t-CO_2/year, this project is classified as a small-scale CDM project.

2) Project boundary

The project boundary is defined as "the power generation plant built in this project." And, the use of fossil fuel in collecting and transporting banana stalks and substandard banana fruits from the packing houses of the 10 banana farms to the power generation plant will also be included in the boundary.

3) Baseline scenario

Now, all waste banana stalk generated from the packing houses, has been dumped in the open at the farms and the electric power for packing houses is sourced from the public grid.

The baseline scenario is the methane produced from the decay of banana stalks openly dumped at the farms is released into the atmosphere and the packing houses utilize alternative grid power consumption being supplied from this project. In the project scenario, decay of these banana stalks is avoided, electricity is supplied to the public grid and the fossil fuel consumption is reduced.

In the Philippines, there is no case of effective utilization of waste banana stalks. Since open burning is prohibited by law ("Philippine Clean Air Act") on air pollution prevention, open dumping in the farms is the general disposal method for waste banana stalks. Therefore, it could be considered that setup of the baseline is valid.

4) Baseline emission

The quantity of baseline emission of this project is calculated with (1) the quantity of baseline emission from the electric power substitution through this project and (2) the amount of methane generations from the decay of open dumped banana stalks in the farms if the project will not be carried out.

(a) Grid electric power alternative (AMS-I.D.)

BEy = {EGy - EGbaseline} × EFy (Emission factor of grid)
= {1 MW × 300 days × (24 – 0) hours} × 0.487 t-CO_2/MWh
= 3,506 t-CO_2/year

BEy : Quantity of baseline emission from the electric power substituted by the project activity in the year “y”
EGy : Electric energy from the public grid substituted by the project activity
EGbaseline : Electric energy substituted by project implementation (0)
EFy : Emission factor of the grid

(b) Avoidance of methane generation (AMS-III.E.)

The quantity of baseline emission by the avoidance of methane emission is calculated by the following formula using “Tool to determine methane emissions avoided from dumping of waste at a solid landfill site”.

$$BE_{CH4,SWDS,y} = \varphi \cdot (1-f) \cdot GWP_{CH4} \cdot (1-OX) \cdot \frac{16}{12} \cdot F \cdot DOC_f \cdot MCF \cdot \sum_{x=1}^{y} \sum_{j} W_{j,x} \cdot DOC_j \cdot e^{-k_j \cdot (y-x)} \cdot \left(1 - e^{-k_j}\right)$$

φ = 0.9, f = 0.5, DOC_f = 0.5, MCF = 0.28 (stock pile), DOCj = 0.4, kj = 0.07, GWP_{CH4} = 21 (at this point, refer to IPCC2006 parameter), and production of waste banana stalks; 90 t × 300 day = 27,000 t/year

BEy = annual average 5,824 t-CO_2/year

(2) Project emission

The amount of gas emission in this project is calculated with (1) consumption of electricity through this project activity, and (2) the distance of collection and transport of waste banana stalks and the amount of the fossil fuel used in this project.

1) Consumption of electricity through this project activity (AMS-I.D.)

PEy = {PGy × EFy}
= {0.05 MW × 300 days × (24-9) hours} × 0.487 t-CO_2/MWh
= 175 t-CO_2/year.
(It is assumed that 5% is consumed by project activities)
PEy : the amount of project emission
PGy: electric energy used in the project

2) Collection and transport of waste banana stalk (AMS-III.E.)

PEy,transp = (Qy/Cty) × DAFw × EFCO2
={((27,000 t/ year)/(7 t/set)) × 26 km} + 1.10787 kg-CO2/km
= 111 t-CO2/year

Qy : the quantity (t/year) of transportation of waste banana stalks
CTy : average track cargo (t/set)
DAFy : transportation distance in track (km)
EFCO2 : CO2 emission coefficient of track fuel (light oil) (t-CO2/km).

(3) Monitoring plan

Based on AMS-I.D and AMS-III.E, the plan which can collect and record required monitoring data synthetically is adopted.

1) The monitoring methodology

In this project, parameters required for verification of the amount of emission reduction are monitored based on the AMS-I.D. and the AMS-III.E.

In monitoring, those values are measured by instrumentation apparatus on the basis of directly measuring the consumption amount of waste banana stalks and production of electricity in each part of the power generation plant and the dynamo, etc.

2) The item of monitoring

The items which should be monitored in this project are as follows (Table 4).

