FS Project Title

The pineapple waste to energy project in Mindanao Island, Philippines

Implementer

Eight-Japan Engineering Consultants Inc.

1. The members of this study

In Japan

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

In the Philippines

- Del Monte Philippines Inc.	Local partner

2. Outline of the project

(1) About the project

This Feasibility Study aims to evaluate the feasibility and economic profitability of power generation using pineapple waste instead of the existing fossil fuel. Del Monte Philippines Inc., hereafter called as (“DMPI”) in Mindanao, Philippines annually produces approximately 600,000t of pineapple and other fruits. The pineapple and other fruits are delivered to their own cannery in Cagayan de Oro City where it is processed into canned and juice products. From the processing line, 12,000 m^3/day of wastewater with high organic content are continuously generated during the cannery operation. Also, approximately 270t/day of solid pineapple fruit waste, hereafter called as (“pineapple pulp”), approx. 50t/day solid waste of papaya and other fruits, hereafter called (“other fruit pulps”) are produced. Approximately 50t/day of the pineapple pulp is used as cattle feed for their own farm within the plantation and the remaining pineapple pulp and other fruit pulps ,hereafter called as (“pulps”), are mixed into the soil in the plantation. The wastewater is treated by an existing wastewater treatment facility utilizing the aerobic treatment process in the cannery. Its wastewater treatment facility is in overload condition.

Conceptual diagram of the project is shown in Fig. 1.

In this project, the methane is captured from the anaerobic fermentation of pineapple pulp (220t/day) , other fruit pulps (50t/day) and wastewater (11,000m^3/day). Previously, no recycling or alternative use of wastewater was done. In addition, the methane generation from an aerobic wastewater treatment facility is avoided by improvement of overloaded condition. This project will capture the methane which will be fed into gas generators to produce electricity.

The baseline scenario is, “the power consumption from the public grid which is substituted by power generation from this project" and "methane generation from an aerobic wastewater treatment facility in overload condition". Since pineapple pulp is now being used as soil mixing fertilizer in the DMPI’s plantation, methane avoidance does not apply in the project scenario.

Power generation capacity is projected at ten (10) MW (6 MW using wastewater; 4 MW using fruit pulps). In using methane gas to power the electric generator for the supply of power to DMPI and the local grid, the amount of fossil fuel utilization in the grid will be reduced as well as the amount of greenhouse gas (GHG) emission. It is estimated that GHG emission will be reduced on the average of 106,654t CO_2/year over a period of 10 years (2013-2022) throughout the implementation of the project.

This project was conceived to improve the global environment using collected methane as a clean energy source and therefore contribute to the sustainable development of the project area yielding both environmental and economic benefits.

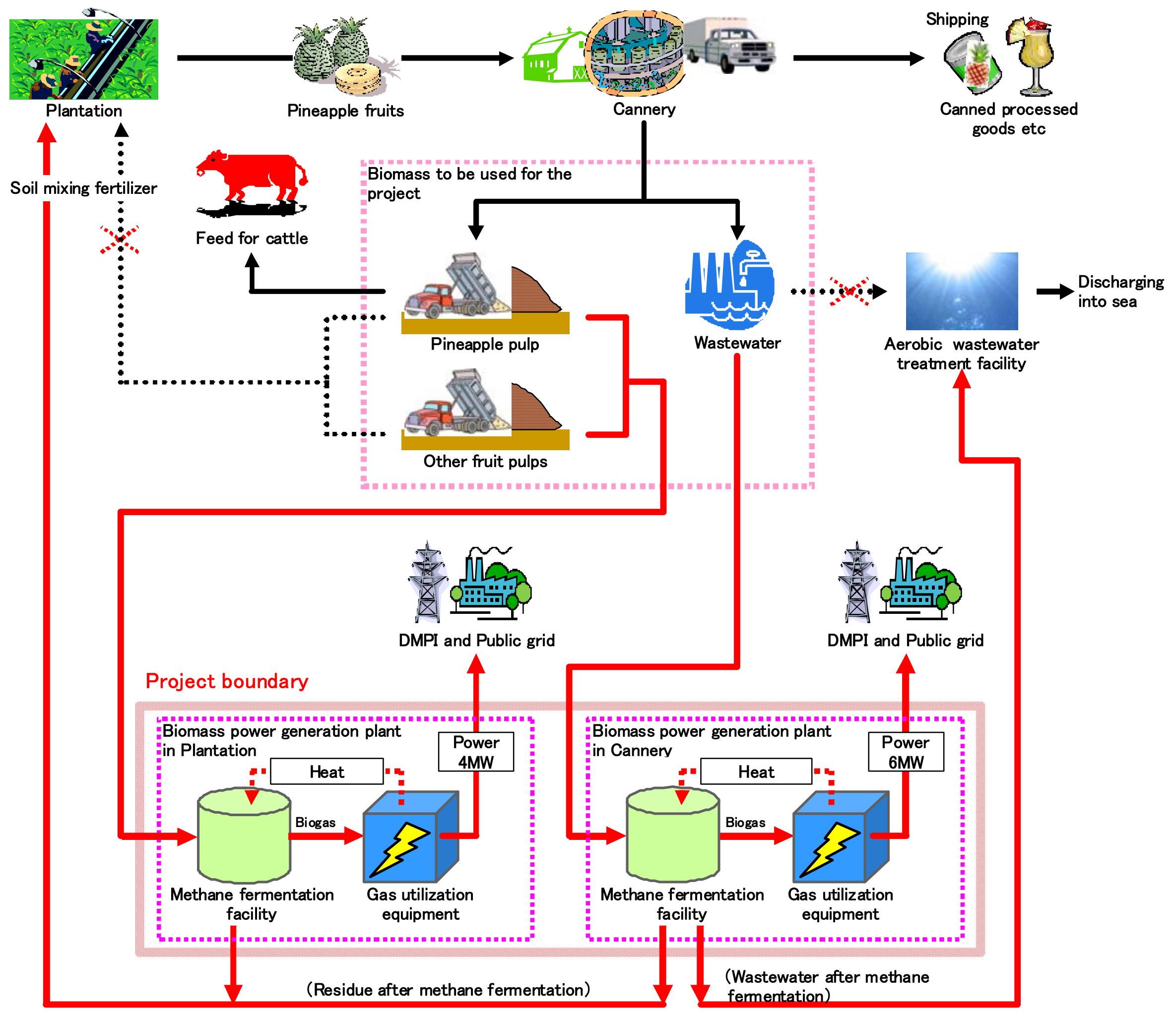


Fig. 1　Conceptual diagram of the project

(2) About application of baseline methodology

AMS-I.D.; Grid connected renewable electricity generation

AMS-III.H.; Methane recovery in wastewater treatment

3. The methods of this study

(1) The subject of this study

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

- Organization of the CDM approval in the Philippine government
- The conditions for approval (days required for approval, similar projects, etc.)

