2007 CDM/JI Feasibility Study

Survey of the Efficient Piggery Biogas Utilization Business in Rio Grande do Sul, Brazil

(Digest Version)

Report

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The Japan Research Institute, Limited.

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Chapter 1　　Outline of the Host Country, Brazil

1.1　General Information

Brazil is a federal republic that consists of twenty six states and one federal district (the capital, Brasilia). It is a large South American country with a total population of 186.77 million people (as of 2006). Brazil has gone through a stagnation period due to inflation, but its GDP is currently in the top ten in the world and it is a fast-growing economic power.

1.2　The Livestock Industry

Brazil is one of the world's leading livestock producers and exporters. The production volume and export volume of the country's livestock industry are increasing at a fast rate because of increasing demands for meat within the country as well as overseas, especially in Asian countries, and improving production and managerial skills, low-priced feed, and so on. The livestock industry has not only affected the production of meat, but has also spread to peripheral industries such as the processing industry and the leather industry, and this has led to increased employment. In particular, the broiler chicken industry is a field in livestock that has shown the highest growth rates. The production volume has increased by eleven times and the export volume has increased by twenty five times since the 1970's, and now, the production volume accounts for 15% in the entire world.

Diagram 1　Production Volume of Brazil's Major Livestock Products

Year		1992	1997	2001	2005
Beef	Production Volume	5,069	6,444	6,996	7,817
Pork	Production Volume	1,190	1,540	2,730	2,708
Chicken	Production Volume	2,727	4,461	6,736	9,297

(units) thousand tons

1.3　CDM Businesses in Brazil

The DNA (Designated National Authority) that is in charge of approving CDM businesses within Brazil is the CIMGC (Interministerial Commission on Global Climate Change), which is in charge of policies concerning climate changes, and is composed of ministries and agencies that are headed by the Ministry of Science and Technology.

A characteristic of the approval of CDM projects in Brazil is that the amount of contributions that are made to economic growth based on concern for Brazil's social problems is taken into consideration. For example, contributions to employment rates, profit sharing, technical

developments, etc. are included in PDDs (Project Design Documents) as conditions for the approval of a project. Another condition is that an office of a DOE (Designated Operational Entity), which conducts third-party approval of the project, is established in Brazil.

As of the middle of January 2008, there are a hundred and fifteen CDM businesses that are registered in Brazil, and the total reduction volume is 17.5 million [t-CO_2/year]. The actual number is even larger when projects that are under review for registration, those that are under review for validation, and those that have not been discovered yet are included. However, of those that have been registered with the U.N., there are only twenty that Japan has made investments in.

In addition, there are a hundred and seventeen CDM businesses that are under review for validation in Brazil as of the middle of January 2008, and there are pipelines that equal the number of projects that have already been registered through executive CDM boards. There are not large-scaled projects that exceed a million tons in yearly reduction volumes, but there is an increase of small-scaled CDM ventures that amount to only tens of thousands of tons. Furthermore, there is also the characteristic where there are many unilateral CDM projects with no investing countries that are under review for validation.

1.4 The Present State of Brazil's Pig Raising Industry

Brazil produces as well as consumes pork on a worldwide scale. Brazil's pork production was forecasted at 2.88 million tons in 2007. There was a great increase in Brazil's production of pork for export and the pig raising industry for export continues to grow.

The southern, southeastern, and midwestern areas are the main pig raising areas, and most of the piggeries are located there. The pig raisers in these areas belong to producers' organizations of their areas or states and these producers' organizations are organized well and are closely-knit.

However, there was an outbreak of food-and-mouth disease in Brazil in 2006. This resulted in worldwide import restrictions on meat products from Brazil because it spread all throughout the country. Distribution management of imported pork from Brazil was tightened in Russia, which is the greatest market for Brazilian pork, and exports to Russia significantly decreased. Food-and-mouth disease had a major negative impact on the exporting of meat products through cases like this, but it has also resulted in vaccinations, hygiene control, etc.

Diagram 2 The Production Volumes of the World's Major Pork Producing Countries[1]

	2003	2004	2005	2006	2007 (Forecast)
China	45,186	47,016	50,106	52,261	54,352
EU25	21,150	21,192	21,101	21,400	21,450
U.S.A.	9,056	9,312	9,392	9,559	9,795

[1] USDA website.