Table 4 The item of monitoring and measurement frequency

No.	Item	Content	Location of measurement	Measurement frequency
1	Qst-prod,y	Produce of waste banana stalks	Packing houses	1 time/month
2	CTy	Cargo of track	-	1 time/year
3	MLtrans	Fuel mileage of track	-	1 time/year
4	Qst-cons,y	The amount of consumption of waste banana stalks (the amount of receiving in the plant)	Plant	Opportune
5	H	Operation time.	Plant	1 time/day
6	ECy	Annual amount of used electricity	Plant	1 time/month
7	Qfuel,y	The annual amount of consumption of fossil fuel.	Plant	1 time/month
8	Qgas	The flow of generating biogas	Plant	1 time/minute
9	CH_4gas	Methane concentration in biogas	Plant	1 time/minute
10	Pgas	Biogas pressure at the time of methane concentration measurement	Plant	1 time/minute
11	Tgas	Biogas temperature at the time of methane concentration measurement	Plant	1 time/minute
12	EG**y**	Annual electric power production	Plant	1 time/month
13	Qby_prod, y	The annual amount of emergence of digestive sludge (compost).	Plant	1 time/day

In addition, it is necessary to investigate the laws and regulations relevant to the project activity, and to compare equipment specification with the actual condition about the consumption amount of waste banana stalks per unit production of electricity.

(4) Greenhouse gas emission reduction

The quantity of greenhouse gas (GHG) emission reduction expected in this project is estimated as follows (Table 5).

Table 5 Greenhouse gas emission (GHG) reduction through this project

Operating year	GHG emission reduction by grid electric power alternative (t-CO2)	GHG emission reduction by avoidance of methane generation (t-CO2)	Baseline emission (t-CO2)	Project emission (Consumption of electricity) (t-CO2)	Project emission (Transport of materials (t-CO2)	Total emission reduction (tCO2)
2012	3,506	1,288	4,794	175	111	4,508
2013	3,506	2,489	5,995	175	111	5,709
2014	3,506	3,609	7,115	175	111	6,829
2015	3,506	4,653	8,159	175	111	7,873
2016	3,506	5,626	9,132	175	111	8,846
2017	3,506	6,534	10,040	175	111	9,754
2018	3,506	7,380	10,886	175	111	10,600
2019	3,506	8,169	11,675	175	111	11,389
2020	3,506	8,905	12,411	175	111	12,125
2021	3,506	9,591	13,097	175	111	12,811
Total	35,064	58,242	93,306	1,753	1,111	90,442

(5) Duration of the project activity / crediting period

The project will start in 2010. Four months is required for validation, six months is needed for the U.N. approval including the approval of both-countries government, and about 12 months is needed for the construction of the plant. The target of commencement of commercial operation is on January 2012. The crediting period will be ten years from 2012 to 2021.

(6) Environmental impacts and other indirect influence

As an environmental impact of the project implementation, the air pollution coming from the exhaust gas of the engine, plant noise and the dust at the time of construction, etc. can be considered. However, these influences can be minimized by doing high level exhaust management and operation and maintenance of suitable apparatus.

In the law and ordinances related to the environmental impact assessment of the host country, the procedure which relates to the group classification and the required environmental impact according to project scales (plant scale, power generation capacity, area, etc.) could be determined. According to the standard procedure concerning the environmental impact indicated in the "REVISED PROCEDURAL MANUAL FOR DENR ADMINISTRATIVE ORDER NO.30 SERIES OF 2003" (DAO 03-30), this project is classified into a waste power generation project. Demand standards differ as shown in Table 6, according to the power generation capacity. This project is classified into category-D because the planned power generation capacity is 1MW (Table 6). Submission of Project Description (PD) and issuance of Certificate of Non-Coverage (CNC) are need.

Table 6 Category classification of environmental-impact-assessment system of the Philippines (in case of generating electricity from waste materials)

Category	A	B	C	D
	Environmentally Critical Project (ECPs) with significant potential to cause negative environmental impacts.	Projects that are not environmentally critical in nature, but which may cause negative environmental impacts because they are located in environmentally critical areas (ECAs)	Project intended to directly enhance environmental quality or address existing environmental problem.	Project not failing under other categories or unlikely to cause adverse environmental impacts.
Category; Waste-energy project including biogas projects	>= 50.0 MW rated capacity	< 50.0 MW rated capacity	-	=< 10.0 MW rated capacity
Documentary Requirements for Proponent	Submission of Environmental Impact Statement (EIS) and issuance of Environmental Compliance Certificate (ECC)	Submission of Initial Environmental Examination (IEE) Report and issuance of Environmental Compliance Certificate (ECC)	Submission of Project Description (PD) and issuance of Certificate of Non-Coverage(CNC)	Submission of Project Description (PD) and issuance of Certificate of Non-Coverage(CNC)

(7) Stakeholders' comments

The stakeholders interviewed by site investigation team are the banana farm owners, farm employees, and the local electric cooperative (Davao del Norte Electric Cooperative, Inc.: DANECO). The disposal of banana stalks is a burden to Banana farm owners because of additional labor expense so they welcome the possibility of stable supply of electric power from the utilization of waste banana stalks. They also expect a more stable purchase price of substandard banana fruits compared with the volatile present selling price. Moreover, the farm employees expect an increase in job opportunities. The power transmission company also welcomes the additional power generation enterprise, most especially from renewable energy, since there is an existing shortage electric power in Mindanao.

