AWMS GHG Mitigation Project BR05-B-06, Bahía, Brazil

UNFCCC Clean Development Mechanism
Project Design Document

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SECTION A. General description of project activity

A.1 Title of the project activity:

AWMS GHG Mitigation Project BR05-B-06, Bahía, Brazil.

A.2 Description of the project activity:

General: Worldwide, agricultural operations are becoming progressively more intensive to realize economies of production and scale. The pressure to become more efficient drives significant operational similarities between farms of a "type," as inputs, outputs, practices, genetics, and technology have become similar around the world.

This is especially true in livestock operations (swine, dairy cows, etc.) which can create profound environmental consequences, such as greenhouse gas emissions, odour, and water/land contamination (including seepage, runoff, and over application), that result from storing (and disposing of) animal waste. Confined Animal Feeding Operations (CAFOs) use similar Animal Waste Management System (AWMS) options to store animal effluent. These systems emit both methane (CH_4) and nitrous oxide (N_2O) resulting from both aerobic and anaerobic decomposition processes.

This project proposes to apply to multiple swine CAFOs (located in northeast Brazil) a GHG mitigation methodology which is applicable to intensive livestock operations. The proposed project activities will mitigate AWMS GHG emissions in an economically sustainable manner, and will result in other environmental benefits, such as improved water quality and reduced odour. In simple terms, the project proposes to move the designated farms from a high-GHG AWMS practice; an open air lagoon, to a lower-GHG AWMS practice; an ambient temperature anaerobic digester with the capture and combustion of the resulting biogas.

Purpose: The purpose of this project is to mitigate animal effluent related GHG by improving AWMS practices.

Contribution to sustainable development:

According to Brazil's *Inter-Ministerial Commission on Global Climatic Change,*[1] manure management is an important issue that needs to be solved. Failure to do so will allow existing problems (such as increased (insect) pest populations, problems with allergies and livestock disease, including foot-and-mouth disease (FMD) which exists in Brazil) to continue unabated. To this end, Brazil has in recent years required all CAFOs to transition (from single) to multi-lagoon systems, and even more recently has required them to line the bottom of their primary sedimentation lagoon to prevent effluent seepage.[2]

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[1] http://www.ambientebrasil.com.br

[2] A re-lined lagoon typically delivers a nominal 20-30 years of performance. For additional data refer to: R.J. McMillan, et al, "Studies of Seepage Beneath Earthen Manure Storages and Cattle Pens in Manitoba," Manuscript in Preparation, University of Manitoba & The Water Branch of Manitoba; Ground Water Monitoring & Assessment Program, (2001) "Effects of Liquid Manure Storage Systems on Ground Water Quality," Minnesota Pollution Control Agency; American Society of Agricultural Engineers, (2003) "Seepage Losses From Animal Waste Lagoons: A Summary of a Four Year Investigation in Kansas", Technical Library

Establishing a positive model for other livestock operations is essential. In the last ten years, Brazilian swine production grew by 28%, reaching breeding levels of approximately 36 million animals.[3] In 2001, the swine population in Bahía, Brazil was 2,052,603.[4] Considering that a typical hog produces 5.8 kilograms of effluent daily (Table A1), annually some 4.3 million metric tons of hog waste is produced in Bahía alone. Introducing progressive AWMS practices throughout the region could result in an annual reduction of approximately 1.8 million tonnes[5] of carbon dioxide equivalent (CO_2e) in the state of Bahía alone.

Table A1. Daily production of effluent by type of porcine[6]

Stage	Manure kg/day	Manure and Urine kg/day	Volume litres/day	Volume m^3/animal/month
25-100 kg	2.3	4.9	7.0	.25
Gestating sows	3.6	11.0	16.0	.48
Nursing sows	6.4	18.0	27.0	.81
Boar pig	3.0	6.0	9.0	.28
Piglet	0.35	0.95	1.4	.05
Average	2.35	5.8	8.6	.27

Furthermore, the proper handling of this large quantity of CAFO animal waste is critical to protecting human health and the environment. Because of the practices employed by farmers, the design, location, and management of livestock operations are critical components in ensuring an adequate level of protection of human health and the environment.[7]

Energy problems are also a major issue in rural regions of Brazil. Dilma Rousseff, Brazil's Minister of Energy states, "We are facing a great crisis in the country's electricity system." In July, 2003, Roussef warned that the country could face another power crisis by 2007.[8] Anaerobic digesters produce biogas containing a high percentage of methane, which can be used for localized energy (either heat or electricity) production. This previously untapped energy potential can serve to augment or offset local supply.

The proposed GHG mitigation project satisfies the Brazilian government priorities for environmental stewardship and sustainability while positioning the project activity participants to develop and use renewable ("green") energy. Indeed, it does so with no negative consequences and affords a series of environmental and infrastructure co-benefits (some of which are outlined in Section F).

Because the proposed project establishes an advanced AWMS and includes means for subsequently establishing on-farm electricity generation, the project participants believe the farm managers will adopt –

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[3] Anaulpec, 2001

[4] www.agricultura.gov.br/pls/portal/docs/PAGE/MAPA/ESTATISTICAS/PECUARIA/3_5.XLS, February 2003

[5] Approximate calculation using IPCC model and emission factors

[6] KRUEGGER et al, (1995); Another outstanding reference for manure output is: Lorimor, Powers, et.al "Manure Characteristics", Manure Management Series, MWPS-18, Section 1; pg 12.

[7] Speir, Jerry; Bowden, Marie-Ann; Ervin, David; McElfish, Jim; Espejo, Rosario Perez, "Comparative Standards for Intensive Livestock Operations in Canada, Mexico, and the U.S.," Paper prepared for the Commission for Environmental Cooperation.

[8] http://www.eia.doe.gov/emeu/cabs/brazil.html

and continue to practice these AWMS practice changes that result in meaningful, and permanent, GHG emission reductions.

This project activity will have positive effects on the local environment by improving air quality (by reducing the emission of Volatile Organic Compounds (VOCs) and odour, for instance) and will set the stage for future possible on-farm projects (such as changes in land application practices) that would have an additional positive impact on GHG emissions with an attendant potential for reducing groundwater contamination problems.

This project activity will also increase local employment of skilled labour for the fabrication, installation, operation and maintenance of the specialized equipment. Finally, this voluntary project activity will establish a model for animal waste management practices, which can be duplicated on other CAFO livestock farms, dramatically reducing livestock related GHG and providing the potential for a new source of revenue and green power.

A.3 Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
Brazil (host)	• AgCert Do Brasil Solucoes Ambientais Ltda.	No

A.4 Technical description of the project activity:

A.4.1 Location of the project activity:

A.4.1.1 Host Party(ies):

The host party for this project activity is Brazil.

A.4.1.2 Region/State/Province etc.:

The sites included in this project activity are located in the state of Bahía.

A.4.1.3 City/Town/Community etc:

The project sites are shown in Figure A1 with specifics detailed in Table A2.

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

The physical location of each of the sites involved in this project activity is shown in Figure A1 and listed in Table A2.

Fazenda Alecrim e Funil is an approximately 2,500 animal farrow to finish operation.[9] The manure/effluent flows from the barns through a field to a lagoon. The site has ten containment areas to house animals through the various stages of production. It is located in Feira de Santana.

Fazenda Bons Irmãos is an approximately 1,500 animal farrow to finish operation in Mata de São João. It uses four open lagoons for its AWMS. The site has seven containment areas, which were built in 2002, to house animals through the various stages of production. This site is in an initial production stage, which is why there is 12 months data for gilts and boars only. The farmer plans to reach a 520 sow complete cycle by December of 2005.

Fazenda Sol do Amanhecer is an approximately 4,250 animal farrow to finish operation in Feira de Santana. It uses four lagoons and a distribution box for its AWMS and has 13 containment areas. These areas, which were built between 1993 and 2005, house animals through the various stages of production.

Granja JB is a 7,300 animal farrow to finish operation, which uses one lagoon for its AWMS. The site has eight containment areas, which were built in 2000. Granja JB is located in or near Ibirá.

[9] A ‘farrow to finish operation’ is defined as a production system that contains all production phases, from breeding to gestation to farrowing to nursery to grow-finishing to market