2) The current state of pulps and wastewater generation

- The present condition of the pineapple plantation and the cannery.
- The canning process of fruits
- Pineapple pulp generation
- Amount of other pulps
- Amount of wastewater
- Power supply used in the cannery and in the plantation

3) The current state of treatment and disposal of pulps and wastewater

- The state of treatment and disposal of pulps
- The condition of treatment and disposal of wastewater

4) Analysis of the biomass power generation system

- Determination of practicality of the use of biomass
- The conceptual design of the power generation system

5) 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
- Monitoring methodology and the monitoring plan

6) Evaluation of the environmental impact of the project

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

7) Analysis of the project's business potential

- Estimated cost of 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

8) Project promotion discussion

- Project implementation structure
- Duration of the project activity/crediting period
- Project implementation schedule

9) Investigation about the co-benefit

- The items for evaluation
- The baseline scenario and the project scenario
- The evaluation method and monitoring plan of the baseline

- Trial calculation before project implementation (quantification)

(2) The contents of the study

1) CDM Project Policy in the Philippines

(a) Organization of the CDM approval in the Philippines government

The Philippines signed the Kyoto Protocol on April 15, 1998, and was ratified in November, 2003. By virtue of Executive Order No.320, Series of 2004, the Department of Environment and Natural Resources (DENR) has been designated as the National Authority (DNA: Designated National Authority) for CDM in Philippines. Information from DENR and scanning through DENR's website, the period required for approval of the CDM project in the Philippines, organization and procedure of CDM approval were investigated (Fig. 2 and 3).

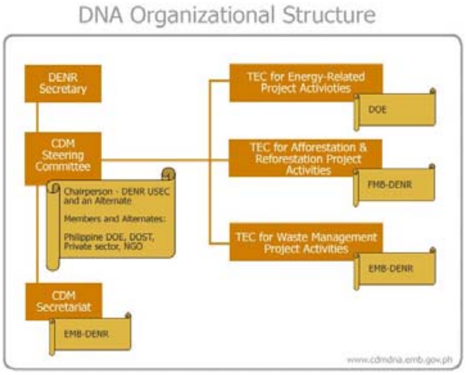


Fig. 2　DNA organizational structure in the Philippines (*)

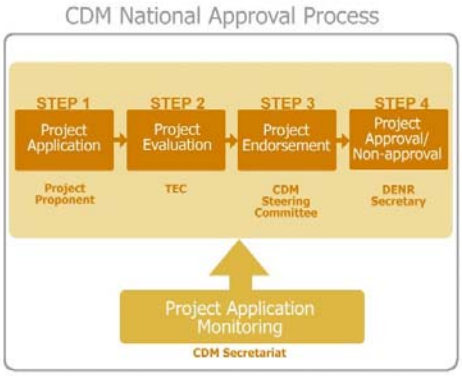


Fig. 3　CDM national approval process in the Philippines (*)

(*)From website of Clean Development Mechanism - Philippines

(b) The conditions for approval (days required for approval, similar projects, etc.)

According to the latest project list approved by the Philippine government as disclosed by the DENR, the letters of approval from the host country were published for 89 projects, 42 of these projects have obtained approval from the CDM executive board (as of end of December, 2010). About 80 percent of these projects are classified into waste management.

There is no similar project using pineapple waste as biomass for power generation that has been registered yet. The use pineapple for one is an additional attraction of the project since pineapple is one of the major fruit products of the Philippines. The innovation introduced by this project would hopefully find approval from the DENR.

2) The current state of pulps and wastewater generation

(a) The present condition of the pineapple plantation and the cannery

The project sites are in DMPI's plantation in Bukidnon province which is near Cagayan de Oro City, and the cannery in Bugo, Cagayan de Oro City. The pineapple harvested in the plantation at Bukidnon province is transported to the cannery in Cagayan de Oro City about 40 km away from the plantation.

(b) Pineapple pulp generation

The average amount of pineapple pulp generated from pineapple processing in the cannery is around 270t/day.

(c) Other fruit pulps generation

In the cannery, papaya and other fruits are also processed in addition to pineapple where pulps are also generated. The amount of the other fruit pulp produced is about 50t/day.

(d) Wastewater generation

The cannery also generates wastewater from pineapple and other fruits pocessing in the cannery. The amount of wastewater generated from the cannery is around 11,000m^3/day.

(e) BOD of wastewater

DMPI is monitoring regularly Biochemical Oxygen Demand (BOD) which is an index of contamination for water quality. The average BOD value of wastewater for every year generated in the cannery is around 8,000mg/L.

(f) Use of power supply in the cannery and in the plantation

Annual power consumption is about 1.5 MW/year in the plantation, and 7-7.5 MW/year in the cannery which are all purchased from the local public grid.

3) The state of treatment and disposal of pulps and wastewater

(a) The state of treatment and disposal of pulps

The fruit pulps generated from the cannery are hauled back to the plantation. About 50t/day of the pineapple pulps is used as cattle feed for their own farm within the plantation and the remaining pulps are mixed into the soil at the plantation. Since the pulps have high moisture content and their balance of nitrogen, phosphorus and potassium is not ideal, they are not good as compost materials.