In the future, according to the standard procedure concerning environmental impact assessment as indicated in the "REVISED PROCEDURAL MANUAL FOR DENR ADMINISTRATIVE ORDER NO.30 SERIES OF 2003" (DAO 03-30), the public scoping includes the provision of global warming and the outline of CDM, etc., that will be scheduled after establishment of the SPC.

(8) Project implementation structure

The project implementation structure will be as follows.

- Equity participant : Celebrate Life Agriventure Philippines Inc. (CLAVI)
  Foundation for Agrarian Reform Cooperatives in Mindanao, Inc. (FARMCOOP)
  EJ Business Partners Co., Ltd. (EJBP)

- PDD maker : EJ Business Partners Co., Ltd. (EJBP)
- CER buyer: New Energy and Industrial Technology Development Organization (NEDO) (the first candidate)

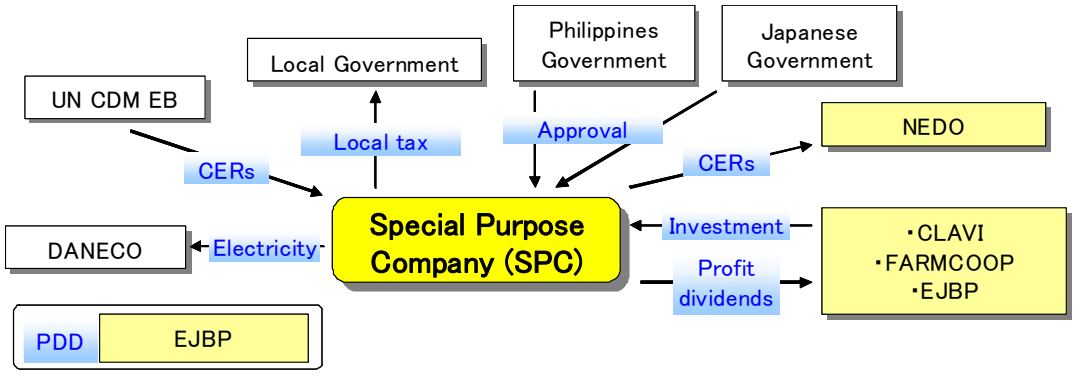

Fig.3 CDM project implementation structure

(9) Financing plan

1) Initial investment: 350 million yen

The breakdown of initial investment needed will be the cost of the pretreatment facility and the digestive facility; 170 million yen, the gas power generation equipment (1MW); 100 million yen, the cost of civil engineering and construction; 30 million yen, and other general expenses; 50 million yen.

2) Cash planning (loan and interest rates)

The 30% (105 million yen) of the initial gross investment of the project (350 million yen) will be raised as the initial capital, and the remaining 70% (245 million yen) will be loaned from the banks etc.

Concrete discussion about cash planning will be carried out; funds will be raised through project financing or a corporate financing from domestic banks such as Philippines Development Bank and One Network Bank in Davao, or main financing banks of each investor.

3) The main setting conditions

The main setting conditions (assumption value in this study) are as follows

- Electricity-sales-to-utilities unit price (6.0 pesos/kWh)
- Power generation capacity (1 MW)
- Borrowing rate of interest (8% of interest rates, one-year deferment and five-year payment)
- Annual cost: 36 million yen/year (materials purchase, maintenance and repair, labor cost, contingency)
- Initial investment: 300 million yen (10% of residual book-value, ten-year depreciation)

- Corporation tax is duty-free for seven years by the application of Renewable Energy Act.
- After seven years, corporation tax rate is 10% from the corporation tax rate tax cut action.
- Local tax is a small sum.
- Also exempted from value-added tax (VAT) by the application of the Renewable Energy Act.
- Acquisition CERs (Certified Emission Reduction) gives priority to negotiation with NEDO(New Energy and Industrial Technology Development Organization) (it is assumed at 10 U.S. dollars/t-CO_2)

(10) Analysis of the project business potential

1) Business balance

The business balance of this project is in Table 7. IRR (Internal Rate of Return) with CERs profit on the sale of 10 U.S. dollars/t-CO_2 is 11.4 %.