	2003	2004	2005	2006	2007 (Forecast)
Brazil	**2,560**	**2,600**	**2,710**	**2,830**	**2,930**
Russia	1,710	1,725	1,735	1,805	2,000
Canada	1,882	1,936	1,914	1,870	1,810
Other	8,944	9,020	9,178	9,291	9,530
Total	90,488	92,801	96,136	99,016	101,867

(units: thousand tons)

Chapter 2 Contents of the Project

2.1 Business Outline

The incorporating of a system that recovers and efficiently utilizes biogas that is generated at one piggery in Rio Grande do Sul and eight piggeries in Santa Catarina, totaling nine piggeries, is under consideration. Incinerators for burning the recovered biogas will be installed at each piggery. This will reduce the emission of methane gas, which has twenty one times the greenhouse effects of CO_2, and will contribute to the sustained development of Brazil and the region.

2.2 Project Objectives

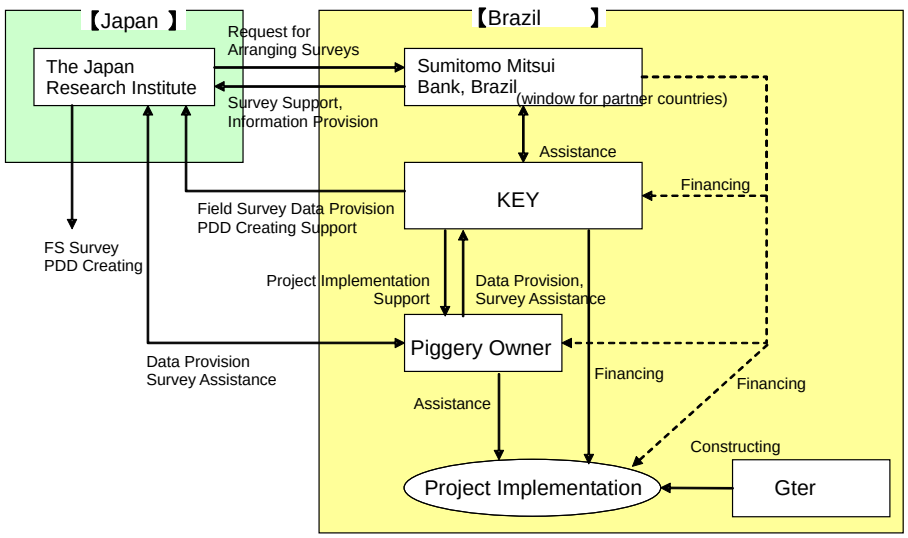
The goal of this project is to contribute to sustainable developments of the host country. The concrete points in environmental improvement are as follow.

- The reduction of greenhouse gasses is made possible when some of the fuel used in the piggeries is converted to energy that can be regenerated.
- To reduce contamination of the land, water, etc. resulting from from open lagoons, and to contribute to the improvement of the regional environments.
- The amount of chemical fertilizers that is used in the host country can be reduced because residue that comes from methane fermentation can be used as fertilizers.
- To create new jobs for the constructing, maintaining, and managing of facilities for methane fermentation, power generation, etc.

2.3 Project Implementation Structure

The implementation structure of the project is as shown in Diagram 3.

Diagram 3 Implementation Structure of the Project



2.4 Project Implementation Site Outline

This project will take place in southern Brazil and is to be implemented in Rio Grande do Sul and Santa Catarina, which are at the center of Brazil's pig raising industry. The piggeries are located in various cities in both of the states.

2.5 Project Outline

The manure from the piggeries at the locations where the project is scheduled to be implemented will be gathered and undergo solid-liquid separation before being naturally evaporated at open lagoons. The solid residue is used as a fertilizer for corn fields for feed. Methane gas is being generated at open lagoons that are under anerobic conditions. There is also the danger of leachate from open lagoons flowing into nearby rivers, underground water, etc, and causing environmental pollution.

Therefore, biodigesters (where open lagoons are covered with vinyl sheets) will be installed in the project so that methane can be fermented without it being released into the atmosphere. Furthermore, the methane gas that has generated will be recovered and undergo flare burning. The organization that is responsible for implementing the program is the Brazilian CDM developing company KEY, and one piggery from Rio Grande do Sul and eight piggeries from Santa Catarina will participate.