(b) The state of treatment and disposal of wastewater

The wastewater and other factory effluents are processed at the wastewater treatment facility in the cannery and are discharged into the sea. Inflow amount and inflow BOD of wastewater have exceeded the design values, and it is in an overload condition.

Design specification

- Design inflow amount of wastewater : 8,175 m^3/day
- Design inflow of wastewater : BOD = 3,000 mg/L

4) The study of the power generation system

Pulps and wastewater are the principal biomass materials and that methane fermentation and their collection from the biomass will be investigated in this study.

(a) Determination of the use of biomass.

After discussion with DMPI, the kind and amount of the biomass which will be used in the project are summarized in Table 1.

Table 1　Kind and amount of biomass to be used for the project

Kind of biomass to be used	Amount to be used
Pineapple pulp	220 t/day
Other fruit pulps	50t/day
Wastewater	11,000 m^3/day

(b) The conceptual design of the power generation system

Methane is collected from the fermentation of pulps and wastewater produced. The biogas will be used as fuel to produce electric power. Since the pulps and wastewater will have different characteristics, different methane fermentation systems will be adopted. Electric power generation from biomass that will use wastewater from the cannery and pulps from the plantation is recommended.

Power generation by using pulps

The power generating facility using biomass (pulps) will be built at the plantation instead of the cannery. Since pulps are solids, the dry methane fermentation method will be adopted. The outline of the power generation system is shown below.

i) Fermentation method

Dry methane fermentation method

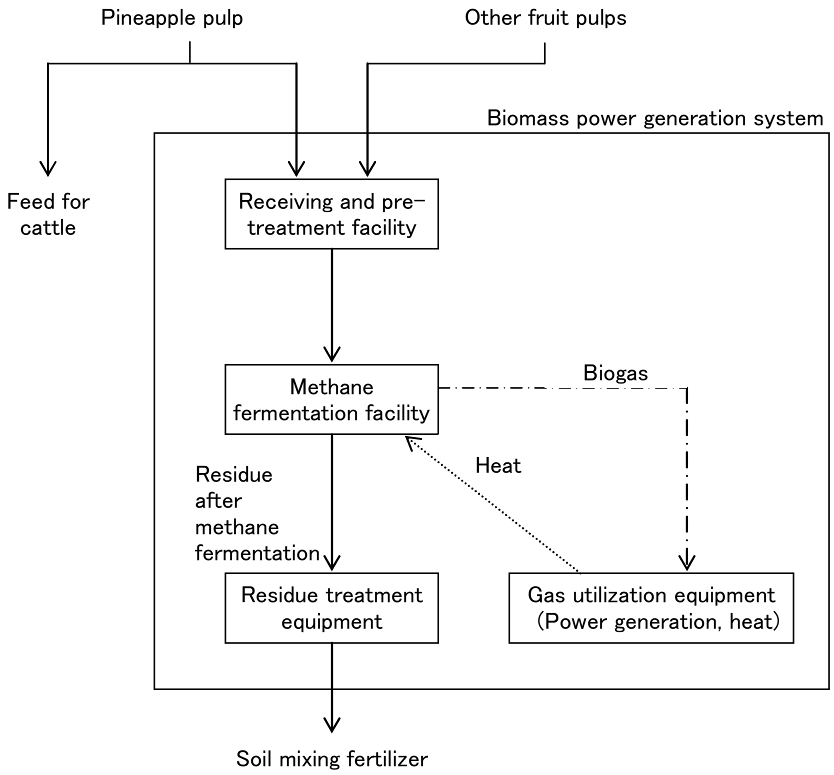
ii) System components

The system consists of a receiving and pre-treatment facility, methane fermentation facility, gas utilization equipment (power generation, heat) and residue treatment equipment. The power generated from this system is projected to be 4 MW.

iii) Simplified process flow

The biogas power generation concept of the system is shown in Fig. 4.

- The pulps will be transported from the cannery to the plantation and delivered to the facility.
- After pre-treating (crushing, mixing, moisture adjustment), the pulps will be added to the methane fermentation digester.
- Methane fermentation will result from the activity of methanogenic bacteria in the methane fermentation digester.
- Electric power and heat are produced from the biogas containing methane through the use of power generation and heat equipment through the pretreatment of dehumidification, desulfurization, etc.
- The generated electricity will supply the requirements of DMPI’s plantation and the excess generated power will be sold to the local public grid. The heat from the generation of electric power will be recycled for use in warming the methane fermentation equipment, among others.
- The residue, after methane fermentation, is dried and mixed into soil of the plantation.



【Project site : in Plantetion】

Fig. 4　Biomass power generation system using pulps

Power generation by using wastewater

Wastewater from the cannery operations will be utilized for power generation through the production of methane and used as an alternative fuel to run a generator that will produce electricity. The wastewater after fermentation will be treated at the aerobic wastewater treatment facility. The quality of the water at the treatment plant improves and eventually addresses the issue of overload condition of the treatment plant.

i) Fermentation method)

Wet methane fermentation method

ii) System components

The system consists of a receiving facility, methane fermentation facility and gas utilization equipment (power generation, heat). About 6 MW of power is projected to be generated by this system.

iii) Simplified process flow

The processes involved in the system are shown in Fig. 5.

- The wastewater that passes through a screen in the aerobic wastewater treatment facility will be collected and added into the methane fermentation digester.
- Methane fermentation occurs through the activity of methanogenic bacteria in the methane

fermentation digester.

- Electric power and heat are produced from the biogas containing methane through the use of power generation and heat equipment through the pretreatment of dehumidification, desulfurization, etc.
- The generated electricity will supply the requirements of DMPI and the excess generated power will be sold to the local public grid. The heat from the generation of electric power will be recycled for use in warming the methane fermentation equipment, among others.
- The wastewater after methane fermentation is again processed at the aerobic wastewater treatment facility and is discharged into the sea.
- Any residue, after methane fermentation, of the wastewater collected at the treatment facility is dried and mixed into the soil of the plantation.