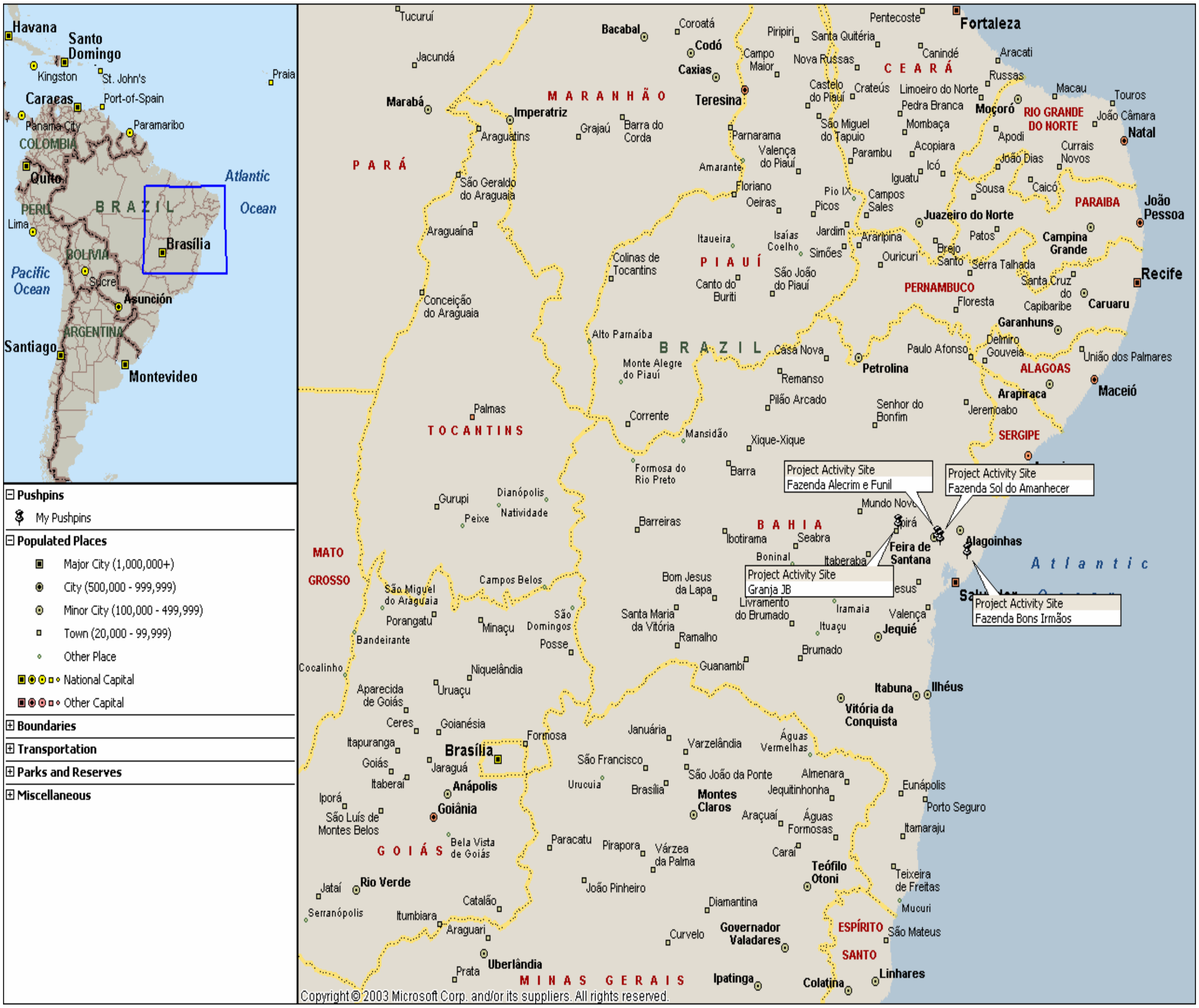

Figure A1. State of Bahía, Brazil and project activity sites

Table A2. Detailed physical location and identification of project sites

Farm/Site Name/Legal Entity	Address	Town/State	Contact	Phone	GPS Coordinates	Animal Category
Fazenda Alecrim e Funil/ Avícola Alecrim Ltda	Fazenda Alecrim s/n - Bairro Limoeiro	Feira de Santana Bahía 44.070-230	Marilton Moreira de Carvalho	+55.75.614-1414	12.32 S 38.89 W	Swine, Farrow to Finish
Fazenda Bons Irmãos/ Agrosuínos Bons Amigos Ltda	Fazenda Bons Irmãos s/n - Sempre Verde	Mata de São João, Bahía, 48.280-000	Balbino Barreto Santana	+55.71.207-2694	12.59 S 38.83 W	Swine, Farrow to Finish
Fazenda Sol do Amanhecer/ Gujão Alimentos Ltda	Rod. BR101 Povoado de Humildes - Zona Rural	Feira de Santana Bahía 44.025-360	Carlos Augusto Pimenta da Silva	+55.75.244-2121	12.36 S 38.84 W	Swine, Farrow to Finish
Granja JB/ JB Empreendimentos e Participações Ltda	Estrada Ipirá a Pintadas, km 01.	Ibirá Bahía 44.275-490	José Alírio de Oliveira	+55.71.358-6444	12.15 S 39.75 W	Swine, Farrow to Finish

A.4.2 Category(ies) of project activity:

The category of the project activity is in Sectoral Scope 13 - Waste Handling and Disposal, and Sectoral Scope 15 – Agriculture.

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

The technology to be employed by the project activity includes the total replacement of the open primary lagoon at the project activity sites with positive pressure covered lagoon "cells," creating ambient temperature anaerobic digesters. The system will be comprised of one or more cells with sufficient capacity to create an adequate Hydraulic Retention Time (HRT). The digester's size will be based on each farm's potential animal capacity. Each cell will use a liner affixed to a reinforced outer concrete frame. The outer cover consists of a synthetic UV-treated multi-layer membrane, which is also fastened to the frame. The liner and cover will be sealed together. The cells have been designed to enable solids residue removal without breaking seal and the biogas from each cell can be independently sectioned off. Maintenance and repairs can be made to one cell without affecting operation of the other cells. All cell components will be sourced from in-country manufacturers. Processed effluent from the lagoon cells will be routed to the clarification lagoon(s) and captured gas will be routed to a flare and/or other renewable energy equipment (e.g., heaters) to be combusted.

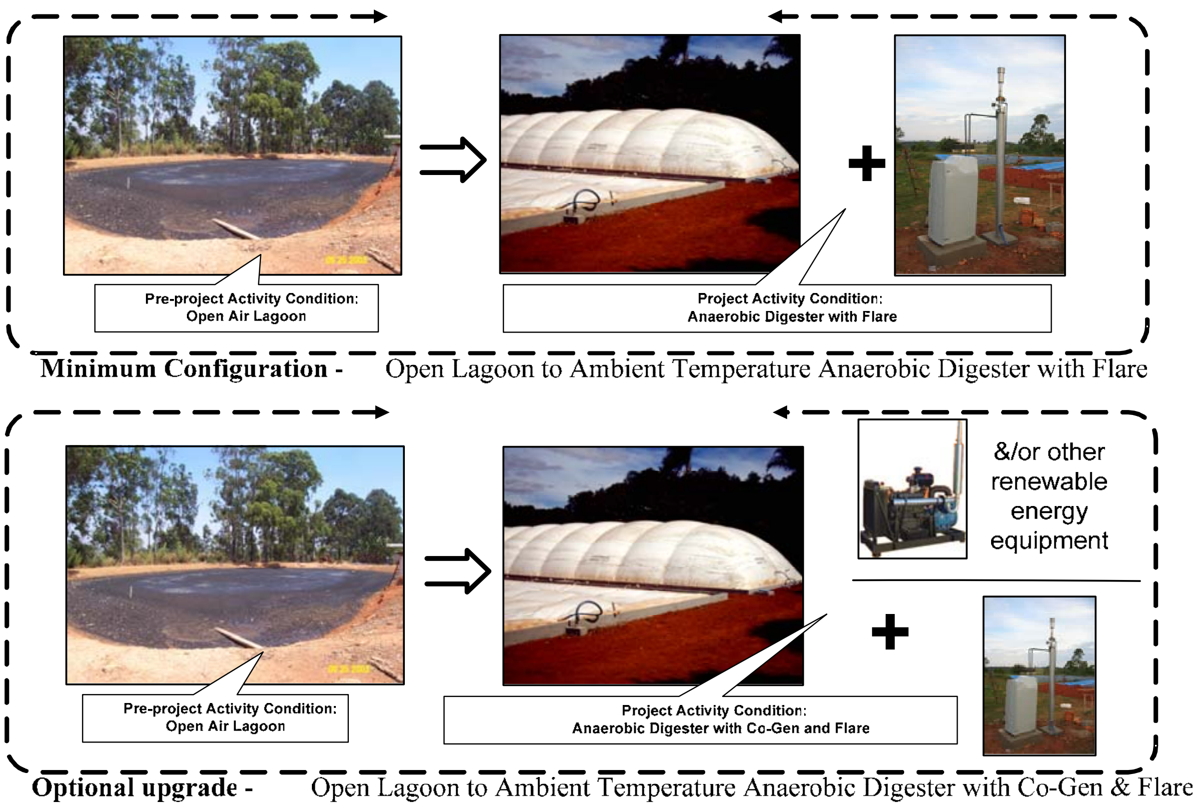

Figure A2. Project Activity Configurations.

Figure A2 depicts two approaches to mitigate AWMS GHG emissions. The minimum configuration constructs cells and a flaring system as described above. The optional upgrade incorporates the use of a cogeneration, or other renewable energy system to produce on-farm electricity and/or heat, using methane produced by the covered cells as fuel. The minimum configuration flare is retained to burn methane not required by the renewable energy equipment.

Care was given to use compatible components in the design of the AWMS. For example, the geomembrane cover has a tensile and tear strength which far exceeds the flare over-pressure release threshold. Furthermore, the flare combustion capacity exceeds the estimated GHG production forecasts. Depending on the flare assembly selected for this project, it may include a pilot light to ignite the methane. The pilot light would be fueled with a liquid petroleum gas stored in a small 13kg tank located at the base of the flare assembly. Based on the emission coefficient of LPG (1534.23 Kg CO_2/m^3)[10], a tank of LP gas would conservatively emit approximately .042 tCO2e per tank and 4 to 6 tanks of gas would be used each year.

In the case that project participants choose to implement the optional upgrade, the project participants have analyzed the predicted methane production and likely usage patterns to determine an appropriate generator size. Analysis indicated an average unit sizing of 62 KVA of energy.

The project developer shall provide to the validating DOE technical characteristics of the subsystems and material employed in the project.

Technology and know-how transfer:

The project developer is implementing a multi-faceted approach to ensure the project, including technology transfer, proceeds smoothly. This approach includes careful specification and design of a complete technology solution, identification and qualification of appropriate technology/service providers, supervision of the complete project installation, farm staff training, ongoing monitoring (by the project developer) and developing/implementing a complete Operations & Maintenance plan using project developer staff. As part of this process, the project developer has specified a technology solution that will be self-sustaining, i.e., highly reliable, low maintenance, and operate with little or no user intervention. The materials and labour used in the base project activity are sourced primarily from within Brazil.

By working so closely with the project on a “day to day” basis, the project developer will ensure that all installed equipment is properly operated and maintained, and will carefully monitor the data collection and recording process. Moreover, by working with the farm staff over many years, the project developer will ensure that personnel acquire appropriate expertise and resources to operate the system on an ongoing/continuous basis well into the future.

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:

Anthropogenic GHG Reductions

[10] US Department of Energy – Fuel and Energy Source Codes and Emission Coefficients – www.eia.doe.gov/oiaf/1605/factors.html

Anthropogenic GHGs, specifically methane and nitrous oxide, are released into the atmosphere via decomposition of animal manure and a nitrification/denitrification process associated with the volatilization of nitrogen. Currently, farm produced biogas is not collected or destroyed.

The proposed project activity intends to improve current AWMS practices. These changes will result in the mitigation of anthropogenic GHG emissions by controlling the lagoon's decomposition processes and collecting and combusting the biogas.

The figure listed in section A.4.4.1 is based upon the current animal head counts. The proposed project activity AWMS will be sized to accommodate each farm's maximum expected animal capacity.

There are no existing, pending, or planned national, state, or local regulatory requirements that govern GHG emissions from agricultural operations, specifically, pork production activities as outlined in this PDD. The project participants have solicited information regarding this issue during numerous conversations with local and state government officials and through legal representation, namely Trench, Rossi E Watanabe Advogados (associates of Baker & McKenzie)(See Section G), and have determined there is no regulatory impetus for producers to upgrade current AWMSs beyond an open air lagoon. The following paragraphs discuss the Brazilian pork industry and how conditions hinder changes in AWMS practices.