Diagram 4 Overview of the Project

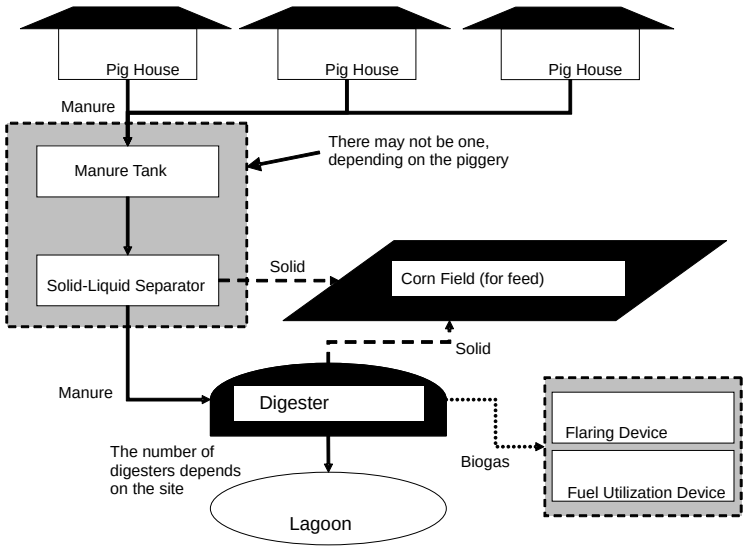
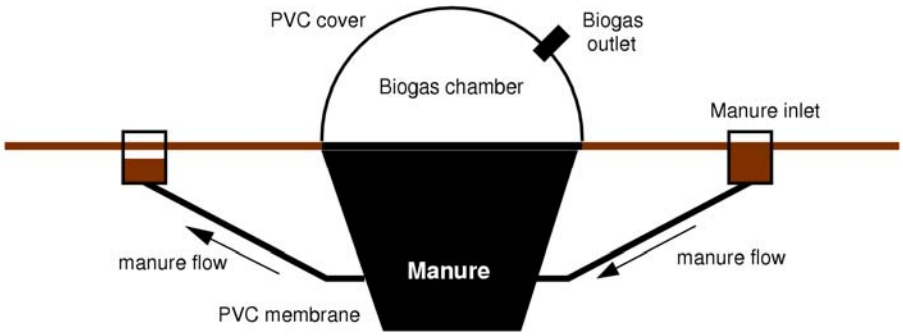


Diagram 5　Overview of Biodigesters



2.6　Establishing a Baseline Methodology

As for the baseline methodology concerning the recovering of the methane gas that is generated from piggery manure lagoons, the approved integrated methodology ACM0010 that has been created based on AM0006 and AM0016 has been prepared. The small-scale methodology AMSⅢ.D. that was created based on the ACM0010 will be used because the yearly emission reductions of this project are sixty thousand tons or below. The conditions below must be met so that this small-scale methodology can be applied. It should be noted that all of the piggeries in this project meet the following prerequisites and conditions for application.

【Prerequisites】

The said methodology is to be applied in projects that recover and disintegrate methane that is generated from the decomposing of manure or agricultural waste under anerobic conditions. In this case, the two items below must be covered.

a) Equipment for recovering the generated methane gas and facilities for burning the recovered gas must be installed

b) Management practices for manure and agricultural waste must be modified because controlled anerobic fermentation that involves a system that recovers and disintegrates methane gas is implemented

【Conditions for Application】

a) Sludge must be processed aerobically. If sludge is to be used as fertilizer, it must be done so under appropriate conditions and implemented with appropriate processing methods.

b) All methane gas that is generated by digesters must be processed through some form of technological means (burning, flare burning, etc.).

2.7　The Baseline Scenario

The proof of additionality with the small-scale methodology AMSⅢ.D. is simplified when compared with the approved integrated methodology ACM0010, but it has been determined in this survey through the following four steps in accordance with the methods of the approved

integrated methodology ACM0010.

[Step 1] The Identifying of an Alternative Scenario of the CDM Project Activities to be Proposed

The two methods concerning “anerobic lagoons” that are generally used in Brazil, and the advanced “anerobic digesters” for those that have not been adopted very much, are conceivable alternative scenarios.