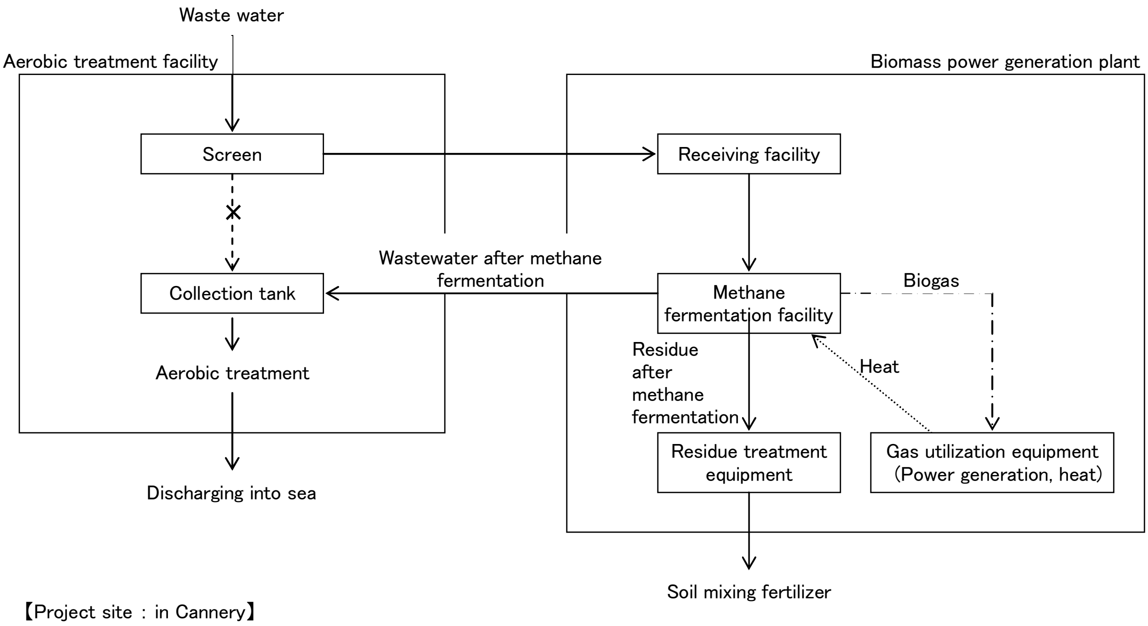


Fig. 5 Biomass power generation system using wastewater

In this project, the overload condition of the wastewater treatment facility will be improved through the methane fermentation of the wastewater.

4. 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, electric power from the public grid will be substituted by the generated power from alternative sources that involve treatment of pulps and wastewater. The AMS-I.D. (Grid connected renewable electricity generation) and the AMS-III.H. (Methane recovery in wastewater treatment) served as guides in quantifying the benefit of the project as shown in the calculations in the succeeding sections.

2) Project boundary (SCOPE OF THE PROJECT)

The scope of this project will only involve that part shown in Fig. 1 where a “biomass power generation plant will be built.”

3) Baseline scenario

Only a part of the total volume of pulps is used as cattle feed while the rest are mixed in the soil within the plantation. Thus, it is deemed not used effectively considering that there are alternative uses for these pulps such as for the production of methane (as a fuel source) to run a generator to produce electricity.

The power requirements of DMPI in its plantation and cannery facility are supplied by a local electric distribution company whose supply in turn is sourced from the national grid. Its wastewater treatment facility is in overload condition where the inlet amount and inlet BOD of wastewater have exceeded the design values.

The baseline scenario is, “the power consumption from the public grid which is substituted by power generation from this project" and "methane generation from the water treatment facility in overload condition". The project set-up will involve anaerobic fermentation of pulps and wastewater and production of biogas containing methane which will then be used as an alternate fuel to generate power. Power generated by this project will be sold to DMPI and the local grid through the local power utility company thereby reducing the use of fossil fuel for power generation. Other benefits of this project include improvement of the wastewater treatment facility where its overload condition is addressed or improved and that the methane produced will be put into better use.

Not only wastewater but the pulps can also be used to generate methane which will be used as an alternative fuel for power generation. There is no other case in the Philippines in which these kinds of biomass are utilized effectively and converted to power.

4) Baseline emission

The quantity of baseline emission of this project is calculated from (1) the quantity of baseline emission from the electric power which will be replaced by this project and (2) the amount of carbon dioxide (CO_2) during the aerobic treatment at the wastewater treatment facility.

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

$BE_{y\ (AMS\text{-}I.D.)} = EG_y \times EF_y$

Parameter	Content	Value	Calculation basis
$BE_{y(AMS\text{-}I.D.)}$	Baseline emission in year y (tCO_2/year)	54,451	＝76,800MWh/year×0.709t-CO2/MWh
EG_y	Quantity of net electricity supplied to the grid as a result of the implementation of the CDM project activity in year y (MWh/year)	76,800	＝10MW×24hours×320days
EF_y	CO2 emission factor of the grid in year y (tCO_2/MWh)	0.709	(Mindanao grid)

(b) Methane generated from the DMPL wastewater facility (AMS-III.H.)

$BE_{y\ (AMS\text{-}III.H.)} = \{BE_{power,y} + BE_{ww,treatment,y} + BE_{ww,dischaege,y}\}$

Parameter	Content	Value	Calculation basis
$BE_{y(AMS\text{-}III.H.)}$	Baseline emission in year y (tCO_2/year)	84,257	=5,990+78,004+263
$BE_{power,y}$	Baseline emission from electricity or fuel consumption in year y (tCO_2/year)	5,990	=1.1MW×320days×24hours×0.709
$BE_{ww,treatment,y}$	Baseline emission of wastewater treatment systems affected by the project activity in year y (tCO_2/year)	78,004	=4,015,000m3/year×0.0139t/m3×0.3×0.25tCH4/tCOD×0.89×21tCO2/tCH4
$BE_{ww,discharge,y}$	Baseline methane emission from degradable organic carbon in treated wastewater dishcharged into sea (tCO_2/year)	263	=4,015,000m3/year×21tCO2/tCH4×0.25tCH4/tCOD×0.89×0.00014t/m3×0.1