Brazilian pork producers face the same economic challenges as farmers in other nations due to increased worldwide pork production and low operating margins. Farm owners focus on the bottom line, and odour benefits, alleged water quality enhancements, and the incremental savings associated with heating cost avoidance, are rarely enough to compel an upgrade to an (expensive) advanced AWMS.[11] Unless the AWMS upgrade activity affords the producer means to (partially) offset the practice change cost (via the sale of Certified Emission Reduction (CER) credits, for instance) the open lagoon will remain the common AWMS practice – *and all AWMS GHG (biogas) will continue to be emitted*. Speaking to this affordability issue, the President of the Santa Catarina Association of Swine Producers (ACCS) recently said:

> *…water pollution from swine manure is a very grave environmental problem…changes are required…the swine producer by himself does not have the capacity to resolve.*
>
> *Porkworld Magazine, 12/10/03*

This sentiment was corroborated by representatives[12] of Brazilian Agricultural Research Corporation (EMBRAPA)[13] as well as officers of national and state agricultural associations (ABCS, ASEMG).

The proposed AWMS practice change will afford these farms the financial means (via CER revenues) to adopt and maintain an advanced AWMS with reductions in GHG emissions and associated environmental co-benefits (including reduced water contamination).

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[11] DiPietre, Dennis, PhD, Agricultural Economist, (18 June, 2003) Private communication

[12] Conversation between AgCert's Michael Mirda and EMBRAPA's Airton Kunz, Paulo Armando V. de Oliveira, and Paulo Antônio Rabenschlag de Brum on March 2, 2004 at the EMBRAPA National Research Centre of Swine and Poultry in Concórdia, Santa Catarina, Brazil

[13] The Brazilian Agricultural Research Corporation's mission is to provide feasible solutions for the sustainable development of Brazilian agribusiness through knowledge and technology generation and transfer.

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

A.4.4.1 - Estimated Emission Reductions over chosen Crediting Period	
Years	**Annual estimation of emission reductions in tonnes of CO_2e**
Year 1	10,887
Year 2	14,163
Year 3	14,163
Year 4	14,163
Year 5	14,163
Year 6	14,163
Year 7	14,163
Year 8	14,163
Year 9	14,163
Year 10	14,163
Total estimated reductions (tonnes CO_2e)	**138,354**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	13,835

A.4.5 Public funding of the project activity:

There is no official development assistance being provided for this project.

SECTION B. Application of a baseline methodology

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

This project activity utilizes the CDM approved baseline methodology AM0016/Version 02 entitled "*Greenhouse gas mitigation from improved Animal Waste Management Systems in confined animal feeding operations*."

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

This baseline methodology was chosen because it offers a GHG emissions model that can be used to characterize baseline emissions for project activity livestock operations. Specifically, the methodology is applicable because:

1. The captured gas is being flared; or
2. The captured gas is being used to produce energy (e.g., electricity/thermal energy), but no emission reductions are claimed for displacing or avoiding energy from other sources.[14]
3. The farms with livestock populations are managed under confined conditions which operate in a competitive market.
4. The livestock populations are comprised of swine animals, an applicable animal type.
5. The AWMS system, including both the baseline scenario and the manure management systems introduced as part of the project activity, is in accordance with the regulatory framework in the country, excluding the discharge of manure into natural resources (e.g., rivers or estuaries).
6. On-farm project systems introduce AWMS practice and technology changes to reduce GHG emissions.
7. The project farm systems reduce GHG emissions due to the AWMS improvements.
8. The project farm systems establish a sound framework for sustaining these improvements over time to provide economic sustainability and ensure that mitigation measures result in a continuous, verifiable, reduction of GHGs.

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

The methodology calls for the classification and categorization of the farm systems to include animal type, population, AWMS in use/projected, climate, region, etc. This data is used to properly select lookup table parameters and can be found in Table B1.

Table B1. Data Characterization

Farm System	AWPS		AWMS				Other	
	Animal Category	Genetics Source	Base-line	#	Project	#	Region - Climate	Population Data
Fazenda Alecrim e Funil	Swine	Annex I Country	Lagoon	1	Anaerobic Digester	2	Latin America - Temperate	See Annex 3
Fazenda	Swine	Annex I	Lagoon	4	Anaerobic	2	Latin	See Annex 3

[14] Although in this project no emission reductions are claimed for displacing or avoiding energy from other sources, all possible financial revenues and/or emission leakages will be taken into account in the analysis performed.

Farm System	AWPS		AWMS				Other	
	Animal Category	Genetics Source	Base-line	#	Project	#	Region - Climate	Population Data
Bons Irmãos		Country			Digester		America - Temperate	
Fazenda Sol do Amanhecer	Swine	Annex I Country	Lagoon	4	Anaerobic Digester	3	Latin America - Temperate	See Annex 3
Granja JB	Swine	Annex I Country	Lagoon	1	Anaerobic Digester	2	Latin America – Temperate	See Annex 3

The methodology further calls for the application of the Emission Factor Determination Test, again, in order to select the appropriate IPCC lookup parameters. The project developer applied the "Emission Factor Determination Test" described in AM0016 to ascertain that "developed" country emission factors are appropriate for use with the project activity as host country factors are not available. The methodology also requires that developed nation genetics are used and that the farms employ formulated feed rationing which can be verified. Table B2 lists the farms answers to the four questions posed in the Emission Factor Determination Test which allowed "developed" country emission factors to be used.

Table B2. Emission Factor Determination (EFD) Test Results

Farm System	EFD Test Question				Result
	1	2	3	4	
Fazenda Alecrim e Funil	No	Yes	Yes	Yes	Use developed nation default EFs
Fazenda Bons Irmãos	No	Yes	Yes	Yes	Use developed nation default EFs
Fazenda Sol do Amanhecer	No	Yes	Yes	Yes	Use developed nation default EFs
Granja JB	No	Yes	Yes	Yes	Use developed nation default EFs

The data obtained from the above activities are required for use in the equations identified in Section D and the results described in Section E of this document.

The following steps are used to determine the baseline scenario:

Step 1: List of Possible Baseline Scenarios

The following list of scenario alternatives is derived from different AWMSs presented in the approved methodology:

- Daily spread
- Solid storage

- Dry lot
- Liquid/Slurry
- Anaerobic lagoon
- Pit storage below animal confinements
- Anaerobic digester
- Deep litter
- Composting
- Poultry manure
- Aerobic treatment

Step 2: Identify Plausible Scenarios

Listed below are the proposed project activity and other plausible scenarios for the project farms operations and conditions. Justification for including or excluding a scenario from consideration is provided.

- *Liquid Slurry*: Most of the barriers to this technology relate to the cost required to store the volumes of liquid necessary from confined animal operations. It is a viable technology alternative and has been considered.
- *Anaerobic Lagoon*: The relevant technical/regulatory barrier relating to this scenario is that lagoon systems, by Brazilian law, must be lined. The anaerobic stabilization lagoon represents project farms current practice. It is generally considered to be the most economical, efficient, and reliable AWMS, and is the most common AWMS technology in Brazil, and in the developed and developing world. Pierre Vilela from the Federation of Agriculture and Livestock of Minas Gerais (FAEMG)[15] supports this finding stating: "*Biogas is a technique that is rarely used in Brazilian swine and layer operations; lagoon treatment (open-air) is the most common*."
- *Pit Storage below animal confinements*: Installing pit storage would require excavation underneath each of the existing barns or actual replacement (which is more likely). Further, reliable, uninterrupted electric supply is essential; if power fails, the animal herd will be quickly killed by the accumulation of toxic fumes, including hydrogen sulphide (H_2S). Power in rural Brazil is not reliable.[16] Although less plausible as a solution to an existing operation, an economic evaluation of this scenario is included.
- *Anaerobic digester*: The barriers to this technology are developed in section B.4 as part of an additionality test. This scenario has been included as the "proposed project activity."

Excluded scenarios:

The overall criterion used in evaluating potential scenarios is to assess the 'practicality' and economics of a technology/approach. Said differently, is a given technology/system both practical to implement and

[15] FAEMG is a private institution created in 1951. It is supported by the rural producers. It is part of the Rural Trade Union Patronage System: led by CNA Brasil (Brazilian Confederation of Agriculture and Livestock), major representative entity of Brazilian producers.

[16] Energy problems are a major issue in rural regions of Brazil. Dilma Rousseff, Brazil's Minister of Energy states, "We are facing a great crisis in the country's electricity system." In July, 2003, Roussef warned that the country could face another power crisis by 2007.

economically attractive to be adopted? Applying this criterion resulted in excluding the scenarios listed below:

- *Daily spread*: This technology is less effective than the open lagoon system currently in use. Animal waste generated from project farm production operations would only be applied to land at certain periods throughout the growing season, so a storage system would also be required. Further, the application of animal waste directly to the field (under aerobic conditions) has the potential to result in a higher release of Nitrous Oxide (N_2O) emissions, a gas which has a GWP 310 times worse than CO_2. Finally, the incorporation of this solution requires additional manpower resources. It has been excluded as a plausible scenario.
- *Solid Storage*: Depending on storage design, this system will not be efficient enough for odour and vector control; so the exclusion of this potential baseline scenario can be justified.
- *Dry lot:* This AWMS has been excluded because it is not applicable to the conditions of barns which incorporate the use of slats and paved pens.
- *Deep litter*: Pig farmers have found tending deep litter bedding systems so laborious and unpleasant, that this approach has been replaced with liquid-manure or solid-manure systems. It becomes difficult to optimize the composting process with large numbers of animals; this is counter to achieving economies of scale associated with large animal counts (typical of the CAFO approach). Farms seek the most cost effective solution meeting local regulatory and farm conditions, and, therefore, use liquid manure systems.[17] Further, the deep litter practice is not often used in Brazil and has been excluded from consideration.
- *Composting*: Composting systems are not adapted to large volumes of water, or moisture contents. This dry aerobic system can only be applied after solid separation stages of activated sludge. For this reason, it is excluded from the list of plausible scenarios.
- *Poultry manure*: This AWMS has been excluded as it is a management technique associated with poultry operations. The project sites are a pork production operation. This scenario has been excluded from the list of plausible scenarios.
- *Aerobic treatment*: Aerobic treatment is typically suited for separated slurry or diluted effluents. Solids in manure increase the amount of oxygen needed and also increase the energy needed for mixing. The biggest drawbacks to aerated lagoons are (a) the cost of energy to run the aerators; (b) biosolids production, which is higher than in anaerobic systems; and (c) the potential for release of ammonia if the aeration level is not correct. This scenario has been excluded from the list of plausible scenarios.