[Step 2] Barrier Analyses

Anerobic digesters require much financing as well as close monitoring, equipment maintenance, and so on. However, anerobic lagoons require simple and inexpensive technology, and it is easy to operate and maintain them. Anerobic lagoons should therefore be set as the baseline scenario when considering both the investment barriers and the technical barriers.

[Step 3] Investment Analyses

Investment analyses have been made for neither anerobic lagoons nor anerobic biodigester systems because they are systems that do not generate revenues.

[Step 4] Revisions of the Baseline due to Updates in the Credit Term

Step 4 is not needed as the credit term of this project is fixed at ten years.

2.8 GHG Emission Reductions due to the Implementing of the Project

GHG emission reductions in AMSⅢ.D. are calculated by subtracting emissions from the project cases and leakage emissions in project activities from the emissions in the baseline scenario. However, the estimated emissions reductions are calculated with the calculating formula of the IPCC and the parameters during the stage where the PDDs are being created for reasons concerning the data that can be gathered. In addition, when monitoring data after the implementation of business is maintained, the GHG reduction complexity that is reduced with the incorporating of the project system is calculated with use of the monitoring data.

The amount of credits that are ultimately issued (CER) is to be the value that is lower between both parties. (Even if the emission reduction complexities are greater than the estimated emissions reductions through the monitoring results, the estimated emissions reductions that were previously shown with the PDDs shall be used as the upper limit of the emission reductions that are to be approved of by the executive CDM boards.)

The baseline emissions, project emissions, leakage emissions, and estimated emissions reductions are all shown in Diagram 6. The estimated emissions reductions have been estimated at 28,354 [t-CO_2e/year] and the total of the credit term up to 2012 is 141,772 [t-CO_2e].

Diagram 6 Estimated Emissions Reductions

	Baseline	Project	Leakage	Estimated Emissions Reductions
	t-CO_2e	t-CO_2e	t-CO_2e	t-CO_2e
Yearly	28,516	162	0	28,354
Credit Term (2008 to 2012) Total	142,581	809	0	141,772
Ten Year Total	285,163	1,618	0	283,544

2.9 Monitoring

The monitoring items are as shown in Diagram 7.

Diagram 7 Monitoring Items

Item	Frequency	Notes
C_{CH4}	Month	The proportion of methane in the biogas. Measured with a fixed exhaust gas analyzer. The exhaust gas analyzer is to be properly maintained.
N_{LT}	Month	The average numbers of pigs. Increases and decreases are to be managed by pig type. The number of pigs that has been directly enumerated and the indirect data (for example: number of shipments, purchase records of feed, etc.) must be consistent.
$W_{i,site}$	Month	The average weights of the pigs. The average weights must be counted by pig type.
FE	Month	Flaring efficiency. Measured with a fixed exhaust gas analyzer. The exhaust gas analyzer is to be properly maintained.
Vf	Week	Biogas flow rate. Measured with two gas flow meters. The areas to be measured are exit ports of the anerobic digesters and the entrance ports of the gas combustion chambers. Flow meters are to be appropriately maintained and regulated in accordance with industrial standards.
NEF	Month	Emissions factor of the system.
SRC	When Appropriate	Number of sludge discharges.
$Elec_y$	Month	Purchased energy from the system.

2.10 Environmental Impact Analyses / Contributions to Regions

The risks of rivers, underground water, etc. being contaminated can be reduced with the implementing of this project. In addition, the technology used in installing biodigesters and the technology used in the recovering and using of biogas have been adopted in Brazil through CDM businesses in the past, but they haven't been widely used yet in the piggeries in Brazil. Through the project, the benefits of this technology, which is environment-conscious, and the technology itself being acknowledged and voluntarily adopted in Brazil can be anticipated in the future. Furthermore, it will contribute to reductions in the risks of infectious diseases from livestock because sanitary forms of manure treatment can be accomplished.

2.11 Comments from Concerned Parties

Parties concerned with the project include the Brazilian government as DNA, local governments, piggery owners, and local residents. Everything up to pre-validations will be implemented in this survey, but they are still in the process of being validated during the creating of this report. This is why official comments from concerned parties are not being gathered. Therefore, a list of the hearing results will be created when visits to the sites are made.

（1） Piggeries of Santa Catarina

Motives for getting involved in CDM projects include making contributions to sustainable developments, gaining credit accompanied with CER sales, preventing infectious diseases through environmental improvement efforts, and preparing measures for environmental control.

