Preface and Acknowledgements – Faxinal and Toledo

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CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-PDD)
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CONTENTS

Annexes

SECTION A. General description of project activity

A.1 Title of the project activity:

>> "GHG capture and combustion from swine manure management systems at Faxinal dos Guedes and Toledo".

A.2. Description of the project activity:

>> In 2003, Sadia S/A, one of the largest Brazilian food producers, decided to implement a voluntary sustainability program at its swine farms, to improve waste management systems, reduce GHG emissions and provide better living conditions for the producers.

This voluntary program started at three of SADIA's own swine farms (Faxinal dos Guedes, Toledo Luz Marina and Toledo São Sebastião), functioning as prototypes to be extended to its outsourced producers.

The three farms have the same project concept: the installation of a not-heated anaerobic digester which captures and flares greenhouse gases (mainly methane), which is different of the business-as-usual anaerobic lagoons treatment system.

The objective of the project is to start a deeper program to promote sustainable development among outsourced swine producers. Swine production in Brazil is not sustainable due to its severe environmental pollution and poor working and living conditions of the producers.

The expected result of this project is a significant reduction of GHG emissions compared to those emissions that would have occurred in the absence of the project and also promotion of sustainable swine production farms, bringing environmental and social benefits.

This project is based on the approved methodology AM0006 (Methane capture and combustion from swine manure treatment for Peralillo) developed by Agricola Super Limitada (Agrosuper), Urquidi, Riesco & Co, POCH Ambiental and CO2e.com.

A.3. Project participants:

>> The participants involved in the project are:

BRAZIL

1. Project Developer: SADIA S/A, private Brazilian company and one of the world's leading food producers.

2. Technical Advisors: PricewaterhouseCoopers – Brazilian branch, engaged in sustainable business solutions.

SADIA: Company Profile

Sadia is one of the world's leading producers of chilled and frozen foods.

Established in Brazil in 1944, Sadia is today the market leader in all segments in which it is present, and it is also Brazil's main exporter of meat-based products.

Sadia's brand name has been voted the most important and valuable brand among all Brazil's food brands. In Portuguese the word Sadia means "healthy".

Sadia has 12 industrial plants in Brazil that together produce over 1.3 million tons of protein-based products coming from chicken, turkey, pork and beef, and also pastas, margarines and desserts.

More information can be gathered at www.sadia.com.

A.4. Technical description of the project activity:

A.4.1. Location of the project activity:

>> The project is located in southern Brazil, at the provinces of Paraná (Toledo) and Santa Catarina (Faxinal dos Guedes).

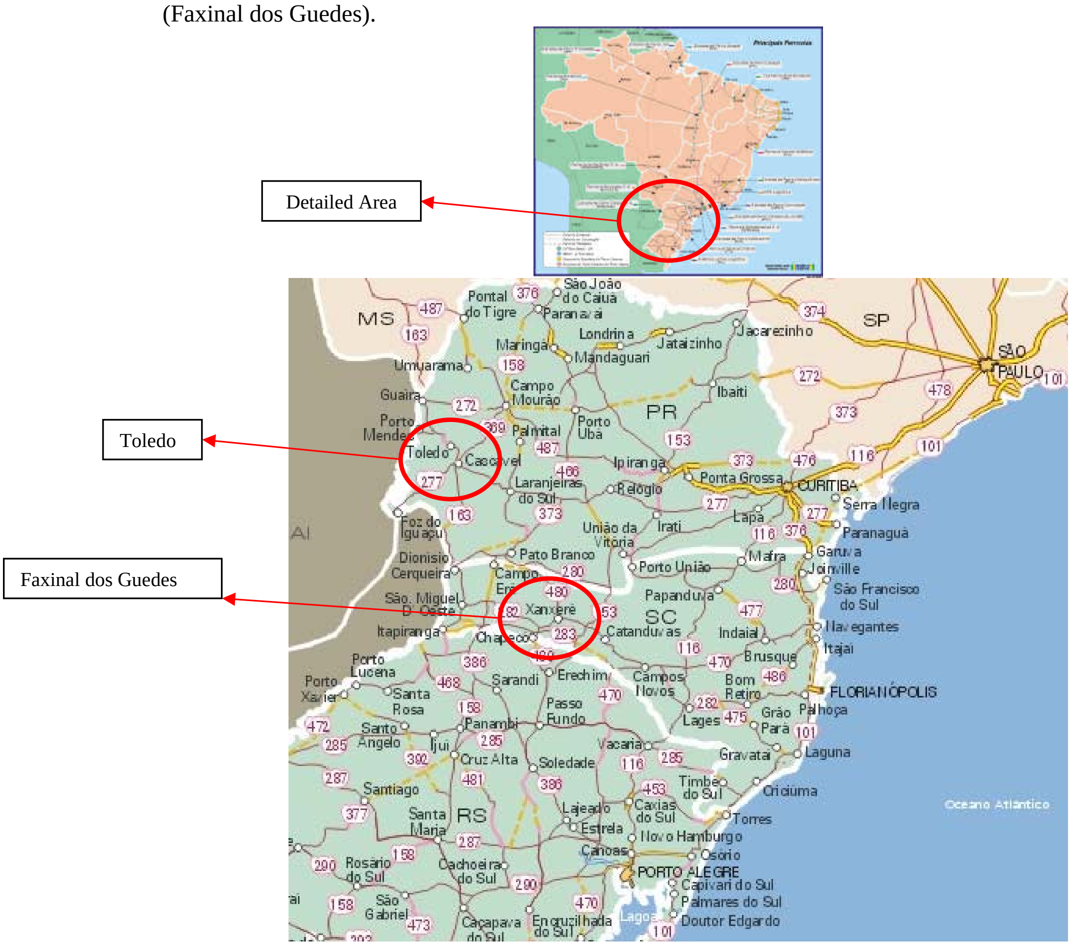

Fig. 1 – Project Location within Brazil - (map source: http://www.transportes.gov.br/bit/inmapa.htm).

A.4.1.1. Host Party(ies):

>> The host party for the project is Brazil.

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

>> Toledo (Luz Marina and S. Sebastião): South Region / State of Paraná / Municipality of Toledo.
Faxinal: South Region / State of Santa Catarina / Municipality of Faxinal dos Guedes.

A.4.1.3. City/Town/Community etc:

>> Toledo: Núcleo Luz Marina – Granja 8 / Núcleo São Sebastião – Granja 5 – Toledo – Paraná
Faxinal: Rodovia BR 282 KM 491 – Faxinal dos Guedes – Santa Catarina

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

>> The locations below are identified with UTM (Universal Transversal Mercator) co-ordinates:

Project	**Farm Name**	**Nearest Location**	**North (UTM)**	**East (UTM)**
Faxinal	Faxinal	Faxinal dos Guedes - SC	7.027.344,06846	370.837,95652
Project	**Farm Name**	**Nearest Location**	**South (UTM)**	**West (UTM)**
Toledo	Luz Marina – Granja 8	Toledo - PR	22 J S 0197532	W 7250540
Toledo	São Sebastião – Granja 5	Toledo - PR	22 J S 0211820	W 7247953

Table 1 – Project Activities Co-ordinates

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

>> The project is categorized into sectorial scopes 13 (Waste Handling and Disposal) and 15 (Agriculture).

Following the concepts stated on the approved methodology AM 0006, the emissions considered in this analysis include the release of methane from open anaerobic lagoons, CH4 losses due to digester leakage, and N2O emissions for baseline and project scenarios. The fugitive CO2 generated from anaerobic digestion does not represent any difference in emission volumes between each scenario, since there are no possible additional transformations by flaring this component.

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

>>The project technology is based on anaerobic digestion in two ambient temperature storage cells (lagoons). An anaerobic digester works as a reactor that receives a daily load of organic material (barn effluent) and maintains a steady population of methanogenic bacteria that converts organic acids into bio-gas. This technology is employed in livestock manure management and treatment.

The management of livestock manure produces methane when the organic material in the manure decomposes in an anaerobic environment. Conditions are favorable for the methane production when livestock is stored and treated in liquid systems, particularly anaerobic lagoons.

The bacterial decomposition of the organic material, that take place in anaerobic lagoons, is a process in which certain bacteria species, that develop under the absence of oxygen, decompose the complex organic structure and produce simpler ones, such as: methane, CO2, water, etc, obtaining energy and other components necessary for their growth.

The gas emission resultant from the anaerobic digestion is a mixture called biogas, which is combustible. The main component of the biogas, methane, does not have odor, color or taste, though others existent gases provide unpleasant odors (Seixas, 1980).