Therefore, the list of plausible scenarios has been reduced to three alternative scenarios and one proposed project activity scenario:

Plausible alternative scenarios:	(i)	Liquid/Slurry
	(ii)	Anaerobic Lagoon
	(iii)	Pit storage
Proposed project activity scenario:	(i)	Anaerobic digester

Step 3: Economic Comparison Tables B3 through B7 illustrate the economic comparison between plausible baseline scenarios and the proposed project activity scenarios. Data presented has been based

[17] Klemola, Esa and MalKKi, Sirkka, Handling of Manure in Deep-Litter Pig Houses, 1998, http://www.ramiran.net/doc98/FIN-ORAL/MALKKI.pdf

on a typical 500 to 600 sow potential project activity in Minas Gerais, Brazil. The scalability of this data when applied to larger or smaller project activities is not strictly linear, but the economic relationship between the scenarios will remain generally the same. This comparison was prepared by AgCert and reviewed by a swine industry economist.[18]

The comparison was made using a 10% discount rate, which might be typically used in a developed nation. As shown in Figure B1, this rate is extremely conservative in Brazil as the calculated rate can exceed 25%.[19]

	Brazil
Cost of Equity Capital	25.45%
Industry beta adjustment	0.25%
Operational - Sovereign Risks	
Macroeconomics	0.00%
Political/Legal	0.42%
Force Majeure	0.00%
Financial Risks	-0.70%
Adj. Project Discount Rate:	25.42%

Figure B1. Brazilian discount rate.

Tables B3 through B7 illustrate the economic comparison between plausible baseline scenarios and the proposed project activity scenarios. Data presented has been based on potential project activity at a farm in Minas Gerais, Brazil.

Table B3. Economic analysis of the liquid/slurry AWMS baseline scenario.

AWMS: LIQUID SLURRY				
COSTS AND BENEFITS	**Year 1**	**Year 2**	**Year n**	**Year n+1**
Equipment costs (pump & piping)	$ (280,004)	$ -	$ -	$ -
Installation costs of a slurry system	$ (31,100)	$ -	$ -	$ -
Maintenance costs	$ (3,000)	$ (3,000)	$ (3,000)	$ (3,000)
Other costs (e.g. operation, transportation, consultancy, engineering, etc.)	$ (6,000)	$ (6,000)	$ (6,000)	$ (6,000)
Revenues from the sale of electricity or other project related products, when applicable	$ -	$ -	$ -	$ -
SUBTOTAL	$ (320,104)	$ (9,000)	$ (9,000)	$ (9,000)
TOTAL BASELINE	$ (320,104)	$ (9,000)	$ (9,000)	$ (9,000)
NPV (US$) (10% discount rate)	($341,277)			
IRR (%)	undefined			

[18] DiPietre, Dennis, PhD, Agricultural Economist, formal communication

[19] http://faculty.fuqua.duke.edu/~charvey/Teaching/BA456_2003/Despegar/Despegar.ppt#591,25, Project's Risks Cost of Capital Implications

Table B4. Economic analysis of the anaerobic lagoon AWMS baseline scenario.

AWMS: ANAEROBIC LAGOON				
COSTS AND BENEFITS	**Year 1**	**Year 2**	**Year n**	**Year n+1**
Equipment costs (geomenbrane, pump & piping)	$ (8,562)	$ -	$ -	$ -
Installation costs of a lined lagoon system	$ (5,246)	$ -	$ -	$ -
Operations and maintenance costs	$ (100)	$ (100)	$ (100)	$ (100)
Other costs (e.g. consultancy, engineering, etc.)	$ (500)	$ -	$ -	$ -
Revenues from the sale of electricity or other project related products, when applicable	$ -	$ -	$ -	$ -
SUBTOTAL	$ (14,408)	$ (100)	$ (100)	$ (100)
TOTAL BASELINE	$ (14,408)	$ (100)	$ (100)	$ (100)
NPV (US$) (10% discount rate)	($13,657)			
IRR (%)	undefined			

Table B5. Economic analysis of the pit storage AWMS baseline scenario.

AWMS: PIT STORAGE				
COSTS AND BENEFITS	**Year 1**	**Year 2**	**Year n**	**Year n+1**
Equipment costs (pump & piping)	$ (995,358)	$ -	$ -	$ -
Installation costs of a pit storage system	$ (75,732)	$ -	$ -	$ -
Maintenance costs	$ (30,000)	$ (30,000)	$ (30,000)	$ (30,000)
Other costs (e.g. operation, consultancy, engineering, etc.)	$ (10,000)	$ -	$ -	$ -
Revenues from the sale of electricity or other project related products, when applicable	$ -	$ -	$ -	$ -
SUBTOTAL	$ (1,111,090)	$ (30,000)	$ (30,000)	$ (30,000)
TOTAL BASELINE	$ (1,111,090)	$ (30,000)	$ (30,000)	$ (30,000)
NPV (US$) (10% discount rate)	($1,177,661)			
IRR (%)	undefined			

Table B6. Economic analysis of the anaerobic digester with flare AWMS project activity scenario.

AWMS: AMBIENT TEMPERATURE ANAEROBIC DIGESTER WITH FLARE				
COSTS AND BENEFITS	**Year 1**	**Year 2**	**Year n**	**Year n+1**
Equipment costs (lined lagoon, cover, piping, flare)	$ (36,379)			
Installation costs	$ (21,220)	$ -	$ -	$ -
Maintenance costs	$ (1,400)	$ (1,400)	$ (1,400)	$ (1,400)
Other costs (e.g. operation, consultancy, engineering, etc.)	$ -	$ -	$ -	$ -
Revenues from the sale of electricity or other project related products, when applicable	$ -	$ -	$ -	$ -
SUBTOTAL	$ (58,999)	$ (1,400)	$ (1,400)	$ (1,400)
TOTAL BASELINE	$ (58,999)	$ (1,400)	$ (1,400)	$ (1,400)
NPV (US$) (10% discount rate)	($61,456)			
IRR (%)	undefined			

Table B7. Economic analysis of the anaerobic digester with cogeneration/flare AWMS project activity scenario.

AWMS: AMBIENT TEMPERATURE ANAEROBIC DIGESTER W/CO-GEN /FLARE				
COSTS AND BENEFITS	**Year 1**	**Year 2**	**Year n**	**Year n+1**
Equipment Costs (covered lagoon, flare, engine, generator)	$ (63,425)			
Installation costs	$ (21,220)	$ -	$ -	$ -
Maintenance costs	$ (3,000)	$ (5,925)	$ (4,325)	$ (4,325)
Other costs (e.g. operation, consultancy, engineering, etc.)	$ (5,000)	$ -	$ -	$ -
Revenues from the sale or use of electricity or other project related products, when applicable	$ 7,600	$ 7,600	$ 7,600	$ 7,600
SUBTOTAL	$ (85,045)	$ 1,675	$ 3,275	$ 3,275
TOTAL BASELINE	$ (85,045)	$ 1,675	$ 3,275	$ 3,275
NPV (US$) (10% discount rate)	($63,869)			
IRR (%)	undefined			

As shown in the above tables, none of the above scenarios yield potential revenues. Because there are no positive cash flows, the economic analysis compares Net Present Value (NPV) parameters between the different scenarios. An economic comparison suffices to identify the best AWMS scenario - favouring those with lower costs. In this instance it can be seen that the anaerobic lagoon AWMS, the prevailing practice, is the most economically attractive course of action.

Both configurations of the project activity scenario, ambient temperature digester with or without cogeneration, have ranges of NPV that are far more negative than the baseline scenario. The cost of implementing this system (in either configuration) is much higher than the cost of an open lagoon system, so it is determined that the project is "additional" from an economic perspective. The economic value ascribed to project generated electricity is the offset "retail" cost the farm pays for this supply.

A sensitivity analysis was performed to determine whether any variables or inputs could cause significant variations in the results.

Animal Waste Management Systems are sized or scaled to accommodate the number of animals present at a given farm. The volumetric storage requirement scales linearly with the number of animals (so long as population mixes are similar, for instance: farrow-to-finish compared to farrow-to-finish).

The deep pit solution typically accommodates up to approximately 1,200 animals per building, so as animal population rises there can be a "discontinuity" in the costs as additional buildings have to be brought "online." The other solutions can be scaled without such discontinuities. Indeed, a volume increase can often be accommodated with a modest material/equipment change plus an incremental increase in excavation costs.

In summary: With regards to the AWMS solutions of greatest interest (open lagoon vs. digester), there are no variables whose minor variations could cause significant variations in the result.

Conclusion: The most likely plausible scenario, the anaerobic lagoon, is the "baseline scenario." The proposed project activity scenario is not an "economically attractive" course of action and therefore it is not the baseline scenario.

The application of baseline methodology Steps 4 and 5 follow in the next section, B.3.

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:

In the absence of the project activity, the project farms would not change their AWMS practice. As noted earlier in Section A.4.4, pork producers do not have the motivation or resources (especially financial resources) to change their AWMS: there are no laws or regulatory directives driving such change and even if a producer were so inclined, it has been demonstrated in Table B6 and Table B7 that they would find the upgrade costs prohibitive. This, in itself, demonstrates additionality between the baseline scenario and project activity scenario. Additionally, Step 4 of the methodology requires a barrier assessment of the proposed project activity:

Step 4: Assessment of barriers.

Absent CDM project activities, the proposed project activity has not been adopted on a national or worldwide scale due to the following barriers:

a. *Investment Barriers*: This treatment approach is considered one of the most advanced AWMS systems in the world. Only a few countries have implemented such technology because of the high investment costs compared to other available systems and due to regionalized subsidies for electric generation. The Brazilian energy market does not currently offer incentives to sell biogas into the grid. The investment required to produce energy by utilizing biogas is still too high compared to electricity prices in Brazil. Additionally, much of the power distributed in Brazil is derived from hydroelectric sources.