$BE_{ww,treatment,y} = Q_{ww,y} \times COD_{removed,BL} \times MCF_{ww,treatment,BL} \times B_{o,ww} \times UF_{BL} \times GWP_{CH4}$

Parameter	Content	Value	Calculation basis
$Q_{ww,y}$	Volume of wastewater treated in baseline wastewater treatment system in year y (m^3/year)	4,015,000	=11,000m3/day×365days
$COD_{removed,BL}$	Chemical oxygen demand removed by baseline treatment system in year y (t/m^3)	0.0139	=0.014t/m3×99%
$MCF_{ww,treatment,BL}$	Methane correction factor for baseline wastewater treatment system (－)	0.3	(AMS-Ⅲ.H./Ver.15) Aerobic trematment, overloaded
$B_{o,ww}$	Methane producing capacity of the wastewater (tCH_4/tCOD)	0.25	(AMS-Ⅲ.H./Ver.15)
UF_{BL}	Model correction factor to account for model uncertainties (－)	0.89	(AMS-Ⅲ.H./Ver.15)
GWP_{CH4}	Global Warming Potential for methane (tCO2/tCH_4)	21	(AMS-Ⅲ.H./Ver.15)

$BE_{ww,discharge,y} = Q_{ww,y} \times GWP_{CH4} \times B_{o,ww} \times UF_{BL} \times COD_{ww,discharge,BL} \times MCF_{ww,BL,discharge}$

Parameter	Content	Value	Calculation basis
$COD_{ww,discharge,BL}$	Chemical oxygen demand of the treated wastewater discharged into sea in the baseline situation in the year y (t/m^3)	0.00014	=0.014t/m3×(100−99)%
$MCF_{ww,BL,discharge}$	Methane correction factor based on discharge pathway in the baseline situation of the wastewater (－)	0.1	(AMS-Ⅲ.H./Ver.15) Discharge of wastewater to sea

(c) Total baseline emission

Parameter	Content	Value	Calculation basis
$BE_{y\ (total)}$	The total of baseline emission (tCO_2/year)	138,708	=54,451+84,257

(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 amount of carbon dioxide (CO_2) in the anaerobic treatment from the wastewater treatment system used for the project.

(a) Consumption of electricity through the project activity (AMS-I.D.)

$PE_{y\ (AMS\text{-}I.D.)} = PG_y \times EF_y$

Parameter	Content	Value	Calculation basis
$PE_{y(AMS\text{-}I.D.)}$	Project emission in year y (tCO_2/year)	2,723	＝3,840MWh/year×0.709t-CO2/MWh
PG_y	Emissions from electricity consumption through the project in the year y (MWh/year)	3,840	＝0.5MW×24hours×320days
EF_y	CO2 emission factor of the grid in year y (tCO_2/MWh)	0.709	(Mindanao grid)

(b) CO_2 from the wastewater treatment system used for the project (AMS-III.H.)

$PE_{y\ (AMS\text{-}III.H.)} = \{PE_{power,y} + PE_{ww,treatment,y} + PE_{ww,dischaege,y} + PE_{fugitive,ww,y}\}$

Parameter	Content	Value	Calculation basis
$PE_{y(AMS\text{-}III.H.)}$	Project emission in year y (tCO_2/year)	29,331	＝6,806＋50＋22,475
$PE_{power,y}$	Emissions from electricity consumption for the wastewater treatment system in the project in the year y (tCO_2/year)	6,806	＝1.25MW×320days×24hours×0.709
$PE_{ww,treatment,y}$	Methane emissions from wastewater treatment systems affected by the project activity in year y (tCO_2/year)	0	＝4,015,000m3/year×0.0021t/m3×0.0×0.25×1.12×21tCO2/tCH4
$PE_{ww,discharge,y}$	Methane emissions from degradable organic carbon in treated wastewater in year y (tCO_2/year)	50	＝4,015,000m3/year×21tCO2/tCH4×0.25tCH4/tCOD×1.12×0.00002t/m3×0.1
$PE_{fugitive,ww,y}$	Fugitive emissions through capture inefficiencies in the anaerobic wastewater treatment systems in the year y (tCO_2/year)	22,475	＝(1－0.9)×4,015,000m3/年×0.25tCH4/tCOD×1.12×0.0119t/m3×0.8×21tCO2/tCH4

$PE_{ww,treatment,y} = Q_{ww,y} \times COD_{removed,PJ,k} \times MCF_{ww,treatment,PJ,k} \times B_{o,ww} \times UF_{PJ} \times GWP_{CH4}$

Parameter	Content	Value	Calculation basis
$COD_{removed,PJ,k}$	Chemical oxygen demand removed by project wastewater treatment system affected by the project activity in year y (t/m^3)	0.0021	＝0.014t/m3×(100－85)%×99%
$MCF_{ww,treatment,PJ,k}$	Methane correction factor for project wastewater treatment affected by the project activity (－)	0.0	(AMS-Ⅲ.H./Ver.15) anearobic treatment, well managed
UF_{PJ}	Model correction factor to account for model uncertainties (－)	1.12	(AMS-Ⅲ.H./Ver.15)

$$PE_{ww,discharge,y} = Q_{ww,y} \times GWP_{CH4} \times B_{o,ww} \times UF_{PJ} \times COD_{ww,discharge,PJ} \times MCF_{ww,PJ,discharge}$$

Parameter	Content	Value	Calculation basis
$COD_{ww,discharge,PJ}$	Chemical oxygen demand of the treated wastewater discharged into the sea in the project scenario in year y (t/m^3)	0.00002	＝0.014t/m3×(100-85)%×(100-99)%
$MCF_{ww,PJ,discharge}$	Methane correction factor based on the discharge pathway of the wastewater in the project scenario (－)	0.1	(AMS-Ⅲ.H./Ver.15) Discharge of wastewater to sea

$$PE_{fugitive,ww,y} = (1 - CFE_{ww}) \times Q_{ww,y} \times B_{o,ww} \times UF_{PJ} \times COD_{removed,PJ} \times MCF_{ww,treatment,PJ} \times GWP_{CH4}$$

