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Swine Farms in the State of Santa Catarina, Brazil

Research into Effective Commercial Applications of Biogases

(Overview)

Report

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Chapter 1: Overview of the Host Country – Brazil

1.1 General Information

Brazil is a federal republic comprised of 26 states and one federal district (capital: Brasília). The biggest country in South America, its population of 184.1 million (August 2004 estimate) is the fifth largest in the world. Despite enduring a period of stagnation due to runaway inflation, it has developed into a major economic force with a top ten global ranking in terms of GDP.

1.2 Agriculture and Livestock Business

Brazil is an agricultural powerhouse, and one of the leading exporters of agricultural products in the world. Its export earnings from coffee, orange juice, sugar, beef, and chicken are ranked top in the world, while soy beans rank second, making agriculture crucial to its foreign currency earnings. To date, the lion's share of such exports have been to Europe, which used to account for about half of the total, but recently, the ratio for Asia has increased.

It is also one of the primary livestock production and exporting countries. Total livestock production (value basis) throughout the country in 2002 was $19.6 billion, representing one of the main pillars of agricultural commerce together with agricultural products ($26.8 billion). Both production and export supplies of livestock have experienced a rapid increase to support increased demand for meat – both locally and overseas, especially from Asia – by improved production and business management skills, and inexpensive feedstuff. The livestock business not only produces meat, but also impacts on peripheral industries, such as the processing and leather industries, and has created many additional jobs.

Fig. 1 – Principle livestock production and export volumes in Brazil

	Year	1992	1997	2001
Beef	Production volume	5,069	5,820	6,900
	Export volume	444	274	632
Pork	Production volume	1,190	1,540	2,216
	Export volume	45	64	265
Chicken	Production volume	2,727	4,461	6,736
	Export volume	372	649	12,49

(Unit: 1,000 tons)

1.3 CDM Trade in Brazil

The Designated National Authority (DNA), which approves Clean Development Mechanism (CDM) trade in Brazil, is a member of the Interministerial Commission on Global Climate Change (CIMGC), and is comprised of various ministries and agencies under the chairmanship of the Ministry of Science and Technology.

The degree of contribution to economical growth bearing in mind social issues in Brazil is

afforded a high weighting when CDM projects are authorized in Brazil. For example, the relevant project's contribution to employment, dissemination of profits, and technological development must be included in the Project Design Document (PDD) as a condition of authorization. The Designated Operational Entity (DOE), which provides third-party authorization for the project, requires the establishment of an office in Brazil as a condition.

In Brazil, as of the end of December 2006, 84 CDM businesses had been registered, representing a total reduction volume of 15.5 million tons of carbon dioxide (t-CO_2) per annum. If those projects awaiting registration screening or being screened for validation, and those being investigated are included, the total is somewhat greater. However, only five of the projects registered by the UN benefit from Japanese investment, a far lower number than from European countries, such as the UK, the Netherlands and Sweden.

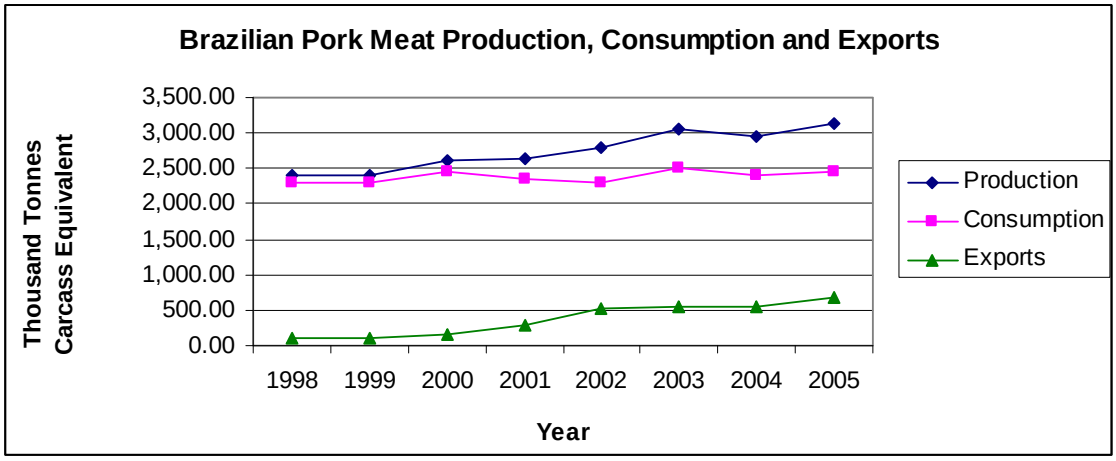
Currently, 36 projects similar to this one – i.e. designed to put pig farm-derived biogas to effective use – are being considered in Brazil, some of which have already been registered under the UN while other UN registrations are being processed. 14 of these projects are small-scale CDMs. AM0006 and AM0016, which had planned to apply as small-scale CDMs, have been integrated as ACM0010, so flaring must be monitored, and it is likely that the amount of credit that can be obtained for most of these small-scale CDMs will be reduced. Project expenses increase with the addition of such monitoring facilities. On the other hand, the amount of credit to be acquired was originally larger for large-scale projects, so the effect of flare monitoring due to the integration of methodologies is small, as is the additional expense compared to the overall cost, so the effect is assumed to be fairly insignificant.