Associated to the odor of the manure, the swine production provokes different types of pollution, as a result of the evaporation of the volatile compounds that are harmful to human beings and animals. The most common air contaminants of the manure are: ammonia, methane, H2S, N2O and ethanol. The gas emission can cause injury in the respiratory organs, as well as contribute to the acid rain trough ammonia emission and to the global warming (Perdomo, 1999; Lucas et al, 1999 in Bulletin BIPERS, 2002).

Anaerobic digestion can be simplified as the following (Seixas, 1980):

Phase I - Hydrolysis – In this phase, bacteria releases extra cellular enzymes that promote the compounds hydrolysis, generating small soluble molecules, as organic volatile acids. The products of this phase are the substrate for bacteria in the next step.

Phase II – Acidogenesis – The decomposed matter from the previous step is converted into organic acids. Other substances are formed: salts, carbon dioxide, water and ammonia

Phase III Methanogenesis – Methanogenic bacteria use hydrogen and carbon dioxide and transform it into methane, forming the biogas.

The digester technology consists in a high density polyethylene cover (1.5 mm) which is laid over a primary lagoon. This system provides anaerobic decomposition of animal manure resulting in bio-gas production.

Bio-gas can be used for electricity production (e.g. barn heating systems or barn lighting) and its surplus can be flared. In this project, there will be no electricity generation involved, therefore it is assumed that all bio-gas generated by the project will be flared.

The effluent treatment system consists in a two – lagoon facility, where the primary lagoon works as an anaerobic digester, maintained as a constant volume treatment lagoon, and the secondary lagoon is used to provide storage of treated effluent until it can be applied to land.

Fig. 2 – Anaerobic digester implantation at Luz Marina – Granja 8 – Toledo – PR

The GHG emission reduction is achieved by the transformation of CH4 into CO2 through combustion, therefore avoiding methane emissions.
The treated water from the secondary lagoon is used for irrigation at SADIA's surrounding eucalyptus plantations and other surrounding crops. The sludge from the digester can also be used on land application for soil recover by adding nutrients and stimulating microbiological activity.

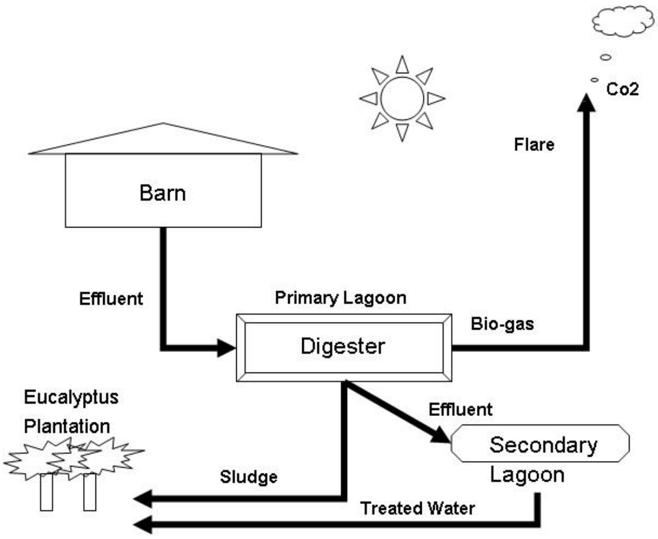

Fig. 3 – Flowchart of Treatment System

Sludge application and irrigation will be done in surrounding fields, out of project boundaries, where methane and nitrous oxide emissions can be considered negligible small since there are no anaerobic conditions regarding these applications.

Several operating conditions affect the amount of the methane produced in this system: 1) the ambient temperature, 2) the lagoon temperature, and 3) residency of manure solids in its system. All theses factors affect the amount of methane emitted because they influence the growth of the bacteria responsible of the methane formation. Methane production generally increases with rising temperature and residency time.

On the other hand, the methane production is proportional to the volume of manure produced that is influenced by:

- The manure colleting and stored path
- Hygiene system (frequency and volume of used water)
- Number and category of animals.

A.4.4. Brief explanation of how the anthropogenic emissions of anthropogenic greenhouse gas (GHGs) by sources are to be reduced by the proposed CDM project activity, including why the emission reductions would not occur in the absence of the proposed project activity, taking into account national and/or sectoral policies and circumstances:

>> **How the GHG emission reduction is achieved in the project:**

SADIA's objective is to improve its swine management systems and use Toledo and Faxinal swine farms as references to implement a deeper sustainable development program among its outsourced producers. This waste management program began in 2003, with the operation of these three anaerobic digesters starting in January 2004.

CDM project activity implemented by SADIA S/A:

Anaerobic Digester:

Manure originated in the barns enters a primary lagoon on a continuous flow powered by gravity. This primary lagoon is covered with an impermeable floating membrane that provides ideal conditions for methanogenic bacteria to decompose organic compounds into bio-gas. The bio gas is collected by perforated surrounding pipes (located at the edges of the digester and under the cover) and than flared, generating carbon dioxide.

Resulting effluent flows due to gravity to a secondary lagoon, where it is stored and can be used for irrigation at the company's surrounding fields. GHG emissions are expected to be dramatically reduced with this system.

Baseline Scenario:

Anaerobic Lagoon:

SADIA already has, in its swine producing farms of Faxinal and Toledo, manure treatment systems based on anaerobic lagoons. Usually this system consists in two aligned storage lagoons where manure, flushed from the surrounding barns is partially digested by naturally occurring micro-organisms and where solids settle at the bottom of the lagoons. Usually the surface water of the secondary lagoon is pumped for irrigation of surrounding fields for storage capacity increase. Solids settled at the bottom of the lagoon are removed once every 5 years and used for land fertilization.

This treatment system is characterized for low investment costs, low levels of management participation, poor environmental safeguards and high rates of GHG emission, especially methane.

Sadia owns 19 regional swine farms and anaerobic lagoons are present in 100% of them.

Fig. 4 – Baseline Anaerobic Lagoon – Toledo - SS - PR

SADIA also could stay with this pre-existing system, and make no further investments, since it is compliant with Brazilian legislation.

However, if the proposed CDM project is not developed, all greenhouse gases from the anaerobic lagoons will be emitted to the atmosphere, and the emission reductions (calculated on section E) will not be achieved.

National Policies and Circumstances

In order to clarify the actual circumstances regarding swine breeding in Brazil, below there is a transcription of the "Background Report of Methane Emissions from Livestock" issued by the Ministry of Science & Technology and EMBRAPA (Brazilian Agricultural Research Corporation) in 2002.(http://www.mct.gov.br/clima/ingles/comunic_old/agropec1.htm)

"*In the mid-90's, the major concentration of swine in Brazil was found in the Western part of the state of Santa Catarina, owing to the presence of the largest agro- industries linked to the sector. The swine wastes were directly drained, untreated, into streams and rivers, causing a serious environmental problem.*

Since 1996, however, a high number of properties with swine is introducing waste treatment systems, stimulated by the Expansion and Waste Treatment Program of the State of Santa Catarina. According to a study carried out in 1996, about 40% of the breeders linked to the swine production industry were using open tanks (esterqueiras) and open digesting (bioesterqueiras) systems in the state.

Currently, according to researchers of Embrapa Swine and Poultry (CNPSA), swine waste storage and treatment systems in the South of Brazil consist of open tanks (esterqueiras), open digesting (bioesterqueiras), ponds (anaerobic, variable and aerobic), cesspit, storage or treatment of compost (in solid form). ***Very few bio-digesters exist****. The material is normally distributed by pumps or gravity and applied to crops and pastures.* ***Information is not available at the state, regional or national level concerning the percentages of different treatment and disposal systems.***

As this report refers to the situation of the waste treatment in the early 90's (1990 to 1994), it was estimated that, for this period, only a fraction of swine manure (about 10%) was treated in the South region and in the state of São Paulo, and an even smaller fraction (5%) was treated in the Center-West and Southeast regions. The wastes generated in these regions were handled in two consecutive stages, first in bioesterqueiras, then a daily spread as fertilizer. For the other regions of Brazil (North and Northeast), it was assessed that there was no swine waste treatment, as the wastes were directly drained into streams and rivers (other systems)."

A.4.4.1. Estimated amount of emission reductions over the chosen crediting period:

>> The table below synthesizes the emission reduction results for Faxinal and Toledo (LM – Luz Marina and SS – São Sebastião) project activities during the proposed crediting period.

Emission Reductions (tCO2eq / year)	Faxinal	Toledo - LM	Toledo - SS
Total emission reductions	19.915,91	2.839,27	1.521,93
Total - 10 years	199.159,11	28.392,73	15.219,33

A.4.5. Public funding of the project activity:

>> There is no public funding involved in this project activity.