Parameter	Content	Value	Calculation basis
CFE_{ww}	Capture efficiency of the biogas recovery equipment in the wastewater treatment systems (－)	0.9	(AMS-Ⅲ.H./Ver.15)
$COD_{removed,PJ}$	The chemical oxygen demand removed10 by the treatment system of the project activity equipped with biogas recovery in the year y (t/m^3)	0.0119	＝0.014t/m3×85%
$MCF_{ww,treatment,PJ}$	Methane correction factor for project wastewater treatment syst emequipped with biogas recovery equipment (－)	0.8	(AMS-Ⅲ.H./Ver.15) anearobic reactor without methane recovery

(c) Total project emission

Parameter	Content	Value	Calculation basis
$PE_{y\ (total)}$	The total of baseline emission (tCO_2/year)	32,054	＝2,723＋29,331

(3) Monitoring plan

Based on AMS-I.D and AMS-III.H, a plan which can collect and record required monitoring data synthetically is adopted. The monitoring system is shown in Fig. 6 and the monitoring plan is shown in Table 2.

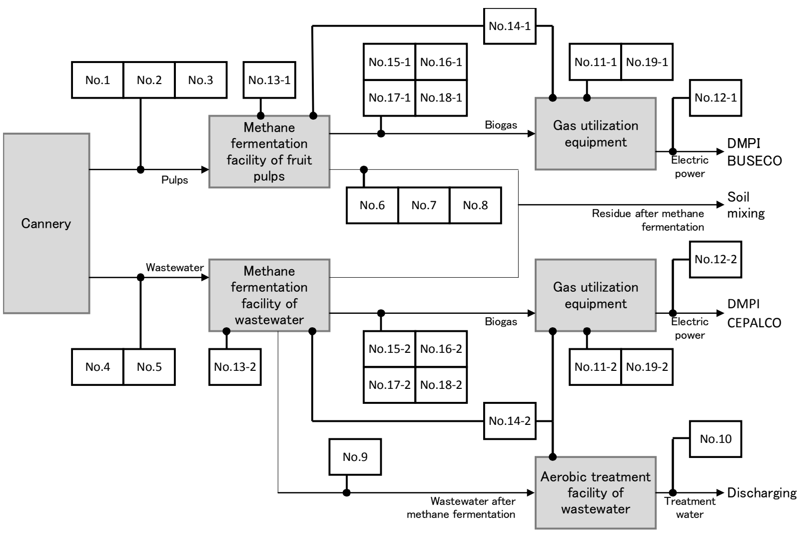


Fig. 6　Monitoring system of the project scenario

Table 2 Monitoring items and frequency of measurements

No.	Item	Content	Measurement frequency
1	$Q_{sw,y}$	Amount of pulps	1 time/day
2	$M_{sw,y}$	Moisture content of pulps	1 time/month
3	$COD_{sw,untreated,y}$	COD of pulps	1 time/month
4	$Q_{ww,y}$	Volume of wastewater	1 time/day
5	$COD_{ww,untreated,y}$	COD of wastewater	1 time/month
6	$Q_{sw,treated,y}$	Amount of residue of pulps after methane fermentation	1 time/day
7	$M_{sw,treated,y}$	Moisture of residue of pulps after methane fermentation	1 time/month
8	$COD_{sw,treated,y}$	COD of residue of pulps after methane fermentation	1 time/month
9	$COD_{ww,treated,y}$	COD of wastewater after methane fermentation	1 time/month
10	$COD_{ww,discharge,y}$	COD wastewater discharged	1 time/month
11	EG_{y}	Amount of electric power production	1 time/day
12	$EG_{facility,y}$	Annual electric power production	1 time/day
13	H	Operation time	1 time/day
14	EC_{y}	Amount of power supplies to the grid	1 time/month
15	$BG_{burnt,y}$	Amount of biogas generation	1 time/day
16	$W_{CH4,y}$	Methane concentration in biogas	1 time/day
17	P	Pressure of biogas	1 time/day
18	T	Temperature of biogas	1 time/day
19	FE	Flare efficiency	Opportune

(4) Greenhouse gas emission reduction

The quantity of greenhouse gas (GHG) emission reduction expected in this project is estimated as follows (Table 3).

Table 3 Greenhouse gas emission (GHG) reduction through this project

(Unit： t CO_2/year)

Operation year	Baseline emission			Project emission			Emission reduction
	Grid electric power alternative	Methane generated from the aerobic treatment facility	Total baseline emission	Consumption of electricity through the project activity	CO2 from the wastewater treatment system used for the project	Total project emission	
2013	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2014	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2015	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2016	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2017	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2018	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2019	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2020	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2021	54,451	84,257	138,708	2,723	29,331	32,054	106,654
2022	54,451	84,257	138,708	2,723	29,331	32,054	106,654

(5) Duration of the project activity / crediting period

The project will start in 2011. The target commencement of commercial operation is on January 2013. The crediting period will be ten years from 2013 to 2022.

(6) Environmental impacts and other indirect influence

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. Since power generation capacity is projected at 4 MW (using pulps) and 6 MW (using wastewater) , both biomass power generation plants do not need enforcement of Environmental Impact Statement (EIS). It will only require submission of an Initial Environmental Examination (IEE) Report for the issuance of Environmental Compliance Certificate (ECC).

The environmental impacts of the project during its implementation are air pollution coming from the exhaust gas of the engine, plant noise and the dust during the construction stage, among others. However, these can be minimized by doing high level exhaust management and the operation and maintenance of suitable apparatus.

(7) Stakeholders' comments

DMPI, which is the materials donor of pulps and wastewater from the cannery, and the Cagayan Electric Power and Light Company, Inc., hereafter referred to as ("CEPALCO") as the local public utility that were interviewed in this study.

DMPI has a positive evaluation on this project because it maximizes the use the pulps and wastewater which are currently not used effectively.

CEPALCO is a power distribution company that purchases electric power from the National Power Corporation, hereafter referred as ("NPC"), and distributes to consumers. In Mindanao, since power supply is insufficient, CEPALCO expects that the implementation of this project would help alleviate this shortage especially in Cagayan de Oro City.