1.4 Current Status of Pig Farming in Brazil

Pork production throughout Brazil grew by an average of 3.9% per annum from 1998 to 2005. During this period, pork exports experienced an average annual increase of 71% compared to just 0.9% for the average increase in domestic pork consumption. Pig farming in Brazil continues to experience growth mainly as a result of export demand. Until the end of the Nineties, pork consumption was principally domestic (96% of production was consumed locally) in much the same way as beef and chicken, etc. but since 2000, exports have soared such that, currently, exports account for some 28%.

Brazil has the largest pig farming industry in South America, with 33 million pigs under production. There are 66,952 pig houses, typically with several per pig farm. The south, south-east, and mid-western areas are most popular for pig farming, and account for the majority of such farms. In these areas, pig farmers belong to regional or state production unions, which are well organized and close-knit. An organization that encompasses production unions nationwide provides instruction on pig farming, and supports members in their work as pig farmers, such as through advice on domestic trade, pricing and how to sell overseas.

Fig. 2 – Changes in Brazilian Pork Production, Consumption and Exports



Chapter 2: Project Details

2. 1 Commercial Overview

In this chapter, we focus on the adoption of a system to collect and effectively utilize biogas emissions from 61 pig farms that belong to the Association of Catarinian Pig Farmers *[Associacao Catarinense de Criadores de Suinos]* (ACCS) in the state of Santa Catarina. Generators that incinerate collected biogas are installed at each pig farm. By adopting this system, emission of gaseous methane – which is 21 times more powerful as a greenhouse effect than CO_2 – is reduced, while contributing to the sustainable development of Brazil and its regions.

2. 2 Project Purpose

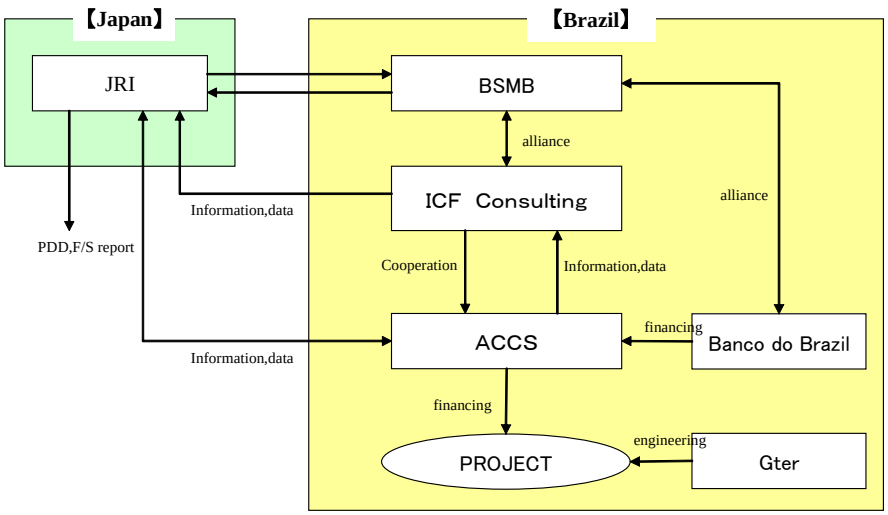
Contributing to the sustainable development of host countries through this project. Specific benefits to the environment are as follows.