SECTION B. Application of a baseline methodology

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

>> The applicable approved baseline methodology for this project is "**GHG emission reduction from manure management systems**", and is referenced as AM0006. The complete approved methodology can be found on the CDM-Executive Board website: (http://www.cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_343163180).

B.1.1. Justification of the choice of the methodology and why it is applicable to the project activity:

>> The approved methodology AM0006 was applied to the project activity because the project fulfils the following required characteristics:

- The project context is represented by farms operating under a competitive market.
- Both manure management systems (project and baseline) are in accordance with the country regulatory framework.
- Livestock populations are managed under confined conditions.
- Barn systems and barn flushing systems are not the baseline scenario or the project activity.
- Livestock populations comprise only swine.
- Both project and baseline scenarios do not discharge manure into natural water resources.
- The project activity does not lead to a significant increase of electricity consumption.

Project participants should select the most relevant baseline approach for the proposed project activity. In this case, the baseline scenario is determined as the scenario that represents "emissions from a technology that represents an economically attractive course of action, considering barriers to investment". Therefore, this approach determines the baseline scenario under a cost – benefit evaluation and assumes that the most costly scenarios would not be implemented. The range of possible baseline scenario alternatives including different manure management technologies is detailed in the IPCC Guidelines (Chapter 4, Table 4-8) and also in the Brazilian Ministry of Science and Technology 1st GHG emission inventory (http://www.mct.gov.br/clima).

B.2. Description of how the methodology is applied in the context of the project activity:

>>

B.2.1 Description of the methodology application

The baseline scenario at Sadia's farms of Faxinal and Toledo was defined based on the following steps:

Step 1: List of possible baseline scenarios.

This list was based on data from the 1st Brazilian inventory of Anthropogenic GHG emissions from the Brazilian Ministry of Science and Technology (http://www.mct.gov.br/clima/ingles/comunic_old/invent1.htm):

According to the Ministry of Science and Technology and EMBRAPA (Brazilian Agricultural Research Corporation) the most common manure management systems in use in Brazil (and therefore plausible baseline scenarios) are:

- Open tank (*Esterqueira*) – small volume anaerobic lagoon

- Open digesting (*Bioesterqueira*) – an open tank plus a tank for waste storage
- Composting
- Pit storage below animal confinements
- Anaerobic lagoon
- Anaerobic digester
- Aerobic treatment

Step 2: Identification of plausible scenarios.

The aspects that are considered in identifying possible baseline scenarios are:

- Legal constraints.
- Historical practice within the company or pre – existing practices.
- Availability of technology.
- Possible and correct application of technology in the context.
- Consideration of technology developments within the National scenario.

The following list contains a brief description of each technology adopted in the country and a justification for the exclusion of some manure management systems that cannot be considered in the baseline scenario:

Open tank (*Esterqueira*)- Objective: Manure storage, manure stabilization and usage as fertilizer. Description: Rectangular structure excavated in the ground (2,5m depth) with impermeable cover. Advantages: easy to operate, low implementation cost. Why this alternative is not applicable as the baseline scenario: This alternative is limited to small farms with restricted waste volume generation (which is not SADIA's case). It also causes storage and transportation cost enhancement due to the fact that the manure is totally used as agriculture fertilizer. Considering the use of the treated swine manure as a nutrient concentration in the liquid waste increases the storage, transportation and application. Hence, the fertilizer usage is feasible only in agriculture areas placed near the swine farms. This alternative is recommended to small farmers that have agricultural surrounding areas and water consumption restrictions (http://www.cnpsa.embrapa.br/invtec/15.html).

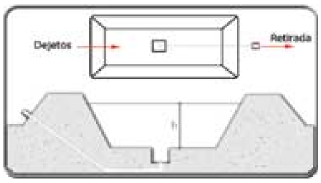

Fig. 5 – Open Tank

Open digesting (*Bioesterqueira*) – Objective: Manure storage, manure stabilization and usage as fertilizer. Description: Concrete rectangular structure excavated in the ground (2,5m depth) composed by two cells, one for the anaerobic digestion and the other for manure storage. Advantages: easy to operate, low implementation cost. Why this alternative is not applicable as the baseline scenario: This alternative is limited to small farms with restricted waste volume generation. It also causes storage and transportation cost enhancement due to the fact that the manure is totally used as agriculture fertilizer. This alternative is recommended to farmers with small effluent volume generation that have surrounding agricultural fields and water consumption restrictions. (http://www.cnpsa.embrapa.br/invtec/13.html).

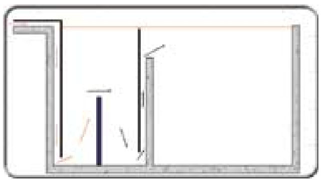

Fig. 6 – Open Digesting

Composting – Objective: To add value to the swine manure as a natural fertilizer. Description: Wood or concrete structure similar to a box, with at least two cells, provided by roof and gate in order to facilitate the waste removal. Advantage: reduction of odor and occurrence of pathogenic insects and parasites and low investment costs. Why this alternative is not applicable as the baseline scenario: Compositing systems are not adapted to large volumes of liquid effluents, so it can only be applied after solid separation stages. Compositing systems also need extra operational workforce. This alternative is recommended for farmers which main interest is selling solid fertilizer. (http://www.cnpsa.embrapa.br/invtec/16.html).

Fig. 7 – Composting System

Pit storage below animal confinements – Objective: Manure removal. Description: Excavation underneath the barns. Why this alternative is not applicable as the baseline scenario: Demands reliable uninterrupted electricity supply (very difficult to achieve at Brazilian rural areas).The excreted volume accumulated under the barns produces enteric fermentation gas, which could intoxicate swine livestock if it is not exhausted out of the barns.

Anaerobic lagoon – Objective: Organic material elimination and stabilization, pollutant and pathogenic substances removal. Description: Rectangular concrete structure excavated in the ground (2,5m depth) with impermeable cover. Advantage: easy to operate, low workforce demand, and low investment and maintenance costs. Disadvantages: requires significant physical area and removal of the accumulated sludge (each 3/ 5 years) and has low nitrogen removal efficiency. This alternative is recommended to breeders that have area availability and low investment capacity. Why this alternative is considered in the baseline scenario: SADIA's farms already have this manure management system in current operation. The farms also have area availability and deal with large liquid waste volumes. This system is compliant with the Brazilian legislation. (http://www.cnpsa.embrapa.br/invtec/17.html).

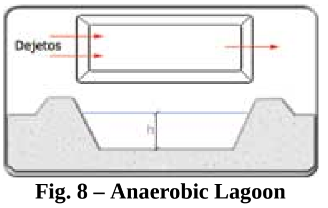

Fig. 8 – Anaerobic Lagoon

Anaerobic digester – Objective: Organic material elimination and stabilization, pollutant and pathogenic substances removal. Also adds value as biofertilizer and biogas for power generation. Description: Rectangular concrete structure excavated in the ground (2,5m depth) with impermeable and flexible cover (Vinimanta) fixed in a ditch (drain) full of water that surrounds the main structure; Should be installed with gas measuring equipment; Advantages: easy to operate, produces biofertlizer and biogas for power generation, and it is also an odor level reducer. Why this alternative is not applicable as the baseline scenario: requires high start – up and maintenance investment. This alternative is recommended to breeders that have area availability for agriculture use and interest in benefiting from biofertilizer in the agriculture and biogas for power generation.

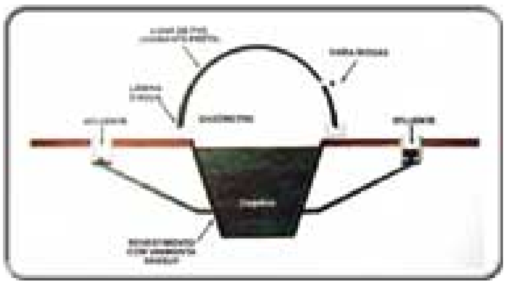

Fig 9 – Anaerobic Digester

Aerobic digester – Objective: Organic material elimination and stabilization, pollutant and pathogenic substances removal. Also adds value as bio – fertilizer and biogas for power generation. Description: Steel equipment (container) including cells, rotors, air injection equipments, sludge recirculation system. Advantages: easy to operate, reduction of treatment area and duration, odor elimination and decrease of work force demand. Why this alternative is not applicable as the baseline scenario: high investments and maintenance costs since the aerated digesters demand high energy supplement. This alternative is recommended to breeders that have area restriction for allocation of the treatment waste system and have interests to benefit from the bio – fertilizer in the agriculture and biogas for power generation.