In the future, according to the standard procedure on environmental impact assessment as indicated in the "INTERIM GUIDELINES ON THE CONDUCT OF STAKEHOLDER'S CONSULTATION UNDER DAO 2005-17", public scoping includes the provision of global warming and the outline of CDM, among others and will be scheduled after establishment of the Special Purpose Company (SPC).

(8) Project implementation structure

The project implementation structure is shown in Fig. 7.

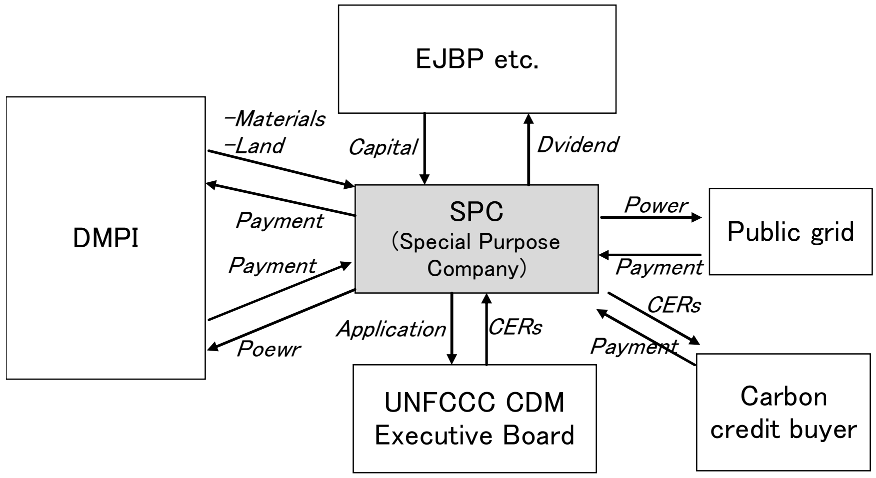


Fig. 7　Project Structure

(9) Financing plan

1) Initial investment

The amount of initial gross investment is estimated at 3 billion yen (1,210 million yen: use of pulps, 1,790 million yen: use of wastewater).

2) Cash planning (loan and interest rates)

The 30% of the initial gross investment of the project equivalent to approximately 900 million yen will be raised as the initial capital and the remaining 70% equivalent to 245 million yen will be loaned from banks and other institutions.

Concrete discussion about cash planning will be carried out; funds will be raised through project financing or corporate financing from domestic banks such as Development Bank of the Philippines, other local banks or the main financing banks of investors.

3) Financial assumptions

The main assumptions in this study are as follows:

- Electricity sales-to-utilities unit price: 6.0 pesos/kWh
- Power generation capacity: 10 MW
- Borrowing rate of interest: 8% (one-year deferment and five-year payment)
- Annual cost: 230 million yen/year (materials purchase, maintenance and repair, labor cost, contingency)
- Plant investment: 2,700 million yen (10% of residual book-value, ten-year depreciation)
- Corporation tax for seven years: Duty-free by the application of Renewable Energy Act
- Corporation tax rate in the 8th and afterwards: 10% from the corporation tax rate tax cut action
- Local tax: Small sum
-Value-added tax: Duty-free by the application of Renewable Energy Act
- Acquisition CERs (NEDO - New Energy and Industrial Technology Development Organization has priority to negotiate sales): 12 U.S. dollars/t-CO_2

(10) Analysis of the project business potential

1) Business balance

IRR (Internal Rate of Return) with CERs profit at the price of 12 U.S. dollars/tCO_2 is 12.1 %.

2) The sensitivity analysis of CERs profit

The result of the sensitivity analysis showing the IRR in the various conditions of CERs price is clearly shown that CERs prices greater than 10 U.S. dollars/tCO_2, the IRR would exceed the benchmark of 11.0%. The importance of this result is discussed in later sections.

3) The standard of investment rating

The likelihood that institutions will invest into this project depends on the comparison of the IRR and some other benchmarks such as loan interest on loans in the host country among others.

In the Philippines, the long-term interest rate ranges from 7.8% to 11%. Hence for this project, the benchmark is set on the high side to 11%. For this project, if the IRR is less than the above benchmark, the project may not be economically feasible. Conversely, if the IRR will be higher than the benchmark, then the feasibility of the project is enhanced.

Applying such rule of thumb to get at least an intial idea on the feasibility of the project, if the CDM framework is not adopted where no profit from CER sales is credited, the project IRR (around 6.6%) will be less than the benchmark, it is unlikely that the project will be feasible. However, if the CDM framework is adopted and CER sales are priced at 12USD/tCO_2, the IRR (around 12.1%) will exceed the abovementioned benchmark and the project may be deemed feasible.

(11) Demonstration of additionality

This project is classified as a 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.

Existence of the investment barrier

In the economic efficiency analysis of this project, great improvement is found in comparing the IRR without CERs profit on sale and IRR with CERs profit on sale at 12 U.S. dollars/tCO_2. The potential of this project to be classified as a CDM project is high.

- IRR without CERs profit on the sale = 6.6% (eight years: recovery of investment)
- IRR with CERs profit on the sale = 12.1% (six years: recovery of investment)

The investment benchmark for this project is determined to be 11.0%, based on the long-term interest rate of the Development Bank of the Philippines. Since the IRR (6.6%) 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. Otherwise, as shown in the previous section, this project may be feasible if this will become a CDM project and CER sales will be at 12 U.S. dollars/tCO_2.

Existence of the technological barrier and the common practice barrier

This potential CDM project will be the first of its kind in the Philippines where pulps will be used to produce an alternative fuel source for power generation. As such, investment, technological and common practice barriers exist. Thus, the additionality of this project is proven.

(12) Feasibility and problems of this project

1) Technical problem

To determine whether the project is technically feasible, actual trials or experiments will be conducted using real samples, i.e., pulps and wastewater. Detailed examination of all parameters such as sample injection method, number of stay days among others will be carried out.