- Conversion of some fuel use at pig farms to recyclable alternatives serves to reduce greenhouse gases.
- Benefits the regional environment by reducing soil and water pollution due to leaching.
- Compost residue can be used as fertilizer after methane fermentation, thus reducing dependency on chemical fertilizers in the host countries.
- Creation of new employment opportunities for the construction, maintenance, and management of methane fermentation and power generation facilities.

2. 3 Project Implementation System

A chart showing how this project system is implemented is presented in Fig. 3.

Fig. 3 – Project Implementation System



2. 4 Overview of the Project Implementation Site

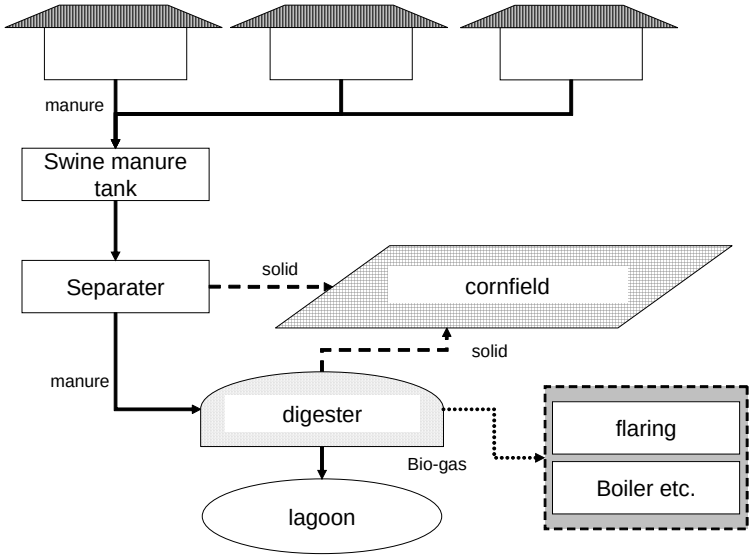
This project is being implemented in Santa Catarina, a state in the south of Brazil that is a major center of pig farming in Brazil. There are pig farms in a number of cities throughout the state.

2. 5 Project Overview

At the pig farms in Santa Catarina at which the project is to be implemented, manure is processed at an open lagoon under anaerobic conditions, leading to the generation of methane. Sewage sometimes overflows into local rivers and the groundwater, resulting in environmental pollution.

Accordingly, under this project, a bio digester (a vinyl sheet that covers the open lagoon) is to be installed, and methane ferments off without being discharging into the atmosphere. Gaseous methane so generated is collected and flared off or used as a fuel to generate power. This project is being implemented by ACCS, whose membership includes 61 pig farmers in Santa Catarina whose enterprises range from small to medium scale.

Fig. 4 Project Overview



2. 6 Establishment of Baseline Methodology

ACM0010, an approved consolidated methodology based on AM0006 and AM0016 – “Consolidated baseline methodology for GHG emission reductions from manure management system” – has been prepared as a baseline methodology for collection of methane generated from manure lagoons at pig farms. Compliance with the following conditions a)~f) is necessary if this consolidated methodology is to be applied. The following application conditions are satisfied for all pig farms in this project, and the approved consolidated methodology ACM0010 can be applied.

[Prerequisites]

This methodology can generally be applied to treatment of manure from livestock farming as a means of reducing greenhouse gas (GHG) emissions by changing the existed anaerobic manure management systems within the project boundary to a livestock waste treatment system comprised of single or multiple units.

[Application conditions]

a) Farms where livestock populations, comprising of cattle, buffalo, pigs, sheep, goats, and/or poultry, are managed under confined conditions.
b) Farms where manure is not discharged into natural water resources (e.g. rivers or estuaries).
c) For anaerobic lagoon treatment systems, the minimum depth of the lagoon under the baseline scenario must be one meter. (In particular, loading in the wastewater streams must be sufficiently high to ensure that an anaerobic bottom layer is generated in the lagoon and no oxygen is generated by algae.)
d) The annual average temperature at the site of the anaerobic manure treatment facility under the baseline scenario must be more than 5°C.
e) Under the baseline scenario, the minimum retention period for manure in the anaerobic treatment facility is one month.
f) Manure must not leak to the groundwater during the animal waste management system process for project activities. In other words, the bottom of the lagoon must be protected by a non-permeable layer.