   EMBRAPA noted that in general, producers view the AWMS as a stage that is outside of the production process and have difficulty financing changes that should be undertaken. Even banks have been unwilling to finance such activities absent government guarantees or other incentives. Professor Dr. Carlos Claúdio Perdomo, a swine and poultry researcher from EMBRAPA, states: "*Many producers don't possess the capacity of investment for a new AWMS. Even the big large producing farms that require more sophisticated systems also lack this capacity of investment*."[20]

b. *Technology barriers*: Anaerobic digester systems have to be sized to handle projected animal/effluent volumes with a Hydraulic Retention Time (HRT) consistent with extracting most/all CH_4 from the manure. These systems become progressively more expensive on a 'per animal' basis as farm animal population (i.e., farm size) is decreased. Moreover, operations and maintenance requirements involved with this technology, including a detailed monitoring program to maintain system performance levels, must also be considered. Worldwide, few anaerobic digesters have achieved long-term operations, due primarily to inappropriate operations and maintenance.

   The proposed AWMS represents the most advanced AWMS technology in the state. The proposed project activity AWMS mitigates GHG emissions with associated environmental co-benefits. See quote from Minas Gerais State Secretary of Environment and Sustainable Development in Section A2 above.

c. *Legal barriers*: The implementation of this project activity by these farms highly exceeds current Brazilian regulations for swine waste treatment. Apart from existing legislation in Brazil that establishes water quality parameters that require lagoons to be lined, hence protecting water supplies from contamination, there is no legislation in place that requires specific swine manure treatment, especially as it relates to the emission of GHG.

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[20] http://www.jornalexpress.com.br/noticials/detalhes.php?id_jornal=2&id_noticia=5802

Per local and state officials, as well as the project developer's legal consul, there were no existing laws or regulations, nor were any anticipated, that would require these farms to change their open lagoon AWMS practice in order to mitigate GHG emissions. See stakeholders' comments from government officials and Baker & McKenzie law firm in Section G

Step 5: Consideration of possible changes in the baseline scenario during the crediting period.

Background

Please note that the planning, construction, and operation of the improved AWMS at the sites listed in this PDD began prior to actual registration as a CDM project activity using the prompt start provision (paragraph 13 of decision 17/CP.7). As shown in Table B8, the availability of the CDM was considered throughout project inception through completion. Further, the infrastructure and data management system at AgCert was developed with the prime goal of managing data related to CDM project activities.

Table B8. Project activity timeline

DATE	ACTIVITY
Jan 2003	AgCert established to perform CDM environmental projects in the agricultural industry
Mar 2003	AgCert begins development of proposed new methodology for CDM activities
May 2003	AgCert opens discussions with representatives of candidate project sites to consider the potential for their inclusion in a CDM Project Activity
Nov 2004	Project start date. AgCert and project farms executed a carbon contract to undertake a Clean Development Mechanism project activity. Initiated construction engineering and planning activities
Nov 2004 –May 2005	Site Survey, Data Collection, Baseline Analysis, PDD preparation
March 28, 2005	Broke ground at first construction site
February 19, 2005	Conducted stakeholders' meeting in Feira de Santana, Bahía.
July 30, 2005	Projected construction completed at final site, flare operational

Analysis

An analysis was performed to assess whether the basis in choosing the baseline scenario is expected to change during the crediting period and the results follow:

a) *Economic performance*: Given that (1) the technology required to implement the proposed project activity is both specialized and "advanced," (2) the demonstrated demand for this technology in Brazil is minimal, and (3) inflation rates in developing nations typically range from 5% to 60% (2002 est.), there is no reason to expect that implementation costs will drop so dramatically that the economic models summarized in tables B.6 and B.7 will become invalid. However, these costs will be periodically assessed and changes presented to the Operational Entity at their request.

b) *Legal constraints*: There is no expectation that Brazilian legislation will require future use of digesters due to the significant investments required. Further, there is no expectation that Brazil will pass any legislation which deals with the GHG emissions (see Step 4c above).

c) *Common practice*: While past practices cannot predict future events, it is worth noting that these farms (see Table A2) have been in existence for many years, during which time they have only used open lagoons as their AWMS practice. Local agricultural officials/inspectors confirmed (at the stakeholders' meetings) that open lagoons have always been used at these farms.

   The project developer conducted a survey to determine the common practice in the industry. Working in conjunction with Brazil's swine producer associations and their global swine genetics suppliers (Danbred, PIC, and Seghers), 171 producers in Minas Gerais, representing over 50% of the CAFO producers in Minas Gerais, were surveyed regarding the AWMS used in their operations. All but two used open anaerobic lagoon AWMS.

   These anaerobic lagoon systems are economically feasible, reliable, effective, and satisfy regulatory and social requirements, and there is no reason to expect that these conditions will change in the foreseeable future.

By incorporating Animal Waste Management Systems (AWMS) such as proposed in this PDD, GHG emissions will be captured and combusted. The resulting emission reduction credits would then be sold to large emitters in developed countries, helping to offset the costs of implementing the AWMS change. This mechanism was the primary factor influencing the decision to install ambient temperature anaerobic digesters at these farms.

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

The project boundary is defined in Figure B1. The proposed project boundary considers the GHG emissions that come from AWMS practices, including the GHG resulting from the capture and combustion of biogas. The project activity sites use systems of two or more lagoons. Proposed AWMS practice changes include covering each primary lagoon into an ambient temperature digester that includes cells that capture the resulting biogas which is then combusted. The project boundary considers these practice changes, as well as future options that the producer may elect to use.

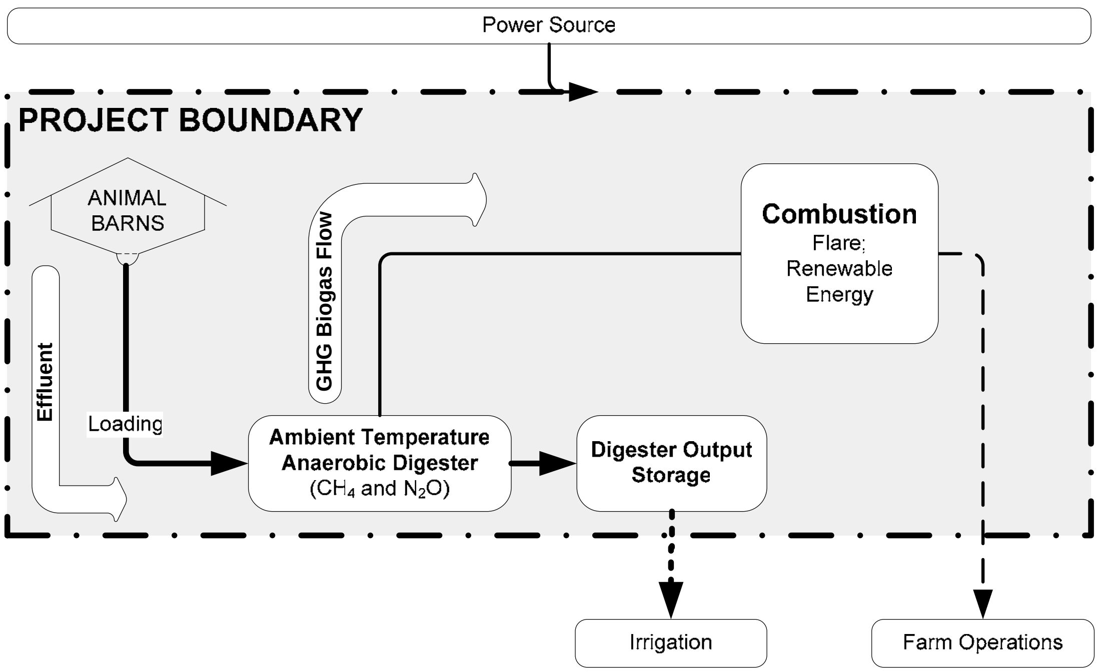

Figure B1. Project Boundary

The project boundary does *not* consider the effects of enteric emissions, nor does it include barn-related emissions, whether directly or indirectly associated with the animals, as these emissions are not affected by the proposed practice changes.

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

The final draft of this baseline section was completed on 22/04/2005. The name of entity determining the baseline is AgCert. AgCert is the project developer. Specific data is contained in Annex 3.

SECTION C. Duration of the project activity / Crediting period

C.1 Duration of the project activity:

C.1.1 Starting date of the project activity:

The starting date of the project activity is 01/11/2004.

C.1.2 Expected operational lifetime of the project activity:

The expected operational lifetime of the project activity is 11y 5m.

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

The project activity will use a fixed crediting period.

C.2.1 Renewable crediting period

C.2.1.1 Starting date of the first crediting period: N/A

C.2.1.2 Length of the first crediting period: N/A

C.2.2 Fixed crediting period:

C.2.2.1 Starting date: 01/09/2005

C.2.2.2 Length: 10y 0m

SECTION D. Application of a monitoring methodology and plan:

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

The project activity utilizes the CDM approved monitoring methodology AM0016/Version 02 entitled "*Greenhouse gas mitigation from improved Animal Waste Management Systems in confined animal feeding operations*."

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

This monitoring methodology was chosen because it offers a GHG emissions model that can be used to characterize baseline and project activity emissions. Specifically, the methodology is applicable because:

1. The captured gas is being flared, or
2. The captured gas may be used to produce energy (e.g., electricity/thermal energy), but no emission reductions will be claimed for displacing or avoiding energy from other sources.[21]
3. The farms have livestock populations managed under confined conditions and operate in a competitive market.
4. The livestock populations are comprised of swine animals, an applicable animal type.

[21] Although in this project no emission reductions are claimed for displacing or avoiding energy from other sources, all possible financial revenues and/or emission leakages will be taken into account in the analysis performed.

5. The AWMS, including both the baseline scenario and the manure management systems introduced as part of the project activity, is in accordance with the regulatory framework in the country, excluding the discharge of manure into natural resources (e.g., rivers or estuaries).
6. The project activity introduces an AWMS practice and technology to reduce GHG emissions.
7. The project activity results in a reduction of GHG emissions due to the AWMS improvements.