Table 7 Business balance (1,000 dollars/t-CO_2)

Item	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Total
Income	931	943	954	964	974	983	991	999	1,006	1,013	9,759
Electricity sale	887	887	887	887	887	887	887	887	887	887	8,873
CERs sale ($10/t-$CO_2$)	44	56	67	77	87	96	104	112	119	126	886
Cost(materials purchase, maintenance and repair, and labor cost)	358	358	358	358	358	358	358	358	358	359	3,582
Depreciation (ten-year depreciation)	270	270	270	270	270	270	270	270	270	270	2,700
Business profit	304	315	326	336	346	355	363	370	378	384	3,477
Interest due	-	196	157	118	78	39	-	-	-	-	588
Profit before tax	304	119	169	219	267	315	363	370	378	384	2,889
Corporation tax								33	33	34	100
Profit after tax	304	119	169	219	267	315	363	338	344	351	2,789

2) The sensitivity analysis of CERs profit

The IRR in the various conditions of CERs price and the result of the sensitivity analysis is shown in Table 8. The analysis clearly shows that, if CERs prices were more than 10 U.S. dollars/t-CO_2, the IRR exceeds the benchmark (9.8%) as discussed later.

Table 8 Sensitivity analysis of CERs

CERs prices （USD/-tCO_2）	0	5	8	10	15	20
Project IRR (%)	8.1	9.7	10.7	11.4	12.8	14.2

3) The standard of investment rating

The benchmark of the investment for this project is determined to be more than IRR9.8%, based on the long-term interest rate of the Development Bank of the Philippines. IRR of this project is 11.4%, and since it exceeds this benchmark, it is judged that this project is feasible.

(11) Demonstration of additionality

This project is classified into small-scale CDM. To demonstrate its additionality, it needs to hurdle one or more investment barriers, the technological barrier, the common practice barrier, and other barriers relevant to project implementation. Since the power generation project (CDM project) using waste banana stalk is a pioneering project in the Philippines, the technological barrier and the common practice barrier exist. The following investment analysis was also carried out as proof of the investment barrier in this study.

In the economical efficiency analysis of this project, IRR without CERs profit on sale is estimated at 8.7%, on the other hand, IRR with CERs profit on sale at 10 U.S. dollars/t-CO_2 is estimated at 11.4%.

- IRR without CERs profit on the sale = 8.1% (seven years: recovery of investment)
- IRR with CERs profit on the sale = 11.4% (six years: recovery of investment)

The investment benchmark for this project is determined to be more than IRR9.8%, based on the long-term interest rate of the Development Bank of the Philippines. Since IRR (8.1%) without CERs profit on the sale is less than the benchmark, the feasibility of this project is judged to be low if this is not a CDM project. As mentioned above, since it is proven that the technological barrier, the common practice barrier and the investment barrier exist, the additionality of this project is proven.

(12) Feasibility and problems of this project

For the commercialization of this project, the technical implementability must be high in order to introduce the methane fermentation technology which has many services overseas (especially Europe). The economical implementability should also be high in order that the economical efficiency of this project will exceed the benchmark. In the future, it is necessary to raise economical efficiency by improving the collection efficiency, reduction of the initial investment and operation and maintenance expenses, negotiation of higher electricity-sales-to-utilities price, etc.

4. Realization of co-benefit in the Philippines

(1) The item for evaluation

The object for the quantification of its environmental pollution control impact is the

"reduction of the quantity of waste disposal."

(2) A baseline / project scenario

This is a power generation project using waste banana stalks which is an agricultural waste residue. By the implementation of this project, the banana stalks which are disposed of now are used effectively, and the quantity of wastes is reduced.

Therefore, the baseline scenario of this project is in the present situation that the banana stalks are open dumped in the farms, if this project will not push through. Meanwhile, the project scenario is the situation that the quantity of wastes is reduced by using waste banana stalks as power generation materials.

With the implementation of this project, since the open disposal of waste is avoided, the use of the banana stalk can be quantified as an environmental pollution control measure, because of the reduction of quantity of waste disposed.

(3) The valuation method of the baseline / monitoring plan

Since the quantity of reduction of waste disposal in this project is equivalent to the quantity of waste banana stalks consumed in the project, in principle the measured data could be use in valuation of the baseline. In monitoring of the quantity of waste disposal, the quantity of waste banana stalk delivered to the power generation plant site is measured by the track scale, etc., as installed in the site.

(4)The calculation process and the result of the trial calculation (quantification) before project implementation

The quantity of waste banana stalks generated from 10 banana farms participants of this project is 27,000 t/year. Therefore, since waste banana stalks from these banana farms stops being generated, the quantity of reduction of waste disposal will be 27,000 t/year.

5. The Result of investigation about contribution to sustainable development

Using not only the waste banana stalks but substandard banana fruits sold cheaply now, leads to stabilization of the selling price and contributes to the sustainable development of the host country.

The same contribution to sustainable development was also conceived in rice husk power generation project in Isabela that Japan Engineering Consultants Co., Ltd. (Predecessor concern of EJBP) had conducted CDM/JI feasibility study of Global Environment Centre Foundation last fiscal year. The project that will effectively utilize the no cost waste will contribute to the stabilization of the local farmers' income. Such a contribution to regional economy would be highly regarded by the Department of Environment and Natural Resources (DENR).