Fig.10 – Aerobic Digester

Thus, the list of plausible scenarios has been reduced to one potential baseline scenario and to one project activity:

Possible Baseline Scenario: Anaerobic lagoon

Project Activity: Anaerobic digester

Step 3: Economic Comparison

In the 3rd step, the plausible scenarios identified in step 2 are compared economically. For each scenario, all costs and economic benefits are illustrated in a transparent and complete manner.

According to EMBRAPA - Brazilian Agriculture Research Corporation – (http://www.cnpsa.embrapa.br/invtec/index.html) the average implementation cost involved in each technology is: US$ 50 / m3 for an anaerobic digester and US$ 5,00 / m3 for a standard anaerobic lagoon.

Table B.2.1 – 1 – Faxinal

Baseline Faxinal - Anaerobic Lagoon	Year 1	Year 2	Year n	Year n+1
Equipment costs	0,00	0,00	0,00	0,00
Installation costs - ground excavation / impermeabilization	-111.176,45			
Maintenance costs (sludge drying, sludge removal, land incorporation)	-500,00	-500,00	-500,00	-500,00
Other costs (operation, consultancy, engineering, irrigation)	-1.000,00			
Revenues from the sale of electricity or other project related products, when applicable	0,00	0,00	0,00	0,00
SUBTOTAL	-112.676,45	-500,00	-500,00	-500,00
TOTAL Baseline	-112.676,45	-500,00	-500,00	-500,00
NPV (US$) - Discount Rate = 10%	**-103.563,52**			
IRR (%)	undefined			

Project Faxinal - Anaerobic Digester + Storage Lagoon	Year 1	Year 2	Year n	Year n+1
Equipment costs (Cover, PVC piping and flare)	-242.460,17	0,00	0,00	0,00
Installation costs - ground excavation / impermeabilization	-523.358,73			
Maintenance costs	-1.000,00	-1.000,00	-1.000,00	-1.000,00
Other costs (operation, consultancy, engineering)	-1.500,00			
Revenues from the sale of electricity or other project related products, when applicable	0,00	0,00	0,00	0,00
SUBTOTAL	-768.318,90	-1.000,00	-1.000,00	-1.000,00
TOTAL Baseline	-768.318,90	-1.000,00	-1.000,00	-1.000,00
NPV (US$) - Discount Rate = 10%	**-700.732,50**			
IRR (%)	undefined			

Table B.2.1-2 – Toledo Luz Marina

Baseline Luz Marina – Anaerobic Lagoon	Year 1	Year 2	Year n	Year n+1
Equipment costs	0,00	0,00	0,00	0,00
Installation costs – ground excavation	-5.940,00			

Maintenance costs (sludge drying, sludge removal, land incorporation)	-500,00	-500,00	-500,00	-500,00
Other costs (operation, consultancy, engineering, irrigation)	-1.000,00			
Revenues from the sale of electricity or other project related products, when applicable	0,00	0,00	0,00	0,00
SUBTOTAL	-7.440,00	-500,00	-500,00	-500,00
TOTAL Baseline	-7.440,00	-500,00	-500,00	-500,00
NPV (US$) – Discount Rate = 10%	**-7.894,02**			
IRR (%)	undefined			

Project Luz Marina – Anaerobic Digester + Storage Lagoon	**Year 1**	**Year 2**	**Year n**	**Year n+1**
Equipment costs (Cover, PVC piping and flare)	-19.800,00	0,00	0,00	0,00
Installation costs – ground excavation / impermeabilization	-39.600,00			
Maintenance costs	-1.000,00	-1.000,00	-1.000,00	-1.000,00
Other costs (operation, consultancy, engineering)	-1.500,00			
Revenues from the sale of electricity or other project related products, when applicable	0,00	0,00	0,00	0,00
SUBTOTAL	-61.900,00	-1.000,00	-1.000,00	-1.000,00
TOTAL Baseline	-61.900,00	-1.000,00	-1.000,00	-1.000,00
NPV (US$) – Discount Rate = 10%	**-58.533,50**			
IRR (%)	undefined			

Table B.2.1-3 – Toledo São Sebastião

Baseline São Sebastião – Anaerobic Lagoon	**Year 1**	**Year 2**	**Year n**	**Year n+1**
Equipment costs	0,00	0,00	0,00	0,00
Installation costs – ground excavation	-6.949,50			
Maintenance costs (sludge drying, sludge removal, land incorporation)	-500,00	-500,00	-500,00	-500,00
Other costs (operation, consultancy, engineering, irrigation)	-1.000,00			
Revenues from the sale of electricity or other project related products, when applicable	0,00	0,00	0,00	0,00
SUBTOTAL	-8.449,50	-500,00	-500,00	-500,00
TOTAL Baseline	-8.449,50	-500,00	-500,00	-500,00
NPV (US$) – Discount Rate = 10%	**-8.811,75**			
IRR (%)	undefined			

Project São Sebastião – Anaerobic Digester + Storage Lagoon	**Year 1**	**Year 2**	**Year n**	**Year n+1**
Equipment costs (Cover, PVC piping and flare)	-23.165,00	0,00	0,00	0,00
Installation costs – ground excavation / impermeabilization	-46.330,00			
Maintenance costs	-1.000,00	-1.000,00	-1.000,00	-1.000,00

Other costs (operation, consultancy, engineering)	-1.500,00			
Revenues from the sale of electricity or other project related products, when applicable	0,00	0,00	0,00	0,00
SUBTOTAL	-71.995,00	-1.000,00	-1.000,00	-1.000,00
TOTAL Baseline	-71.995,00	-1.000,00	-1.000,00	-1.000,00
NPV (US$) – Discount Rate = 10%	**-67.710,77**			
IRR (%)	undefined			

The Internal Return Rate (IRR) cannot be calculated due to the existence of only negative flows in the financial analysis, hence the comparison is based on the NPV, using the discount rate of 10%.

As demonstrated above, there is no positive cash flow scenario involved in the baseline or in the project activity. Therefore a cost – effective comparison is assumed to be adequate in order to determine the prevailing practice – usually the one that requires less investment.

The cash flow and present value comparison indicates that the anaerobic lagoon would be the most attractive course of action, so it can be assured that the project activity – anaerobic digester – is additional from an economic point of view.

Since an anaerobic digester requires a much higher investment, it can be assumed that the anaerobic lagoon is the most likely alternative and therefore can be considered the baseline scenario.

Step 4: Assessment of Barriers

As stated by the Brazilian Ministry of Science and Technology "***Very few bio-digesters exist****. The material is normally distributed by pumps or gravity and applied to crops and pastures."*

The project activity is not adopted on a national level due to the following barriers:

Investment Barriers: This manure management system is considered one of the most advanced practices in the world. Only few countries adopted this technology due to the high investment costs involved compared to other systems. Besides that, the Brazilian electrical generation grid does not incentive bio-gas sells into the system, since its implementation requires high investment compared to current electricity prices in Brazil. Furthermore, the producers lack the investment capacity to implement such a system and possible sources of financing are discouraging, since the interest rates are among the highest in the world (11,9% per year in real terms – while the average for developing countries is 3,0% per year) (http://www.amcham.com.br/update/update2004-07-21d_dtml).

Technology Barriers: In order to justify a digester implementation, a significant volume of liquid waste is needed, as well as barn proximity and concentration, since the system becomes progressively more expensive when the livestock population is smaller. Furthermore, consideration should be made on maintenance requirements regarding this technology (to assure optimal operation conditions) including a performance level monitoring program.

Legal Constraints: The existing legislation in Brazil, in order to protect water sources from contamination, establishes water quality parameters that require lagoons to be aligned, avoiding effluent direct discharge to the environment. Apart from that, there is no specific legislation (nor there are any plans to implement one) that requires specific manure treatment or GHG emission control. Based on that, the proposed project activity clearly exceeds current Brazilian regulations for swine waste treatment.

B.2.2 Calculation of the Emission Reductions

The table below summarizes the emissions for the baseline and project scenarios:

Baseline – Anaerobic Lagoon	Project – Anaerobic Digester
CH_4 emissions from anaerobic lagoon	Fugitive CH_4 emissions – inside project boundaries – due to digester losses.
N_2O emissions from anaerobic lagoon	Fugitive CH_4 from the storage lagoon
	N_2O emissions from storage lagoon

Table B.2.2.1 – Emission Summary

In order to represent emissions of each treatment stage in the project and baseline scenarios, Option B of the methodological approaches stated at the Baseline Methodology AM0006 was chosen (IPCC and US-EPA default values).