2. 7 Baseline Scenario

The approved consolidated methodology ACM0010 determines the baseline scenario as per the following four steps.

Step 1: Identification of alternative scenarios for proposed CDM project activities

There are two alternative methods that can be considered, namely the “anaerobic lagoons” that are generally used in Brazil, and “anaerobic digesters”, which are more advanced but rarely adopted.

Step 2: Barrier Analysis

Substantial investment is needed for anaerobic digesters, and detailed monitoring and system maintenance need to be performed. On the other hand, anaerobic lagoons represent simple and inexpensive technology, with straightforward operation and maintenance. Anaerobic lagoons should be installed as the baseline scenario from the perspective of both investment and technological barriers.

Step 3: Investment Analysis

Use of Net Present Value (NPV) analysis, has also confirmed the baseline scenario as the most attractive economically.

Step 4: Baseline Revision at Revision of the Credit Period

The credit period for this project is set as 10 years, so step 4 is not needed.

2. 8 GHG Reduction Volume through Project Implementation

Once this project is approved by the CDM council, data measurement as specified in the monitoring plan is to be implemented, and Emission Reductions (ER) in relation to the project are calculated using the data. Accordingly, ER calculations in this report assume that methane emissions from the digester are fully combusted during flaring.

Fig. 5 shows the baseline emissions, project emissions, leakage emissions, and emission reductions. The emission reduction volume is estimated as 83,868 t-CO_2e per annum, while that for the total credit period until 2012 is 419,342 t-CO_2e.

Fig. 5 – Greenhouse Gas Reduction Volumes

	Baseline	Project	Leakage	ERs
	t-CO_2e	t-CO_2e	t-CO_2e	t-CO_2e
Annually	115,568	31,700		83,868
Credit period (2008~2012) total	577,841	158,499		419,342
10- year total	1,155,682	316,999		838,683

2. 9 Analysis of Environmental Impact

In association with the implementation of this project, the environment at sites that have not been awarded an environmental license due to the unhygienic nature of existing manure treatment facilities will be improved. Technology for the installation of the bio digester to be used for this project and biogas collection usage technology have already been adopted for CDM trade in Brazil, but have yet to be widely adopted by pig farmers in Brazil. It is expected that this environmentally friendly technology's effects will be recognized through this project, and thus voluntary adopted in Brazil.

2. 10 Stakeholder Comments

At this stage, the prepared PDD has not reached the examination stage for validation, so official comments of stakeholders have not been collected. We explained our measures and stance regarding this project and CDM, and measures adopted by the Japan side towards implementation of the project to stakeholders such as ACCS and pig farm owners, and received

the following comments.

(1) ACCS

Originally, 19 pig farms intended to participate in this project, but later, 61 farms expressed their intention to participate due to an increase in interest in CDM trade.

ACCS is coordinating this project, and is also the credit owner and decision-maker for disposal, so individual negotiations with pig farm owners is unnecessary. In terms of financial plans, the ACCS also plans to seek credit. Such credit is intended to be used to improve the management environment of pig farms.

They clearly stated that credits generated will be sold to Japan. (A letter has been received separately.) It is expected that several thousand pig farms under their umbrella may request participation in this CDM trade if this project is successful. They would like to request cooperation if such movement is seen.

(2) Pig farm owners

Currently, pig farms cause environment pollution, and environmental licenses that are needed to implement new projects (expansion of pig houses at pig farms) cannot be obtained. They cannot retain credit rights, but they do not consider this a problem because ACCS will utilize them and business expansion opportunities can be acquired through granting of environmental licenses. Participating owners believe that realizing environmental improvements, which has long been difficult due to their financial circumstances, represents the primary benefit.

Chapter 3: Economic Efficiency Considerations

3.1 Financial Planning

Financing from major financial organizations, notably Banco do Brasil, government financial organizations, and local financial organizations, is expected for the initial investment in this project, such as to cover equipment and engineering work expenses.

3.2 Prerequisites for Economic Analysis

Prerequisites that have been established to consider the business prospects of this project are as follows. These are based on data provided by Banco Sumitomo Mitsui Brasileiro, and a local environmental consultation company (ICF).