2) Economic problem

The economic viability of the project should be high for this to be feasible. In the future, as this technology evolves, it is necessary to increase its economic viability by making improvements in various stages and parameters of the project. For example, reduction of initial capital cost, reduction in operating and maintenance expenses, higher electricity price (sales to utilities) and many other parameters. Another important parameter that is worth special mention is the foreign exchange risk. This is especially true considering the repercussions in the instability of the US dollar as demonstrated during the previous monetary crisis that greatly affected the global economy but particularly Asia in 1997.

3) An institutional problem

The price of CERs-sales negotiation and the price of the electricity-sales contract negotiation through the Renewable Energy Law greatly influence the business potential of this project. The incentive granted to renewable energy is a global trend. It is expected that maintenance and further improvement in the implementation of the renewable energy law is forthcoming although risks such as policy changes that affect implementation especially in the Philippines should be taken into consideration.

4) CDM registration period

A protracted registration period and approval process by the CDM Executive Board may place some uncertainty into the full implementation of this project. Hence, the proper presentation of valid results into the feasibility of this project, based on previous experience in other countries and the actual trials or experiments done will hopefully allow for the smooth endorsement of this project by the Executive Board.

5. Validation (Pre-validation)

(1) Outline of the Pre-validation

1) Major reviewed items

- Applicability of baseline methodology
- Demonstration of the Additionality
- Applicability of monitoring methodology
- Stakeholders'　comments

2) Major suggested items

The following are the major items pointed out by the Designated Operational Entity (DOE).

In response to the items pointed out as followings, corrections such as supplementing PDD entries concerning locations which can be corrected at this time were done. Furthermore, we submitted the Clarification for the applicability of the methodology AMS III.H to the CDM-EB.

(a) Conclusion

As a result of the initial review of the PDD, there are no any clearly fatal issues for the applicability and interpretation of this project as a CDM project.

(b) Applicability of baseline methodology

The application of AMS I.D is sufficiently justified.

Though the clause 1 (a) of the methodology AMS III.H is applicable for “substitution” of an aerobic waste water treatment systems with anaerobic systems, the project activity is described to be “introduction” of a new anaerobic treatment system to an existing aerobic treatment system. DOE recommended the Clarification to CDM-EB due to the difficulty of judgment of the applicability.

(c) Additionality

For the investment barrier, it needs to be demonstrated that the financial analysis considers all applicable incentives for the project activity, including the Japanese government fund support available for the project. Furthermore, sensitivity analysis regarding with IRR calculation condition would be mentioned in detail.

(d) Stakeholders’ comments

Local stakeholders consultation process needs to be completed before the validation process and to be further considered about the stakeholder other than the DMPI.

(2) Background to exchanges with the DOE

Pre-validation has been conducted by DOE during the period from January 14 to January 27, 2011.

In response to the items pointed out above in the pre-validation report, the answers were received from DOE toward our clarifications. In accordance with their reply, a part of PDD was revised in correct and submitted the Clarification for the applicability of AMS-III.H to the CDM-EB.

6. Results of study of co-benefit

(1) The item for evaluation

The quantification item of the effect of the environmental pollution control measure in this study is shown below.

- Reduction of the chemical oxygen demand (COD) load flowing into the plantation
- Reduction of the COD load flowing into the aeroic wastewater treatment facility in overload

(2) A baseline / project scenario

1) Reduction of the COD load which flows into the plantation

Pulps from the cannery are currently left untreated and are simply mixed into the soil. The COD load originates from pulps and the implementation of this project would allow for the extraction of the methane generated from the fermentation of the pulps before the used pulps are mixed with the soil. Therefore, the baseline state is "pulps are mixed with the soil" and the project state is "pulps after methane fermentation are mixed with the soil."

2) Reduction of the COD load flowing into the aerobic wastewater treatment facility in overload

At present, the wastewater treatment facility is in overload condition where the design values are often exceeded in terms of water quality. The improvement in wastewater quality, after methane production from this project, would allow the enhancement of the quality of water thereby resulting in the reduction of the COD load. This wastewater will then be treated at the treatment plant before it is discharged to the sea. Therefore, the baseline state is "wastewater is treated in the aerobic wastewater treatment facility" and the project state is "wastewater after methane fermentation is treated in the aerobic wastewater treatment facility."

(3) Evaluation method of the baseline / monitoring plan

1) Evaluation method of the baseline

As a rule, actual measurement data collected will be used for evaluation of the baseline conditions.

2) Monitoring plan

(a) Reduction of the COD load which flows into the plantation

Several parameters will be monitored and actual measurements taken such as weight, moisture content and COD of the pulps among others after methane fermentation and used power generation will be taken.

(b) Reduction of the COD load flowing into the aerobic wastewater treatment facility in overload

Among the parameters to be strictly monitored and measured are the inflow and COD of the wastewater after fermentation and after power generation.

(4)The calculation process and the result of the property (quantification)

1) Reduction of the COD load which flows into the plantation

Calculation conditions

- Amount of pulps used in the project: 270 t/day
- COD of pulps: 1,300 g/kg (dry)
- Moisture content of pulps: 78%.
- COD decomposition rate of pulps: 85%

Therefore,

COD load reduction

= 270 t/day x (100% - 78%) x 1,300 g/kg x 70% x 365 day

= 19,730 tCOD / year

2) Reduction of the COD load flowing into the aerobic wastewater treatment facility in overload

Calculation conditions

- Amount of wastewater used in the project: 11,000 m^3/day
- COD of wastewater: 14,000 mg/L
- COD decomposition rate of wastewater: 85%.

Therefore,

COD load reduction

= 11,000 m^3/day x 1,400 mg/L x 85% x 365 day

= 47,779 tCOD / year

7. The Result of investigation about contribution to sustainable development

The implementation of this project will not only lead to the reduction of GHG emission of the host country but also contribute to the reduction in the share of fossil fuel to the power generation mix thereby contribute to the reduction of air pollution as a result of the reduced fossil fuel use, address issues regarding the stability of the local power supply and creation of job opportunities during the construction period and operations period of the fermentation and power plants.