Default values are used to represent the volatile solids and nitrogen content in raw and treated manure. This approach was considered for emission quantification since the pre existing manure treatment system does not have a continuous effluent flow and has several entrances to the treatment process which interferes in the flow rate measurement system, leading to high implementation costs and possible malfunction due to obstruction originated from high level of solid content in the effluent.

Carbon emissions from methane combustion at the digester’s flare are considered biogenic. That assumption is based on the fact that organic matter consumed in the animal’s diet has a renewable (and therefore not fossil) origin.

The CO2 originated from anaerobic digestion does not represent any difference in emission volumes between each scenario, since there is no possible additional transformation by burning this component. However, N2O emissions are caused by the anaerobic lagoon at the baseline scenario and the storage (secondary) lagoon in the project activity.

B.3. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered CDM project activity:

>> According to the “Background Report on Methane Emissions from livestock” issued by the Ministry of Science and Technology and EMBRAPA “*Currently, according to researchers of Embrapa Swine and Poultry (CNPSA), swine waste storage and treatment systems in the South of Brazil consist of open tanks (esterqueiras), open digesting (bioesterqueiras), ponds (anaerobic, variable and aerobic), cesspit, storage or treatment of compost (in solid form).* ***Very few bio-digesters exist.*** *The material is normally distributed by pumps or gravity and applied to crops and pastures.”*

Considering the current practices in Brazil, especially open lagoons and storage tanks, all methane generated from these systems is emitted to the atmosphere. Sadia uses anaerobic lagoons in all its own farms, since this system is compliant with Brazilian legislation and it represents one of the likely economically attractive scenarios for swine waste management systems. In an economic point of view, an anaerobic lagoon implantation is much cheaper than a digester implantation (as seen on step 3 of item

B.2). According to EMBRAPA - Brazilian Agriculture Research Corporation – (http://www.cnpsa.embrapa.br/invtec/index.html) the average implementation cost involved in each technology is: US$ 50 / m3 for an anaerobic digester and US$ 5,00 / m3 for a standard anaerobic lagoon.

In an anaerobic lagoon system, swine manure is flushed from the barns and flows to a collection lagoon (or an open tank). The manure is partially digested at ambient temperature by naturally occurring anaerobic micro – organisms, resulting in atmospheric emissions of methane, carbon dioxide, ammonia and hydrogen sulphide.

The manure management system proposed by the project - anaerobic digestion – captures a significant amount of the digested volatile solids (in the form of carbon dioxide and methane) produced from anaerobic bacteria.

An anaerobic digester consists of an impermeable pit covered by a floating membrane. Bio gas produced is collected by surrounding pipes and then flared. The effluent flows to a nearby secondary lagoon, where it is pumped to surrounding crops and eucalyptus fields.

Therefore, emissions to the atmosphere are avoided since the previous existing scenario of open lagoon (emitting CH_4, CO_2, H_2S and NH_3) is replaced by a digester, which captures bio – gas and flares it, converting methane into CO_2.

B.4. Description of how the definition of the project boundary related to the baseline methodology selected is applied to the project activity:

>>The boundaries are restricted to on – site emissions. This implies that application of treated manure on surrounding fields does not contribute to methane emissions in the project boundary. The project boundary includes only emissions (and related reductions) from manure management systems regarding swine manure from producing barns that discharges effluent into treatment systems.

Carbon emissions originated from methane flaring are considered biogenic. This assumption is based on the fact that animal feeding has a renewable (and not fossil) source. Potential fugitive emissions (leakage) related to anaerobic digestion (cover and pipe systems) are already included within the project boundaries.

The project does not estimate emissions generated outside the boundaries which are significant and reasonably attributable to changes in effluent treatment. The project considers aerobic and controlled conditions for sludge removed from the secondary (storage) lagoon bottom for land application in soil recovery. Land application will be done in surrounding fields, outside the project boundaries. Methane and nitrous oxide emissions can be considered negligible since there are no anaerobic conditions involved in the process.
The considered boundary for each scenario is shown below:

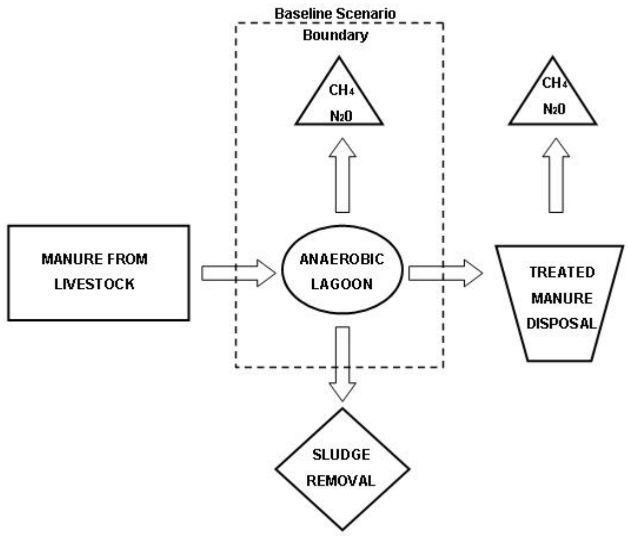

Fig. 11 – Baseline Boundary

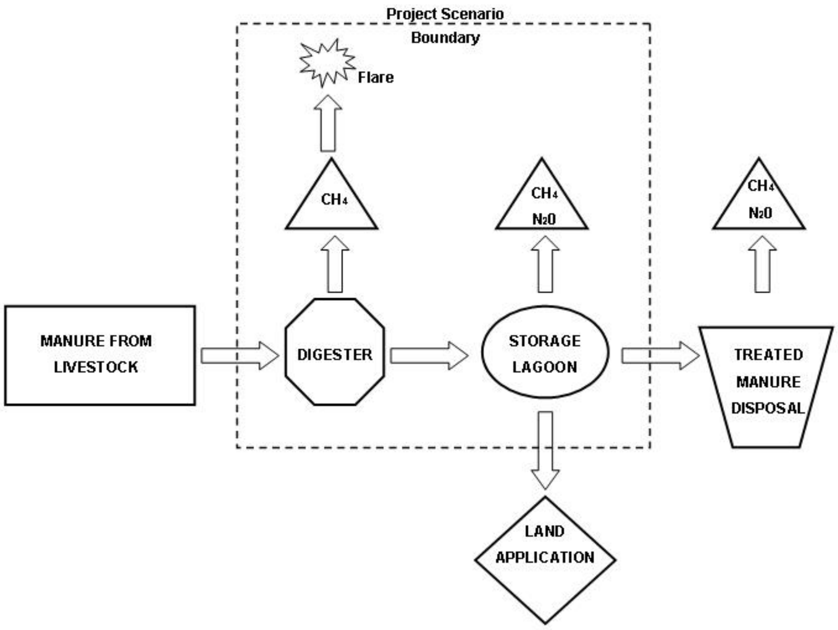

Fig. 12 – Project Boundary

B.5. Details of baseline information, including the date of completion of the baseline study and the name of person (s)/entity (ies) determining the baseline:

>>**Date of completion of the final draft of this baseline section (*dd/mm/yyyy*):**

11/11/2004

Name of person / entity determining the baseline:

PricewaterhouseCoopers
Marco Antonio Fujihara
Av. Francisco Matarazzo, 1.400
São Paulo – SP
CEP 05001 – 903
Brazil
Telephone Number: +55 (11) 3674 – 2000
e-mail: marco.fujihara@br.pwc.com

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

The duration of the project activity is 10 years.

C.1.1. Starting date of the project activity:

>> The starting date of the project activity is 1st of January of 2004 (for Faxinal and Toledo).

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

>> 50 years.

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

C.2.1. Renewable crediting period

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

>> Not Applicable

C.2.1.2. Length of the first crediting period:

>> Not Applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

>>01/01/2004

C.2.2.2. Length:

>>10 years

SECTION D. Application of a monitoring methodology and plan

D.1. Name and reference of approved monitoring methodology applied to the project activity:

>> The approved monitoring methodology is called "GHG emission reduction from manure management systems" referenced as AM0006.

More information regarding this approved methodology can be found at the link:

http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_343163180

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

>> This project activity is based on the approved methodology AM0006 and follows its applicability conditions:

- The project context is represented by farms operating under a competitive market.
- Both manure management systems (project and baseline) are in accordance with the country regulatory framework.
- Livestock populations are managed under confined conditions.
- Barn systems and barn flushing systems are not the baseline scenario or the project activity.
- Livestock populations comprise only swine.
- Both project and baseline scenarios do not discharge manure into natural water resources.
- The project activity does not lead to a significant increase of electricity consumption.