D.2.1 Option 1: Monitoring of the emissions in the project scenario and the baseline scenario:

AM0016 monitoring methodology is a broad based methodology that can be applied to various animal categories, waste management systems, and data types. As such, the methodology defines a superset of ID numbered parameters available for application at individual project activity scenarios. Individual projects will not require monitoring of the entire superset of parameters. The selection of such parameters is dependent on the result of the data characterization and emission factor determination test (Table B.2). The following subset of parameters has been identified for use at the project activities:

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	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?	Comment
1. $Population_{month}$	Integer, Classification	Herd/breed counts per type	#, Type	m	Entrance – exit records of animals to the barn	100%	electronic	Animal counts by population classification and genetics. Classification data also includes mortality and days resident.
6. BA	Classification	Type of AWMS	Type	m	Entrance – exit records of animals to the barn	100%	electronic	AWMS type used to select appropriate parameters from IPCC lookup tables
9. TR	Integer, volume	Temperature	^oC, cm	m	Monthly	100%	electronic	Used to determine climate conditions for selection of appropriate parameters from IPCC lookup tables
12. CF	Volume	Biogas produced	M^3	m	Cumulative monthly production recorded monthly	100%	electronic	QC/QA check. This parameter enables verification of the anaerobic digestion process. Considered over several months, this parameter helps establish “typical” performance for an anaerobic digester.
13. CD	Percent	CO_2 concentration	%	m	Quarterly	100%	electronic	QC/QA check. This parameter monitors digester operation.
14. INT	N/A	Operational status	N/A	m	Weekly	100%	electronic	Operational status of all project equipment is checked. This

ID number	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?	Comment
								parameter helps ensure proper digester operation.

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

Equations 9, 10, 11, 13, 14, 15, and 16 from Approved Methodology AM0016 are used to determine project activity emissions.

Four options are available for the determination of the volatile solids (V_s) excretion rate used with equation 11. Two of the four originate from lookup tables, IPCC and country-specific. If lookup references were not available, then the V_s could have been determined via calculation based on feed nutrition content and animal weight, e.g., equations 1 and 2 in AM0016. IPCC default values for V_s. were selected for use at the project activity farms. Furthermore, country specific factors are not available.

Two options are available for the determination of methane conversion factors (MCF) used with equation 11. One originates from IPCC lookup tables and the other can be calculated using equation 8 in AM0016. IPCC default values were selected for use at the project activity farms.

Four options are available for the determination of the nitrogen excretion (N_{ex}) rate used with equations 15 and 16. Two of the four originate from lookup tables, IPCC and country-specific. If lookup references were not available, then the N_{ex} could have been determined via calculation based on feed nutrition content and animal weight, e.g., equations 3 and 4 in AM0016. IPCC default values were selected for use at the project activity farms. Furthermore, country specific factors are not available.

- Equation 9, Baseline methane (CH_4) emissions in CO_2e:

$$CO_{2eq\ methane} = CH_{4\ annual} * GWP_{CH4}/1000$$

- Equation 10, Baseline methane (CH_4) annual emissions:

$$CH_{4\ annual} = \sum_{mj} EF_{month} * Population_{month} * MS\%j$$

- Equation 11, Animal group emission factor:

$$EF_{month} = V_s * n_m * B_0 * 0.67kg/m^3 * MCF_{month}$$

- Equation 13, Baseline nitrous oxide (N_2O) emissions in CO_2e:

$$CO_{2equiv\ N2O} = GWP_{N2O} * N_2O_{total\ annual}/1000$$

- Equation 14, Baseline nitrous oxide (N_2O) annual emissions:

$$N_2O_{total\ annual} = \sum_{mj} (N_2O_d + N_2O_i) * Population_{month} * MS\%j$$

- Equation 15, Direct nitrous oxide (N_2O) emissions:

$$N_2O_d = N_{ex\ month} * EF_3 * (1- F_{gasm}) * C_m$$

- Equation 16, Indirect nitrous oxide (N_2O) emissions:

$$N_2O_i = N_{ex\ month} * EF_4 * F_{gasm} * C_m$$

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

ID number	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?	Comment
1. $Population_{month}$	Integer, Classification	Herd/breed counts per type	#, Type	m	Entrance – exit records of animals to the barn	100%	electronic	Animal counts by population classification and genetics. Classification data also includes mortality and days resident.
6. BA	Classification	Type of AWMS	Type	m	Entrance – exit records of animals to the barn	100%	electronic	AWMS type used to select appropriate parameters from IPCC lookup tables
9. TR	Integer, volume	Temperature and rainfall	^oC, cm	m	Monthly	100%	electronic	Used to determine climate conditions for selection of appropriate parameters from

ID number	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?	Comment
								IPCC lookup tables

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

Equations 9, 10, 11, 13, 14, 15, and 16 from Approved Methodology AM0016 are used to determine baseline emissions.

Four options are available for the determination of the volatile solids (V_s) excretion rate used with equation 11. Two of the four originate from lookup tables, IPCC and country-specific. If lookup references were not available, then the V_s could have been determined via calculation based on feed nutrition content and animal weight, e.g., equations 1 and 2 in AM0016. IPCC default values for V_s were selected for use at the project activity sites. Furthermore, country specific factors are not available.

Two options are available for the determination of methane conversion factors (MCF) used with equation 11. One originates from IPCC lookup tables and the other can be calculated using equation 8 in AM0016. IPCC default values were selected for use at the project activity sites.

Four options are available for the determination of the nitrogen excretion (N_{ex}) rate used with equations 15 and 16. Two of the four originate from lookup tables, IPCC and country-specific. If lookup references were not available, then the N_{ex} could have been determined via calculation based on feed nutrition content and animal weight, e.g., equations 3 and 4 in AM0016. IPCC default values were selected for use at the project activity sites. Furthermore, country specific factors are not available.

- Equation 9, Baseline methane (CH_4) emissions in CO_2e:

$$CO_{2eq\ methane} = CH_{4\ annual} * GWP_{CH4}/1000$$

- Equation 10, Baseline methane (CH_4) annual emissions:

$$CH_{4\ annual} = \sum_{mj} EF_{month} * Population_{month} * MS\%j$$

- Equation 11, Animal group emission factor:

$$EF_{month} = V_s * n_m * B_0 * 0.67kg/m^3 * MCF_{month}$$

- Equation 13, Baseline nitrous oxide (N_2O) emissions in CO_2e:

$$CO_{2equiv\ N2O} = GWP_{N2O} * N_2O_{total\ annual}/1000$$

- Equation 14, Baseline nitrous oxide (N_2O) annual emissions:

$$N_2O_{total\ annual} = \sum_{mj} (N_2O_d + N_2O_i) * Population_{month} * MS\%j$$

- Equation 15, Direct nitrous oxide (N_2O) emissions:

$$N_2O_d = N_{ex\ month} * EF_3 * (1- F_{gasm}) * C_m$$

- Equation 16, Indirect nitrous oxide (N_2O) emissions:

$$N_2O_i = N_{ex\ month} * EF_4 * F_{gasm} * C_m$$

D.2.2 Option2: Direct monitoring of emission reductions from the project activity (values should be consistent with those in section E):

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	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, emission units of CO_2 equ.):

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:

ID number	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
16. EP_y	Electricity	Power	kWh	m	Monthly	100%	electronic	Electricity used for project equipment
19. EP_p	Electricity	Power	kWh	m	Monthly	100%	electronic	Electricity produced through co generation of the captured methane

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

Equations 17 to 23 from Approved Methodology AM0016 are used to determine project activity leakage.

Equation 17 will be used to determine electrical leakage on a continual basis.

The project developer used equations 18 through 23 in a one-time analysis to confirm that the change in AWMS (project activity) did not adversely affect GHG emissions due to land application, runoff and ammonia volatilization. The results of the analysis show that there is no change in GHG emissions in these areas by the incorporation of an anaerobic digester.

- Equation 17, Project activity electricity emissions in CO_2e:

$$EE_y = (EP_{y\text{-}project} – EP_{p\text{-}project} - EP_{y\text{-}baseline}) * EC_y / 1000$$

- Equation 18, Land leakage:

$$Land\ Leakage = Project\ activity\ land\ emissions – Baseline\ land\ emissions$$

- Equation 19, Direct nitrous oxide (N_2O) emissions from land application:

$$N_2O_{land} = N_{ex} * N * (1\text{-}F_{gasm}) * EF_1 * C_m$$

- Equation 20, Indirect nitrous oxide (N_2O) emissions from runoff:

$$N_2O_{runoff} = N_{ex} * N * (1-F_{gasm}) * F_{leach} * EF_5 * C_m$$

- Equation 21, Indirect nitrous oxide (N_2O) emissions from ammonia volatilization:

$$N_2O_i = N_{ex} * N * EF_4 * F_{gasm} * C_m$$

- Equation 22, Total nitrous oxide (N_2O) emissions:

$$N_2O_{total} = (N_2O_{land} + N_2O_i + N_2O_{runoff}) / 1000$$

- Equation 23, Total nitrous oxide (N_2O) emissions in CO_2 equivalent:

$$N_2O_{CO2\text{-}equiv} = GWP_{N2O} * N_2O_{total}$$

- And, the following equation was used to sum the land application and electricity leakage:

$$\mathrm{L_o = EE_y + N_2O_{CO2\text{-}equiv}}$$

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.):

Equations 24 and 26 from Approved Methodology AM0016 are used to determine project activity emission reductions:

- Equation 24, Total emissions in metric tonnes CO_2e:

$$Total\ Emissions_{mt} = CO_{2eq\ methane} + CO_{2equiv\ N2O}$$

- Equation 26, Net emission reductions:

$$ER_{net} = BE – PE – L_o$$

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

Data *(Indicate table and ID number, e.g., D.2-1, D.2-2)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.2.1.1-1	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.3-1	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-6	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.3-6	Low	Work instructions for the collection of this data point are available in O&M Manual

Data *(Indicate table and ID number, e.g., D.2-1, D.2-2)*	Uncertainty level of data (High/Medium/Low)	Explain QA/QC procedures planned for these data, or why such procedures are not necessary.
D.2.1.1-9	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.3-9	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-12	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-13	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.1.1-14	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.3.1-16	Low	Work instructions for the collection of this data point are available in O&M Manual
D.2.3.1-19	Low	Work instructions for the collection of this data point are available in O&M Manual

AgCert's monitoring and reporting plan has been developed under the organization's pending ISO 9001 and ISO 14001 Quality and Environmental Management System. Additionally, AgCert has been privileged to be afforded the opportunity to comment on draft ISO 14064, Guidelines for measuring, reporting, and verifying entity project-level GHG emissions and has applied the main concepts to its QC and QA procedures. AgCert is working towards ISO 9001/14001 certification.

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:

AgCert has a trained staff located in the host nation to perform O&M activities including, but not limited to monitoring and collection of parameters, quality audits, personnel training, and equipment inspections. The associated O&M Manual has been developed to provide guidance (work instructions) to individuals that collect and/or process data. An AgCert employed "circuit rider" will perform audits of farm operations personnel on a periodic basis to ensure proper data collection and handling.