We ask for cooperation as implementing CDM projects requires additional financing and technical support, and our trying to cover it all by ourselves is not a realistic approach. The pig raising industry in Brazil is very big and every piggery is considering expanding their business. They would suffer a devastating blow under these conditions if a contagious disease were to spread, so they feel that it is very risky. Cars, shoes, etc. are thoroughly sterilized and washed when entering the premises of the piggeries, and forestation is being implemented so that contact with the outside world can be avoided as much as possible.

The revenues that can be earned through CER sales in this CDM project is appealing, but what is at least as worthy of anticipation is the fact that the outbreak of contagious diseases can be prevented with the implementing of appropriate manure processing.

The biogas that is attained through the CDM project is expected to be used as fuel for heating pig pens for young pigs.

（2） Piggeries of Rio Grande do Sul

The reasons for getting involved in this project are in the profits arising from CER sales and environmental responses. The Ministry of the Environment’s environmental regulations in the state are getting stricter every year and various ways of responding to them are becoming more necessary. When taking the managerial environments of the pig raising industry into consideration, processing methods where anerobic lagoons are used are very unlikely become prohibited in the near future and the introduction of biodigesters will not probably become mandatory. However, we may very well see trends like these in the medium- and long-term. Even the said piggeries are showing an interest in manure treatment becoming appropriate, but they needed cooperation from third parties because they didn’t have the needed skills and know-how. We hope that our participation in this project will lead to medium- and long-term environmental measures.

Chapter 3 Examination of Economic Potential

3.1 Financial Planning

The procuring of funds for equipment and construction costs that are needed in initial investments for the project can be expected to be financed by financial institutions, particularly SMB, governmental financial institutions, and local financial institutions.

3.2 Prerequisites for Analyses of Economic Potential

The following prerequisites have been set in consideration of the profitability of the project. They are based on information provided by BSMB, a local environmental consulting company (KEY), and an engineering company (Gter).

Diagram 8 The Set Conditions

Item	Set Conditions
Exchange Rate	US$1 = 1.84Rs (Reals)
Depreciation	Remaining Value 10%, Depreciation Term 10 Years (straight line basis)
Corporate Tax	34% (25% if profits are 240,000Rs or below)
Interest	7%
Initial Cost	Total of 9 sites, about US$1,100,000
Running Cost	Total of 9 sites, about US$35,000
CDM Costs	Verification Cost: US$5,000/year Adaptation Fees: Yearly: US$0.1/CER per year (to 15,000t-CO_2e), US$0.2/CER (from 15,000t-$CO_2$e)
CER Sales Prices	US$20.0/t-$CO_2$

3.3 Sensibility Analyses through CER Prices

The revenues that are generated through this project come from CER sales, so there are profound effects when there are changes in the prices. CER prices depend on the balance between supply and demand so they may drastically change according to the circumstances.

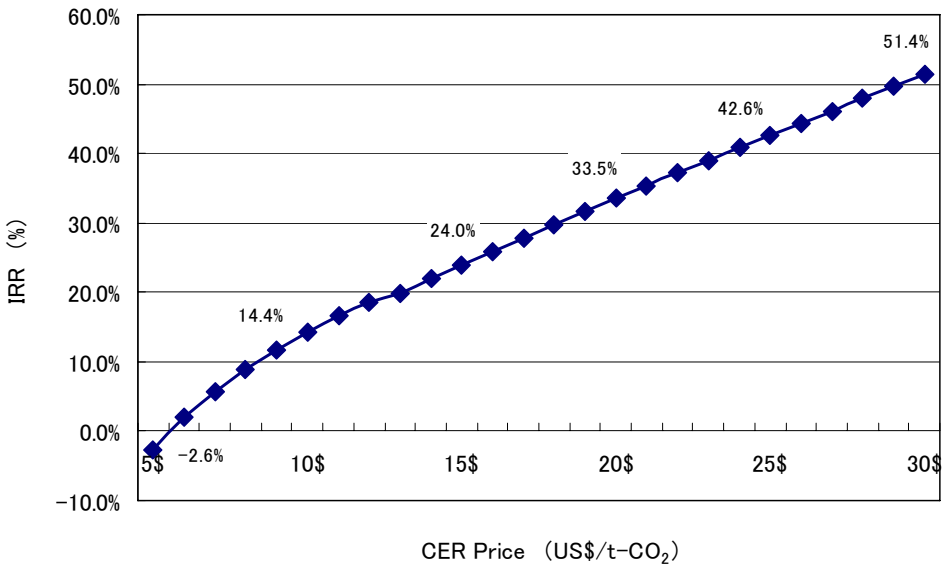
Upon considering the CDM conditions in Brazil, the prices have been set at US$20/t-$CO_2$. Sensibility analyses will be conducted in order to grasp the effects that changes in CER sales will have because the revenues that are generated through this project come from sales and changes in the prices will bring about great risks. Sensibility analyses results are as shown in Diagrams 9 and 10.