Baseline Methodology AM0006 describes the formulae that represent the emissions of every source in the baseline and project scenarios. It also contains the parameters to be monitored that are compliant with the project characteristics and context and which are compared to the baseline and default data to calculate the resulting reductions.

D.2. 1. Option 1: Monitoring of the emissions in the project scenario and the baseline scenario

D.2.1.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
D.2 - 1	Number	Daily Swine Stock	# Heads	Measured	Weekly	100%	Paper	
D.2 - 2	Mass	Swine Stock Average Weight	Kg	Measured	Barn population renovation cycle	100%	Paper	
D.2 – 3	Flow Rate	Biogas flow extracted from the digester	m3 / day	Measured	Daily	100%	Paper and Electronic	This parameter shows the digester performance and gas recovery rate.
D.2 - 4	Percentile	Co2 concentratio n in gas flow	%	Measured	Daily	100%	Paper and Electronic	This parameter shows the anaerobic digestion performance.
D.2 - 5	Percentile	Flare Efficiency	%	Default value from equipment	-	100%	Paper	This efficiency cannot be measured. The value used will be provided by the equipment manufacturer.

D.2.1.2. Description of formulae used to estimate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> This section is based on the equations used on the approved methodology AM0006.

CH4 Emissions for Manure Management Systems Equations:

Equation 1: CH4 Emissions related to the anaerobic digester.

$$E_{ch4,mm,1,y} = VS \times Bo \times D_{CH4} \times MCF_1 \times GWP_{CH4} \times N_y \times 365 / 1000$$

Equation 2: CH4 Emissions related to the storage lagoon

$$E_{ch4,mm,2,y} = VS \times [1 - Rvs] \times Bo \times D_{CH4} \times MCF_2 \times GWP_{CH4} \times N_y \times 365 / 1000$$

Where:

$E_{CH4,mm,1,y}$:	CH4 emissions related to the anaerobic digester during the year y in tons of CO_2 equivalent.
$E_{CH4,mm,2,y}$:	CH4 emissions related to the storage lagoon during the year y in tons CO_2 equivalent.
GWP_{CH4}:	Approved global Warming Potential (GWP) of CH_4.
MCF1:	Methane conversion factor (MCF) for treatment of manure in the anaerobic digester in per cent (digester in the project scenario).
MCF2:	Methane conversion factor (MCF) for treatment of manure in the storage lagoon.
D_{CH4}:	CH_4 density (0,67kg/m^3 at room temperature, 20^o C and 1 atm pressure).
VS:	Volatile solid excretion per day in dry-matter basis for a defined livestock population in kg-dm/animal/day, for year y. For this project it will be considered the use of the corrected default IPCC values.
R_{VS}:	Relative reduction of volatile solids in the second treatment stage in per cent, referenced from EPA_CAFO default value.
B_0:	Maximum CH_4 production capacity from the manure per animal for a defined livestock population (m^3 CH_4/kg-dm).
N_y:	Livestock of a defined population per year.

$N_2$0 Emissions equations from anaerobic lagoon and storage losses

Equation 3: N_2O emissions related to the storage lagoon treatment stage where there are no monitored values available.

$$E_{N_2O,mm,1,y} = GWP_{N_2O} \times NEX_y \times N_y \times EF_{N2O,mmmi} \times CF_{N2O-N,N} / 1000$$

Where:

$E_{N_2O,mm,1,y}$:	Nitrous oxide emissions from the storage lagoon stage of the manure management system in tons of CO_2 equivalents per year.
GWP_{N_2O}:	Approved Global Warming Potential for N_2O
$EF_{N2O,mmmi}$:	N_2O emissions factor for the first treatment stage of the manure management system in kg N_2O-N/kgN (EF_3 in 1996 revised IPCC Guidelines and IPCC GPG).

NEX_{y}: Annual average nitrogen excretion per animal of the defined livestock population in kg N/animal/year, for year y.
$CF_{N2O-N,N}$: Conversion factor N_2O-N to N (44/28)
N_{y}: Livestock of the defined population for year y.

Weighting and Correction of key parameters

1) Volatile Solids in raw manure

The IPCC default values are based on an average weight of 82 kg / swine. In order to obtain a representative figure the IPCC default value for Volatile Solids is corrected as follows:

Equation 4: Volatile solids content in raw manure (Vs).

$$VS_{site} = (W_{site} / W_{default}) \times VS_{default}$$

Where:

VS_{site}: Adjusted volatile solid excretion per day on dry-matter basis for a defined livestock population at the project site in kg-dm/animal/day.
W_{site}: Average site animal weight for defined population in kg.
$W_{default}$: Default average animal weight of a defined population in kg.
$VS_{default}$: Default value (IPCC or US-EPA) for the volatile solid excretion per day on a dry-matter basis for a defined livestock population in kg-dm/animal/day.

2) Nitrogen content in raw manure (NEX)

The IPCC default values are based on an average weight of 82 kg / swine. In order to obtain a representative figure the IPCC default value for Nitrogen Excretion Rate is corrected as follows, whenever monitored data is not available:

Equation 5: Nitrogen excretion rate for raw manure in kg./head/day

$$NEX_{site} = (W_{site} / W_{default}) \times NEX_{default}$$

Where:

NEX_{site}: Adjusted annual average nitrogen excretion per head of a defined livestock population in kg N/animal/year.
W_{site}: Average site animal weight of a defined population in kg.
$W_{default}$: Default average animal weight of a defined population in kg.
$NEX_{default}$: Default value (IPCC) for the nitrogen excretion per head of a defined livestock population in kg N/animal/year.

D.2.1.3. Relevant data necessary for determining the baseline of anthropogenic emissions by sources of GHGs within the project boundary and how such data will be collected and archived :

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
D.2.-1	Number	Daily swine stock	Heads	Measured	Weekly	100%	Paper	These parameters are used for baseline emission calculation.
D.2.-2	Mass	Average weight of pigs	Kg	Measured	Every barn cycle	100%	Paper	

D.2.1.4. Description of formulae used to estimate baseline emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> The formula to quantify the emissions for the Baseline scenario (anaerobic lagoon) has been described in D.2.1.2.

D. 2.2. Option 2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E).

Not applicable. The emission reductions are not directly monitored.

D.2.2.1. Data to be collected in order to monitor emissions from the project activity, and how this data will be archived:

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c), estimated (e),	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
-	-	-	-	-	-	-	-	-

D.2.2.2. Description of formulae used to calculate project emissions (for each gas, source, formulae/algorithm, emissions units of CO_2 equivalent.):

>> The formulae are demonstrated on item D.2.1.2.

D.2.3. Treatment of leakage in the monitoring plan

D.2.3.1. If applicable, please describe the data and information that will be collected in order to monitor leakage effects of the project activity – Not Applicable since the project does not consider anaerobic conditions for treated manure management.

ID number *(Please use numbers to ease cross-referencing to table D.3)*	Data variable	Source of data	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic/ paper)	Comment
-	-	-	-	-	-	-	-	-

D.2.3.2. Description of formulae used to estimate leakage (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> Not applicable. The project activity does not consider anaerobic conditions for sludge removed from the storage (secondary) lagoon's bottom. Digester's losses are already included on project activity calculations.

D.2.4. Description of formulae used to estimate emission reductions for the project activity (for each gas, source, formulae/algorithm, emissions units of CO_2 equ.)

>> The formulae used are demonstrated on item D.2.1.2. Emission reductions are obtained by the different methane conversion factors (MCF) adopted for each scenario. More information can be found on Annex III – Baseline Information.

D.3. Quality control (QC) and quality assurance (QA) procedures are being undertaken for data monitored

Data *(Indicate table and ID number e.g. 3.-1.; 3.2.)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.2-1	Low	QA/QC procedures are already established by SADIA (which is certified ISO 9000 and ISO 14000). Weekly livestock measurement is a common practice within the farms to control population.
D.2-2	Low	QA/QC procedures are already established by SADIA (which is certified ISO 9000 and ISO 14000). Measurement of the livestock weight is already necessary before shipping swine to meat processing plants.

D.2.-3	Low	QA / QC is being established. It will be supported by flow rate, PH and temperature variability control at the farms and will be included on SADIA's Environmental Management System.
D.2-4	Low	QA / QC is being established. It will be supported by flow rate, PH and temperature variability control at the farms and will be included on SADIA's Environmental Management System.
D.2.-5	Low	This parameter will not be monitored. The data relies on manufacturer's specification.