Fig. 6 – Miscellaneous Conditions

Items	Conditions
Exchange rate	US$ 1 = Rs 2.15 (real)
Depreciation	Residual book value 10%, Depreciation period: 10 years (straight-line method)
Corporate tax	34% (25% for profits of Rs 24,000 or less)
Interest rate	7%
Initial cost	Average US$ 57,678 per site
Running costs	Average US$ 1,605 per site
Expense for establishment of CDM	Verification expense: US$ 5,000 annually Adaptation fees (annual): US$ 0.1/CER (~15,000 t-CO_2e), US$ 0.2/CER (15,000 ~ t-CO_2e)
CER sales price	US$ 10.0/t-CO_2

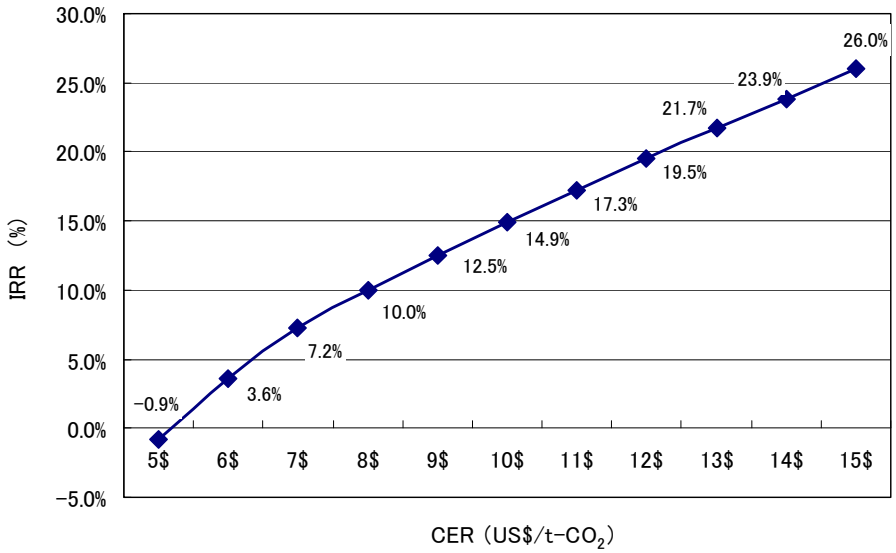
3.3 Sensitivity Analysis based on CER Value

Income for this project is based on CER sales, so any change in its value will have a significant impact. The CER value has been decided based on the balance between supply and demand, so it may fluctuate significantly depending on the status.

Accordingly, the internal rate of return (IRR) and net present value (NPV) are calculated, and assessment is made, based on CER sales values of between US$ 5 and 15. IRR sensitivity analysis results are shown in Fig 7.

As a result, an IRR of 14.9% was returned for the CER value (US $10) that has been specified as a prerequisite. This is a tougher investment target compared to the nominal interest rate in Brazil (annually 13.25%, Banco Central do Brasil, December 2006). Thus, it was determined that a CER value of at least US $12 is needed.

Fig 7 – Sensitivity Analysis Results based on CER Value



Chapter 4: Commercialization Issues

Methodologies are consolidated within ACM0010 for CDM using manure at pig farms. In line with such consolidation, a section where the monitored volume of methane leaked out (i.e. the non-combustion of methane) during biogas incineration has changed. The specified default values of 50% as the combustion ratio when flaring in an open system, and 90% when using a closed system are to be used, but even after implementation of the project, continued monitoring is requested. Furthermore, monitoring to check for physical leaks is also needed.

These changes are measures to approximate the acquired credit to the actual status, but those implementing CDM initiatives must take due care.

Credit owners tend to overestimate potential credit, and combustion ratio and physical leaks may be underestimated. If the ER was based on false assumptions when the business plan was drawn up, the anticipated CER volume may not be possible under actual business conditions.

Therefore, the ER must be calculated in a conservative manner as far as possible at the business planning stage. On the other hand, drawing up an accurate financial plan after the business has been set up is difficult based on excessively conservative estimates. Thus, an appropriate balance must be born in mind.

In this report, the ER calculation was based on the assumption that “combustion occurs in an closed system, with no physical leaks”. However, leakage during flaring needs to be measured in order to decide the flaring efficiency, so the expected flaring efficiency during actual measurements may not be satisfied, and in this case, the actual ER will be less than expected. It is estimated that an additional investment should be made to realize combustion in a closed

system with an eye to gain the potential increase in ER when an official PDD is submitted to the CDM council. Accordingly, F/S research should be attempted using lower estimates as far as possible.