AgCert has designed and implemented a unique set of data management tools to efficiently capture and report data throughout the project lifecycle. On-site assessment (collecting Geo-referenced, time/date stamped data), supplier production data exchange, task tracking, and post-implementation auditing tools have been developed to ensure accurate, consistent, and complete data gathering and project implementation. Sophisticated tools have also been created to estimate/monitor the creation of high quality, permanent, ERs using IPCC formulae.

By coupling these capabilities with an ISO quality and environmental management system, AgCert enables transparent data collection and verification.

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

AgCert determined the monitoring methodology for use at these project activities. AgCert is the project developer.

SECTION E. Estimation of GHG emissions by sources:

E.1 Estimate of GHG emissions by sources:

The **methane (CH_4)** emissions for the project activity were calculated using AM0016 equations 9, 10, and 11. Within these equations several key parameters and emission factors were utilized.

The **nitrous oxide (N_2O)** emissions for the project activity were calculated using Equations 13, 14, 15, and 16. Within these equations several key parameters and emission factors were utilized.

The **carbon dioxide (CO_2)** equivalent emissions (the extra power required for project equipment) for the project activity were calculated using Equation 17. Within this equation a coefficient factor was utilized.

The following is a table of annual project activity GHG emissions by source in CO_2 equivalents:

E1.A - Project Activity Emissions (Year 1)					
Site	Source	GHG Emissions (CO_2e)			
		CH_4	N_2O		
1	Fazenda Alecrim e Funil	263	62		
2	Fazenda Bons Irmaos	57	13		
3	Fazenda Sol do Amanhecer	450	106		
4	Granja JB	591	140		
	Total:	1,361	321	**1,682**	metric tonnes

E1.B - Project Activity Emissions (Year 2+)					
Site	Source	GHG Emissions (CO_2e)			
		CH_4	N_2O		
1	Fazenda Alecrim e Funil	263	62		
2	Fazenda Bons Irmaos	466	110		
3	Fazenda Sol do Amanhecer	450	106		
4	Granja JB	591	140		
	Total:	1,770	418	**2,188**	metric tonnes

E.2 Estimated leakage:

The leakage estimate for the project activity was calculated using Equations 17 to 23 from the *Emission Reductions* section of AM0016 and Section D.2.3.2 of this document, as well as increased power consumption:

Increased Power Consumption

Electrical demand as a consequence of the project activity is not expected to increase significantly. Additional electrical power will run low voltage sensors, and meters. The total power increase is expected to be less than 500 kWh/year. However power consumption will be monitored to determine if any leakage occurs as a result of the project activity.

Total Estimated Leakage Emissions

The following table gives the estimated project leakage:

E2.A - Total Leakage Emissisons (Year 1)										
Site	Source	GHG Emissions (CO_2e)								
		Baseline			Project			Change		
		CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2
	Land Application									
1	Fazenda Alecrim e Funil		354			354			0	
2	Fazenda Bons Irmaos		76			76			0	
3	Fazenda Sol do Amanhecer		607			607			0	
4	Granja JB		797			797			0	
	AWMS Electrical Power									
1	Fazenda Alecrim e Funil			0			0.36			0.36
2	Fazenda Bons Irmaos			0			0.36			0.36
3	Fazenda Sol do Amanhecer			0			0.36			0.36
4	Granja JB			0			0.36			0.36
							Total:			1.44

1 metric tonnes

E2.B - Total Leakage Emissisons (Year 2+)										
Site	Source	GHG Emissions (CO_2e)								
		Baseline			Project			Change		
		CH_4	N_2O	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	CO_2
	Land Application									
1	Fazenda Alecrim e Funil		354			354			0	
2	Fazenda Bons Irmaos		629			629			0	
3	Fazenda Sol do Amanhecer		607			607			0	
4	Granja JB		797			797			0	
	AWMS Electrical Power									
1	Fazenda Alecrim e Funil			0			0.36			0.36
2	Fazenda Bons Irmaos			0			0.36			0.36
3	Fazenda Sol do Amanhecer			0			0.36			0.36
4	Granja JB			0			0.36			0.36
							Total:			1.44

1 metric tonnes

AWMS Electrical Power project leakage is calculated using emission factors from OECD: Road-Testing Baselines for GHG Projects in the Electric Power Sector, Table 3-1(c), p.19. As directed in the methodology, electrical leakage from project activity is offset by the "green" energy produced using the captured methane. The following table describes the calculation and was the basis for the figure used above for the *AWMS Electrical Power – Project - CO_2* parameter.

Source	Est kwh consumed/produced per yr	kg CO2e emitted per kwh produced - Brazil	metric tonnes CO2e
Leakage	500 kwh	0.7190	0.3595
Green energy produced		0.2750	0
			0.3595

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

The total project emissions are given below as the sum of the totals provided in Sections E.1 and E.2:

E3.A- Total Project Activity Emissions (Year 1)					
Source	GHG Emissions (CO_2e)				
	CH_4	N_2O	CO_2		
E1 - Project Emissions	1,361	321			
E2 - Leakage			1		
Total:	1,361	321	1	**1,683**	metric tonnes

E3.B - Total Project Activity Emissions (Year 2+)					
Source	GHG Emissions (CO_2e)				
	CH_4	N_2O	CO_2		
E1 - Project Emissions	1,770	418			
E2 - Leakage			1		
Total:	1,770	418	1	**2,189**	metric tonnes

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

The following sections describe the baseline emission calculations and the resulting emissions expressed in terms of CO_2 equivalents.

The baseline was calculated using Equations 9, 10 and 11 for methane emissions and Equations 13, 14, 15 and 16 for nitrous oxide emissions. These equations were customized from the *Emission Reductions* section of AM0016 and Section D.2.1.4 of this document. Within these equations several key parameters and emission factors were utilized.

E4.A - Baseline Emissions (Year 1)					
Site	Source	GHG Emissions (CO_2e)			
		CH_4	N_2O		
1	Fazenda Alecrim e Funil	2,364	62		
2	Fazenda Bons Irmaos	511	13		
3	Fazenda Sol do Amanhecer	4,052	106		
4	Granja JB	5,322	140		
	Total:	12,249	321	**12,570**	metric tonnes

E4.B - Baseline Emissions (Year 2+)					
Site	Source	GHG Emissions (CO_2e)			
		CH_4	N_2O		
1	Fazenda Alecrim e Funil	2364	62		
2	Fazenda Bons Irmaos	4196	110		
3	Fazenda Sol do Amanhecer	4052	106		
4	Granja JB	5322	140		
	Total:	15,934	418	**16,352**	metric tonnes

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

The project activity emission reductions are obtained by differencing the totals listed in Sections E.4 and E.3, as shown in the table that follows:

E5.A - Total Project Activity Emission Reductions (Year 1)			
Source	GHG Emissions (CO_2e)		
E4 - Est. Baseline Emissions	12,570		
E3 - Project Activity Emissions	1,683		
Total:	10,887	**10,887**	metric tonnes

E5.B - Total Project Activity Emission Reductions (Year 2+)			
Source	GHG Emissions (CO_2e)		
E4 - Est. Baseline Emissions	16,352		
E3 - Project Activity Emissions	2,189		
Total:	14,163	**14,163**	metric tonnes

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

E6 - Project Activity Emissions				
Year	Tonnes of CO_2e			
	Estimate of Project Activity Emissions	Estimate of Baseline Emissions	Estimate of Leakage	Estimate of ERs
Year 1	1,682	12,570	1	10,887
Year 2	2,188	16,352	1	14,163
Year 3	2,188	16,352	1	14,163
Year 4	2,188	16,352	1	14,163
Year 5	2,188	16,352	1	14,163
Year 6	2,188	16,352	1	14,163
Year 7	2,188	16,352	1	14,163
Year 8	2,188	16,352	1	14,163
Year 9	2,188	16,352	1	14,163
Year 10	2,188	16,352	1	14,163
Total:	21,374	159,738	10	138,354

Values for the parameters/factors used in the formulae in previous sections are listed with their sources and comments in the table that follows:

Table E1-1. Parameter/Factor Values and References

Parameter/Factor	Value	Source/Comment
Baseline		
CH_4 GWP	21	Intergovernmental Panel on Climate Change, *Climate Change 1995: The Science of Climate Change* (Cambridge, UK: Cambridge University Press, 1996)
ID1	Annex 3	Animal population used to estimate baseline and project emission estimates was based on a 12 month period of actual operation production data (See Annex 3).
ID1	Annex 3	Mortality rate
ID1 (n_m)	Annex 3	Days resident in system
ID14	100%	AWMS operation status
MS%j	100%	Percent of effluent used in system.
V_S	0.5	Obtained from 1996 IPCC, Appendix B, Table B-6, p. 4.46
B_o	0.45	Obtained from 1996 IPCC, Appendix B, Table B-6, p. 4.46

Parameter/Factor	Value	Source/Comment
MCF_{month}	0.90	Obtained from 1996 IPCC, Appendix B, Table B-6, p. 4.46
N_2O GWP	310	Intergovernmental Panel on Climate Change, *Climate Change 1995: The Science of Climate Change* (Cambridge, UK: Cambridge University Press, 1996)
C_m	1.5714	Conversion factor from [N_2O – N] to N_2O (Cm=44/23)
F_{gasm}	0.2	Obtained from 1996 IPCC, Table 4-19, p. 4.94
EF_3	0.001	Obtained from IPCC 2000 Table 4.12, Section 4.4.1.2, p. 4.43
EF_4	0.01	Obtained from IPCC 2000 Table 4.18 Section 4.8.1.2, p. 4.73
N_{ex}	20	Obtained from 1996 IPCC, Table 4-20, p. 4.99
Project Activity		
CH_4 GWP	21	Intergovernmental Panel on Climate Change, *Climate Change 1995: The Science of Climate Change* (Cambridge, UK: Cambridge University Press, 1996)
ID1	Annex 3	Animal population used to estimate baseline and project emission estimates was based on a 12 month period of actual operation production data (See Annex 3).
ID1	Annex 3	Mortality rate
ID1 (n_m)	Annex 3	Days resident in system
ID14	100%	AWMS operation status
MS%j	100%	Percent of effluent used in system
V_S	0.5	Obtained from 1996 IPCC Appendix B, Table B-6, p. 4.46
ID1		Days resident in farm
B_o	0.45	Obtained from 1996 IPCC, Appendix B, Table B6, p. 4.46
MCF_{month}	0.10	Obtained from 1996 IPCC Appendix B, Table B-6, p. 4.46
N_2O GWP	310	Intergovernmental Panel on Climate Change, *Climate Change Change* (Cambridge*1995: The Science of Climate*, UK: Cambridge University Press, 1996)
C_m	1.5714	Conversion factor from [N_2O – N] to N_2O (Cm=44/23)
F_{gasm}	0.2	Obtained from 1996 IPCC, Table 4-19, p. 4.94
EF_3	0.001	Obtained from IPCC 2000 Table 4.12, Section 4.4.1.2, p. 4.43
EF_4	0.01	Obtained from IPCC 2000 Table 4.18 Section 4.8.1.2, p. 4.73
N_{ex}	20	Obtained from 1996 IPCC, Table 4-20, p. 4.99
Leakage		
N_{ex}	20	Obtained from 1996 IPCC, Table 4-20, p. 4.99
ID1	Annex 3	Animal population used to estimate baseline and project emission estimates was based on a 12 month period of actual operation production data (See Annex 3).