D.4 Please describe the operational and management structure that the project operator will implement in order to monitor emission reductions and any leakage effects, generated by the project activity

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>> The emission reduction is calculated based on monitored values and not by direct monitoring. These values should be supported by SADIA's Total Quality Management System and Environmental Management System. SADIA is ISO 9000 and ISO 14000 certified.

Direct monitoring of raw manure is not considered in the project since the effluent flow is not continuous and there are several entrances into the treatment process. The waste water contains high rates of solids, which might lead to measurement equipment obstruction and malfunction.

D.5 Name of person/entity determining the monitoring methodology:

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>>
PricewaterhouseCoopers
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SECTION E. Estimation of GHG emissions by sources

E.1. Estimate of GHG emissions by sources:

>> Project emissions by sources are detailed below:

Project Emissions (tCO2eq / year)	Faxinal	Toledo - LM	Toledo - SS
Digester's losses and leakage	1.486,26	211,89	113,58
Lagoon CH4	5.350,54	762,79	408,88
Lagoon N2O	250,64	35,73	19,15
Total project Emissions	7.087,44	1.010,41	541,61
Total - 10 years	70.874,41	10.104,07	5.416,08

Table E.1 – Detailed project emissions by sources.

E.2. Estimated leakage:

>> It is already included within the project boundaries the potential fugitive emissions related to the digester. Emissions generated outside the project boundaries that are significant and reasonably attributable to changes in manure management are not expected. The digester power consumption (100 kWh) is assumed insignificant in Co2 eq. emissions and therefore not considered in leakage calculations.

E.3. The sum of E.1 and E.2 representing the project activity emissions:

>> As there are no leakage emissions considered in this project activity during the crediting period the results shown on table E.1 should be considered representative for the project emissions.

Project Emissions (tCO2eq / year)	Faxinal	Toledo - LM	Toledo - SS
Digester's losses and leakage	1.486,26	211,89	113,58
Lagoon CH4	5.350,54	762,79	408,88
Lagoon N2O	250,64	35,73	19,15
Total project Emissions	7.087,44	1.010,41	541,61
Total - 10 years	70.874,41	10.104,07	5.416,08

Table E.3 – Total project emissions.

E.4. Estimated anthropogenic emissions by sources of greenhouse gases of the baseline:

>> Baseline emissions by sources are detailed below:

Baseline Emissions (tCO2eq / year)	Faxinal	Toledo - LM	Toledo - SS
Lagoon CH4	26.752,72	3.813,95	2.044,39
Lagoon N2O	250,64	35,73	19,15
Total Baseline Emissions	27.003,35	3.849,68	2.063,54
Total - 10 years	270.033,52	38.496,80	20.635,40

Table E.4 – Detailed baseline emissions by sources.

E.5. Difference between E.4 and E.3 representing the emission reductions of the project activity:

>> The emission reductions achieved by the project activity are demonstrated below:

Emission Reductions (tCO2eq / year)	Faxinal	Toledo - LM	Toledo - SS
Total emission reductions	19.915,91	2.839,27	1.521,93
Total - 10 years	199.159,11	28.392,73	15.219,33

Table E.5 – Total emission reductions.

E.6. Table providing values obtained when applying formulae above:

>> Applying the equations listed on section D, the following values are obtained:

E.6.1 – Methane emissions for manure management systems

Anaerobic Lagoon:

	Parameter	Value	Unit	Source
Methane Emissions from Manure Management (E CH4 Pr) FAXINAL	VS Site	0,35	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)
	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)
	D CH4	0,67	kg / m3	Default Data
	MCF 1	0,9	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	36.911	# Head	SADIA S/A
E CH4,mm,1,y	**Total**	**26.752,72**	**ton Co2 eq. / year**	

	Parameter	Value	Unit	Source
Methane Emissions from Manure Management (E CH4 Pr) TOLEDO LM	VS Site	0,39	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)
	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)
	D CH4	0,67	kg / m3	Default Data
	MCF 1	0,9	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	4.721	# Head	SADIA S/A
E CH4,mm,1,y	**Total**	**3.813,95**	**ton Co2 eq. / year**	

Methane Emissions from Manure Management (E CH4 Pr) TOLEDO SS	Parameter	Value	Unit	Source
	VS Site	0,31	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)
	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)

	D CH4	0,67	kg / m3	Default Data
	MCF 1	0,9	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	3.218	# Head	SADIA S/A
E CH4,mm,1,y	**Total**	**2.044,39**	**ton Co2 eq. / year**	

Anaerobic digester:

Methane Emissions from Manure Management (E CH4 Pr) FAXINAL	**Parameter**	**Value**	**Unit**	**Source**
	VS Site	0,35	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)
	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)
	D CH4	0,67	kg / m3	Default Data
	MCF 1	0,05	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	36.911	# Head	SADIA S/A
E CH4,mm,1,y	**Total**	**1.486,26**	**ton Co2 eq. / year**	

Methane Emissions from Manure Management (E CH4 Pr) TOLEDO LM	**Parameter**	**Value**	**Unit**	**Source**
	VS Site	0,39	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)
	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)
	D CH4	0,67	kg / m3	Default Data
	MCF 1	0,05	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	4.721	# Head	SADIA S/A
E CH4,mm,1,y	**Total**	**211,89**	**ton Co2 eq. / year**	

Methane Emissions from Manure Management (E CH4 Pr) TOLEDO SS	**Parameter**	**Value**	**Unit**	**Source**
	VS Site	0,31	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)

	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)
	D CH4	0,67	kg / m3	Default Data
	MCF 1	0,05	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	3.218	# Head	SADIA S/A
E CH4,mm,1,y	**Total**	**113,58**	**ton Co2 eq. / year**	

E.6.2 – Storage Lagoon methane emissions:

	Parameter	Value	Unit	Source
Methane Emissions from Manure Management (E CH4 Pr) FAXINAL	VS Site	0,35	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)
	[1-Rvs]	0,40	N/A	EPA - CAFO default value
	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)
	D CH4	0,67	kg / m3	Default Data
	MCF 2	0,45	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	36.911	# Head	SADIA S/A
E CH4,mm,2,y	**Total**	**5.350,54**	**ton Co2 eq. / year**	

	Parameter	Value	Unit	Source
Methane Emissions from Manure Management (E CH4 Pr) TOLEDO LM	VS Site	0,39	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)
	[1-Rvs]	0,40	N/A	EPA - CAFO default value
	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)
	D CH4	0,67	kg / m3	Default Data
	MCF 2	0,45	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	4.721	# Head	SADIA S/A
E CH4,mm,2,y	**Total**	**762,79**	**ton Co2 eq. / year**	

	Parameter	Value	Unit	Source
Methane Emissions from Manure Management (E CH4 Pr) TOLEDO SS	VS Site	0,31	Kg-dm / animal / day	Revised 1996 IPCC (p. 4.42)
	[1-Rvs]	0,40	N/A	EPA - CAFO default value
	Bo pop	0,45	m3 CH4 / Kg - dm	Revised 1996 IPCC (p. 4.42)
	D CH4	0,67	kg / m3	Default Data
	MCF 2	0,45	%	IPCC Guidelines (Table 4-8 / B-6)
	GWP CH4	21	N/A	Approved Global Warming Potential
	N pop	3.218	# Head	SADIA S/A
E CH4,mm,2,y	**Total**	**408,88**	**ton Co2 eq. / year**	

E.6.3 – Nitrous Oxide emissions from anaerobic lagoon and storage losses.

	Parameter	Value	Unit	Source
Nitrous Oxide Emissions from anaerobic lagoon and storage losses - FAXINAL	GWP N20	310	N/A	Approved Global Warming Potential
	NEX	13,94	Kg N / animal / year	Revised 1996 IPCC (p. 4.99)
	N pop	36.911	# Head	SADIA S/A
	EF 3	0,001	kg N2O-N / kg N	IPCC GPG 2000 (p. 4.43)
	CF	1,5714	N/A	Conversion Factor (44/28)
	Total	**250,64**	**ton Co2 eq. / year**	

	Parameter	Value	Unit	Source
Nitrous Oxide Emissions from anaerobic lagoon and storage losses - TOLEDO LM	GWP N20	310	N/A	Approved Global Warming Potential
	NEX	15,54	Kg N / animal / year	Revised 1996 IPCC (p. 4.99)
	N pop	4.721	# Head	SADIA S/A
	EF 3	0,001	kg N2O-N / kg N	IPCC GPG 2000 (p. 4.43)
	CF	1,5714	N/A	Conversion Factor (44/28)
	Total	**35,73**	**ton Co2 eq. / year**	

	Parameter	Value	Unit	Source
Nitrous Oxide Emissions from anaerobic lagoon and storage losses - TOLEDO SS	GWP N20	310	N/A	Approved Global Warming Potential
	NEX	12,22	Kg N / animal / year	Revised 1996 IPCC (p. 4.99)
	N pop	3.218	# Head	SADIA S/A
	EF 3	0,001	kg N2O-N / kg N	IPCC GPG 2000 (p. 4.43)
	CF	1,5714	N/A	Conversion Factor (44/28)
	Total	**19,15**	**ton Co2 eq. / year**	

SECTION F. Environmental impacts

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

>>The Brazilian environmental legislation and authorities obliges the swine producers to apply for an environmental permit process in which the environmental impacts are evaluated. Once Sadia permits for Toledo and Faxinal has already been issued, the implementation of an anaerobic digester must be communicated to the environmental authorities, thus does not requiring a specific Environmental Impact Study.