The IRR based on the CER price that was set as a premise (US$20) is 33.5%, and it is clear that this is good as a target of investments. However, CER prices of at least US$12 are desired in order to make them targets of investment when they are compared with Brazil's nominal interest rate (11.25% per year).

Diagram 9 Results of Sensibility Analyses through CER Prices (1)

CER Sales Prices [US$/t-$CO_2$]	IRR [%]	NPV [US$]
5$/t-$CO_2$	-2.6%	671,098
6$/t-$CO_2$	2.0%	864,144
7$/t-$CO_2$	5.8%	1,046,042
8$/t-$CO_2$	9.0%	1,208,960
9$/t-$CO_2$	11.7%	1,357,287
10$/t-$CO_2$	14.4%	1,505,614
11$/t-$CO_2$	16.6%	1,630,657
12$/t-$CO_2$	18.5%	1,735,422
13$/t-$CO_2$	19.9%	1,833,161
14$/t-$CO_2$	22.0%	1,961,971
15$/t-$CO_2$	24.0%	2,090,781
16$/t-$CO_2$	25.9%	2,219,592
17$/t-$CO_2$	27.9%	2,348,402
18$/t-$CO_2$	29.8%	2,477,212
19$/t-$CO_2$	31.7%	2,606,022
20$/t-$CO_2$	33.5%	2,734,832
21$/t-$CO_2$	35.4%	2,863,642
22$/t-$CO_2$	37.2%	2,992,452
23$/t-$CO_2$	39.0%	3,121,262
24$/t-$CO_2$	40.8%	3,250,072
25$/t-CO2	42.6%	3,378,882
26$/t-CO2	44.4%	3,507,692
27$/t-CO2	46.1%	3,636,502
28$/t-CO2	47.9%	3,765,312
29$/t-CO2	49.6%	3,894,122
30$/t-CO2	51.4%	4,022,932

Diagram 10 Results of Sensibility Analyses through CER Prices (2)



Chapter 4 Issues for Industrialization

There are various business risks in this project. After examining these business risks, they have been classified as (1) those that have great possibilities of becoming actualized, and (2) those that will have significant effects if they are to become actualized. The risks in order of importance at the moment are assumed to be risks of realizing CDM projects, CER price risks, technical risks, interest risks, country risks, risks arising from the effects of macroeconomic environments, and risks of natural disasters. The utmost efforts are to be made to avoid these risks so that this business can be implemented. Details on the main risks are as shown below.

<Risks of Realizing CDM Projects>

The methodology ACM0010 that can be applied to the efficient utilization of piggery biogas has undergone three revisions, and the small-scale methodology AMSⅢ.D. has undergone thirteen revisions. There are effects such as PDDs having to be rewritten or CER volumes decreasing every time there is a revision in a methodology. This is why discussions with piggery owners must be held quickly and everything from the creating of PDDs to registrations with the U.N. must be done quickly, too.

<CER Price Risks>

CER prices in Brazil are currently staying at relatively high figures. However, CER price risks greatly affect business because revenues in this project come only from CER proceeds. Plans for signing ERPAs with companies that are making purchases through network of our company and SMBC at an early date and proceeding with efforts to reduce the risks of falling CER prices are being made.

<Technical Risks>

It has been pointed out that CER volumes that were obtained were lower than CER volumes that were estimated in PDDs in same kinds of projects that have been registered with the U.N. up to now. This is because methane gas inside digesters was released due to inadequacies in construction techniques and because there are a lot of organic components that precipitate without fermenting in the digesters. Therefore, adjustments in this project where fermentation efficiency is increased through measures against tears in covers and the setting of agitators in the digesters will be made.