Parameter/Factor	Value	Source/Comment
ID1	Annex 3	Mortality rate
ID1 (n_m)	Annex 3	Days resident in system
F_{gasm}	0.2	Obtained from IPCC 1996, Table 4-19, p. 4.94
EF_1	0.0125	Obtained from IPCC 1996, Table 4-18, p. 4.39
C_m	1.5714	Conversion factor from [N_2O – N] to N_2O (Cm=44/23)
F_{leach}	0.3	Obtained from IPCC 1996, Table 4-24, p. 4.106
EF_5	0.025	Obtained from IPCC 1996, Table 4-23, p. 4.105
EF_4	0.01	Obtained from IPCC 2000 Table 4.18 Section 4.8.1.2, p. 4.73
ID16	500 kwh/yr	Electricity consumed by project activity equipment
ID19	90,000kwh/yr	Electricity generated by project activity equipment using captured methane
ECy	0.719kg CO2 / kwh	OECD: Road-Testing Baseline for GHG Projects in the Energy Power Sector. Emission coefficient for electricity (Consumed by Project Activity Equipment)
ECy	0.275kg CO2 / kwh	OECD: Road-Testing Baseline for GHG Projects in the Energy Power Sector. Emission coefficient for electricity (Produced by Project Activity Generator)

Table E1-2. Uncertainty Parameters

Uncertainty Parameter for the eight sites GHG Mitigation Project Estimates	
Uncertainty:	**How Addressed:**
○ Data collection inaccuracies ○ Animal type ○ Animal population, group/type, mortality rates ○ Genetics ○ Choice of appropriate emission coefficients ○ Data security ○ Animal health	○ Accurate data collection is essential. The farms included in this project activity use a standardized industry database package which captures a wide range of incremental production data to manage operations and enable the farm to maximize both productivity and profitability. AgCert uses some data points collected via this system. ○ AgCert employed the emission factor determination test to assist in the selecting of appropriate IPCC "developed" or "developing" country values. ○ AgCert has a rigorous QA/QC system that ensures data security and data integrity. AgCert performs spot audits of data collection activities. ○ AgCert has a data management system capable of interfacing with producer systems to serve as a secure data repository. Project activity data related uncertainties will be reduced by applying sound data collection quality assurance and quality control procedures. ○ Lastly, strict bio-security procedures are observed and adhered to.

SECTION F. Environmental impacts:

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

There are no negative environmental impacts resulting from the proposed project activities. Beyond the principal benefit of mitigating GHG emissions (the primary focus of the proposed projects), the proposed activities will also result in positive environmental co-benefits. They include:

- Reducing atmospheric emissions of Volatile Organics Compounds (VOCs) that cause odour,
- Reducing the risk (of release) of disease-transmitting vectors and airborne pathogens.

The combination of these factors will make the proposed project sites more "neighbour friendly."

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:

All of the impacts on the environment are considered to be significantly positive.

SECTION G. Stakeholders comments

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

AgCert invited stakeholders to a meeting to explain the UNFCCC CDM process and proposed project activity, presided over by Paulo Furtado, AgCert. Invitations to the stakeholders meeting were communicated via e-mail sent directly to project participants and federal, state and local officials. The meeting took place on February 24, 2005 in Feira de Santana, Bahía.

The CDM Project Stakeholders Meeting information was published in the municipal newspaper in the region of the CDM project activity, *Tribuna Fériense*, on February 19, 2005.

Mr. Furtado gave a presentation, which covered the following topics: purpose of meeting; background on global warming and the Kyoto Protocol; UNFCCC CDM processes and responsibilities of the project; participants; equipment to be used for evaluation and audits; information management system; an example of the project; benefits from the project (environmental and economic); and where to get further information.

Attendees were then afforded the opportunity to ask questions and provide comments.

G.2 Summary of the comments received:

No negative issues were raised by local stakeholders. Individuals asked questions, which included whether the contract was renewable after ten years, which party was responsible for the residuals to flow into the biodigester, and under what conditions, if any, could water from the biodigester be used.

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

Overall, there was good feedback from all participants about the project activity.

ANNEX 1.

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

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ANNEX 2.

INFORMATION REGARDING PUBLIC FUNDING

The implementation of this project is not dependent on any Official Development Assistance resource or any other resources from any international development-funding agency.

ANNEX 3.

BASELINE INFORMATION

Farm Data: Fazanda Alecrim e Funil, Apr 2004 – Mar 2005

Sow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	297	298	311	263	259	274	257	275	280	288	289	291
Mortalities	1	3	0	5	0	3	0	0	3	2	1	1
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Gilt	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	59	78	51	52	71	68	65	54	85	66	80	76
Mortalities	0	0	0	0	0	0	1	0	0	0	0	0
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Boar	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	7	7	5	5	6	6	5	6	7	7	7	7
Mortalities	0	0	0	1	0	0	0	0	0	0	0	0
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Finisher	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	1,562	1,504	1,602	1,393	1,302	1,146	1,370	1,356	1,319	1,402	1,433	1,432
Mortalities	9	21	12	6	12	4	8	6	0	5	9	8
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Nurse/Wean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	419	695	532	445	529	566	455	439	573	399	510	560
Mortalities	4	9	11	3	2	4	8	3	6	10	3	8
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0

Farm Data: Fazenda Bons Irmãos, Apr 2004 – Mar 2005

Sow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	125	123	152	0	0	0	39	75	119	130	132	129
Mortalities	0	0	0	0	0	0	0	0	3	2	2	2
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Gilt	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	62	62	86	60	60	134	95	59	14	2	0	62
Mortalities	0	0	0	0	0	1	0	0	0	0	0	1
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Boar	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	5	5	8	4	4	5	5	5	5	5	5	5
Mortalities	0	0	0	0	0	0	0	0	0	0	0	0
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Finisher	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	421	737	1,136	0	0	0	0	0	0	0	0	103
Mortalities	0	0	0	0	0	0	0	0	0	2	0	1
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Nurse/Wean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	543	463	107	0	0	0	0	0	0	0	191	439
Mortalities	0	0	0	0	0	0	0	0	0	4	6	7
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0

Projected Farm Data: Fazenda Bons Irmãos, Jan 2006 – Dec 2006

Sow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	423	423	423	423	423	423	423	423	423	423	423	423
Mortalities	2	2	2	2	2	2	2	2	2	2	2	2
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Gilt	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	62	62	86	60	60	134	95	59	14	2	0	62
Mortalities	0	0	0	0	0	1	0	0	0	0	0	1
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Boar	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	5	5	8	4	4	5	5	5	5	5	5	5
Mortalities	0	0	0	0	0	0	0	0	0	0	0	0
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Finisher	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425	2,425
Mortalities	15	15	15	15	15	15	15	15	15	15	15	15
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Nurse/Wean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100	1,100
Mortalities	30	30	30	30	30	30	30	30	30	30	30	30
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0

Farm Data: Fazenda Sol do Amanhecer, Apr 2004 – Mar 2005

Sow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	419	423	440	387	404	421	414	399	387	383	397	410
Mortalities	1	0	1	1	4	1	3	3	1	2	3	2
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Gilt	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	49	35	25	119	72	40	61	77	79	104	97	76
Mortalities	0	1	0	0	1	0	1	0	1	0	3	0
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Boar	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	8	10	8	4	4	5	4	4	5	8	8	8
Mortalities	0	0	0	0	0	0	0	0	0	0	0	0
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Finisher	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	2,289	2,427	2,590	2,305	2,234	2,243	2,142	2,164	2,274	2,142	2,171	2,182
Mortalities	15	14	8	26	8	11	5	5	5	4	1	0
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Nurse/Wean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	1,134	1,030	1,193	1,272	1,232	1,087	1,096	1,118	1,228	1,096	1,095	1,098
Mortalities	44	17	11	20	8	11	5	5	4	1	0	5
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0

Farm Data: Granja JB, Apr 2004 – Mar 2005

Sow	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	782	787	786	691	687	691	705	719	780	816	788	783
Mortalities	1	0	0	0	1	1	1	1	0	4	1	1
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Gilt	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	90	74	85	95	138	170	146	176	109	32	0	0
Mortalities	0	0	0	0	0	0	0	0	0	0	0	0
Days Unpopulated	0	0	0	0	0	0	0	30	31	0	0	0
Boar	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	10	10	10	10	10	10	10	10	10	10	10	10
Mortalities	0	0	0	0	0	0	0	0	0	0	0	0
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Finisher	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	1,803	2,311	2,831	1,023	967	998	956	758	376	288	1,046	1,494
Mortalities	2	2	0	1	2	1	1	1	0	0	2	2
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0
Nurse/Wean	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Population	3,669	3,483	3,582	2,240	2,394	2,648	2,640	2,934	3,258	3,424	3,187	3,163
Mortalities	5	7	4	5	5	5	6	5	5	8	8	8
Days Unpopulated	0	0	0	0	0	0	0	0	0	0	0	0

ANNEX 4.

MONITORING PLAN

The project developer, in conjunction with its in-country suppliers/partners, have developed an operation and maintenance (O&M) plan and have reviewed the plan with the producer (Attachment 1). The plan lists operation and maintenance requirements including but not limited to:

a. A description of the planned start-up procedures, normal operation, safety issues, and normal maintenance items.

b. Alternative operation procedures in the event of equipment failure.

c. Instructions for safe use and/or flaring of biogas.

d. Inspection criteria.

e. Work instructions for the measurement and recording of key GHG parameters, e.g., animal counts, mortalities, days in system, etc., as well as instructions for quality control measurements and other information collection, as appropriate.