The manure waste treatment proposed by the project will provide several environmental benefits, as described in the section A.4.3 of this report. The project contributes to the sustainable development while promoting the greenhouse gases emission reduction. The anaerobic digester reduces the organic matter of the wastewater in comparison to the anaerobic lagoon. Furthermore, the unpleasant odor of the volatile molecules resultant of the anaerobic digestion is significantly decreased as the gases formed are contained within the floating cover and afterwards burned in the flare. The pioneer position of Sadia to implement an anaerobic digester is a great challenge that should be regarded as an initiative that will stimulate other swine farmers in Santa Catarina and Paraná States to improve the existent manure treatment in order to reduce the environmental impact of livestock.

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

>>The environmental impacts concerning the project activity are considered positive as they contribute to the local and global sustainable development.

SECTION G. Stakeholders' comments

>>

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

>> The stakeholders' invitation followed the procedures of the "Resolution # 1 of September 11, 2003 (Approved by Administrative Rule nº 863 of November, 27, 2003.and published in the Federative Republic of Brazil Diário Oficial (Official Gazette) of December, 2, 2003.)". Invitations and presence lists are available upon request.

The energy manager of SADIA, Mr. Julio Cavasin made two presentations regarding the proposed CDM activities for local stakeholders:

The first one was held on June 23rd 2004 , at avenue Attilio Fontana, 4040, Toledo, Paraná. Attended the meeting representatives of the ACIT - Trade and Industrial association of Toledo, of the University of West Paraná, of PUC - Catholic University, IAP – Environmental Institute of Paraná, Municipal City hall of Toledo and employees of Sadia.

Fig. 13 – Project presentation at Faxinal dos Guedes - SC

The second presentation was held on June 26th 2004, at the Training Center Auditorium of Sadia Company S/A, located on Road BR 282, kilometre 491, Faxinal dos Guedes, Santa Catarina. Attended the event representatives of Municipal City hall of Xanxerê and Faxinal dos Guedes, representatives of the local judiciary and state attorneys, Environmental Institute, Ministry of Agriculture, Local NGOs (Agenda 21) and Universities (UNOESC).

G.2. Summary of the comments received:

>>>>The comments received during the presentations were related to the clarification of the project itself and its operational structure, and there were not any comments regarding objections to the proposed project activity.

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

>>>> All clarifications requested by local attending stakeholders were addressed during the debate after the presentations.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

There is no public funding involved in the proposed project activity.

Annex 3

BASELINE INFORMATION

The following sources were used to calculate baseline emissions:

- 1996 Revised IPCC Guidelines – Chapter 4 – Reference Manual;
- IPCC Good Practice Guidance and Uncertainty management in National GHG inventories – Chapter 4;
- US – EPA 2001: Development document for the proposed revisions to the National pollutant discharge elimination system regulation and the effluent guidelines for concentrated animal feeding operations – Chapter 8.2
- Development of a Methane Conversion Factor to Estimate Emissions from Animal Waste Lagoons – Joseph Mangino, Deborah Bartram and Amy Brazy;
- Approved Baseline Methodology AM0006 "GHG emission reductions from manure management systems".
- First Brazilian Inventory of Anthropogenic Greenhouse Gas Emissions - Background Reports - Agriculture and Livestock.

(1) – Project Specific Data (SADIA farm data):

Location	VS site	NEX site	W site	W default	VS default	# Head	Total livestock weight	Operation Days
Faxinal	0,35	13,94	57,15	82	0,50	36.911	2.109.452,50	365
Toledo LM	0,39	15,54	63,70	82	0,50	4.721	300.730,00	365
Toledo SS	0,31	12,22	50,09	82	0,50	3.218	161.200,00	365

Table 3.1 – Site Corrected Data

(2) – Global warming potential

	GWP
Carbon Dioxide (CO2)	1
Methane (CH4)	21
Nitrous Oxide (N2O)	310

Table 3.2 – GWP values

(3) – Volatile Solids (Vs)

In accordance with the average feed and energy intake at SADIA's barns, the base value used for Vs is the IPCC rate in raw manure (0,5 kg / day / head) for developed countries. This assumption considers that SADIA's practices, including feeding type, rate and livestock genetics are similar to developed countries practices. The volatile solids rate, calculated to a representative weight of 82 kg / head was adjusted to the average farm swine weight, measured on site.

(4) Bo

The default Bo value, which represents the maximum methane production capacity from manure per head, was obtained from the Revised 1996 IPCC Guidelines for National GHG inventories. Considering the actual practices at SADIA farms, it was assumed that a representative value for developed countries (0,45 m3 / kg) should be used.

(5) MCF – Methane Conversion Factors

For MCF the following IPCC default data was used (obtained from Revised IPCC Guidelines – tables 4-8 and B-6 and IPCC Good Practice and Uncertainty Management – table 4.10) for temperate climates (site specific climate specification can be found at www.ibge.gov.br)

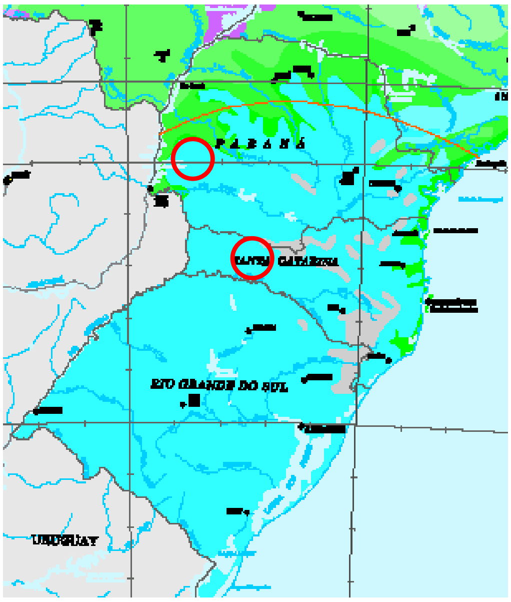

Fig. A-1 – Project Activity climate zone – Areas in blue are considered temperate.

MCF %		
Baseline	Anaerobic Lagoon	90%
Project	Anaerobic Digester Fugitive Emissions	5%
	Storage Lagoon	45%

Table 3.3 – Methane Conversion Factors for different emission sources.

(6) Nitrogen Excretion Rate (NeX)

The nitrogen excretion rate was extracted from the 1996 IPCC Guidelines, table 4-20. The rate used (20 kg / head / day) for developed countries was corrected for the average swine weight of the farms.

(7) Default Emission Factors for N2O (EF 3)

The default parameter used for EF 3 (0,001 kg N2O – N / Kg nitrogen excreted) was extracted from IPCC Good Practice Guidance and Uncertainty Management in National GHG inventories (table 4-13) and from Revised 1996 IPCC Guidelines (table 4-22).

Annex 4

MONITORING PLAN

The following table presents the monitoring plan followed by Sadia in order to achieve certified emission reductions, after each validation and verification process:

DATA VARIABLE	UNCERTAINTY LEVEL	DATA UNIT	DATA ORIGIN
Animal Population	Low	Heads	Daily animal Stock and inlet program of pigs. (Net inlet considering mortality). Information managed by Sadia
Average Weight of Animals	Low	KG	Pavilion test and growing tendency curves. Information managed by Sadia
Biogas Flow Extracted by Digester	Low	m^3/day	Registers from the measurement system. Information managed by Sadia
CO2 Concentration in Gas Flow	Low	%	Registers from the measurement system. Information managed by Sadia
Flare Efficiency	Low	%	Design Combustion Efficiency. Provided by Flare's Manufactor

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