**CLEAN DEVELOPMENT MECHANISM**
**PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)**
**Version 07 - in effect as of: 02 August 2008**

**CONTENTS**



**Annexes**

**Revision history of this document**

| Version Number | Date | Description and reason of revision |
|---|---|---|
| 01 | 21 January 2003 | Initial adoption |
| 02 | 8 July 2005 | • The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>. |
| 03 | 22 December 2006 | • The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM. |

## SECTION A. General description of small-scale project activity

### A.1 Title of the small-scale project activity:

Agroceres – Methane capture and combustion at Granja Paraiso
Version: 02
Date: 24/09/2009

### A.2. Description of the small-scale project activity:

Presently Brazil is ranked among the top five swine beef producers. The production has been increasing reaching the level of Europe and North America. Among the reasons is the higher productivity ratios, changes in the production chain, improvement in the livestock sanitary standards, technical support and researches. Nevertheless, the swine raising is a potentially aggressive activity and represents a threat to natural resources when an inadequately storage and/or disposal occur.

The sustainable program main goals are: to improve the waste management system, to reduce the GHG emissions and to provide better living conditions to the surrounding communities. The project activity consists in the collection and treatment of the swine waste by installing anaerobic digesters (biodigestors) in the farms.

The captured biogas will be flared reducing the methane emission, the main GHG emitted due to livestock activity.

The manure management system introduced as part of the project activity, as well as the one in the baseline scenario, is in compliance with the regulatory framework in Brazil. The livestock populations are managed under confined condition, which is favorable for the methane production, once livestock waste is easily stored and treated in liquid systems, particularly anaerobic lagoons.

The Agroceres group consists of five companies: Agroceres Nutrição Animal, feed producer, concentrates and premix animal nutrition of high performance; Agroceres PIC, a joint-venture with the English Pig Improvement Company, world leader in swine breeding; Atta-Kill, leader company in ant baits; Biomatrix, company responsible for corn production and sorghum seeds, and Inaceres, a joint-venture with the equatorial group Inaexpo, the palm cultivation in the state of Bahia.

The Agroceres Genética e Nutrição Animal LTDA is a market leader company in swine breeding. It is highlights are technology, products and services, brand, reputation and environmental responsibility. It was the first company from pig farming to achieve ISO 14000 certification, and thinking about the sustainability of its business, implementing projects on Clean Development Mechanism (CDM) in its farm of research in genetics and nutrition.

## A.3. Project participants:

The participants involved in the project are listed in the table below:

| 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 country) | **Agroceres Genética e Nutrição Animal LTDA** | No |
| (*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required. | | |

Agroceres is a solid and traditional organization in agribusiness market, with 62 years of activity. Created with the propose of researching, producing and commercializing hybrid corn seeds is, nowadays, a diversified company, with outstanding reputation in various segments of agribusiness: swine breeding, animal nutrition, ants bait, corn and sorghum seeds and palm production.

Owns one of the most remembered brand in rural areas, the Agroceres not only is part of history but also has important contributions to the development of Brazilian agribusiness. Besides being the first to work with hybrid corn in Brazil, who was anticipated the trend of consumers by cuts of chicken, making an alliance in 1985 with Ross Breeders, for the implementation of the first program of Breeding Birds of the country.

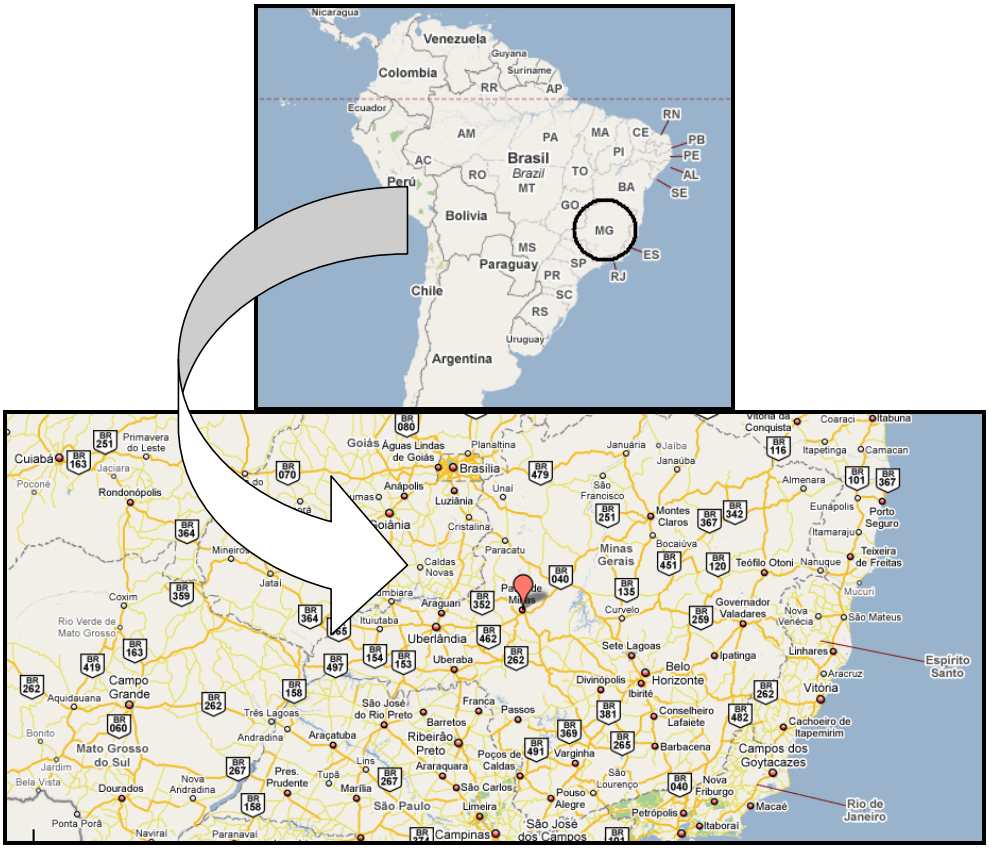
Early, in 1978, the Agroceres initiated the first nucleus for breeding pigs, spreading the concept of breeding of pigs between the scientific class and launched the first hybrid matrix. In 1980, Brazil introduced the concept of biosecurity, in 1985, developed the first program of nutrition exclusively devoted to pigs for high performance and in 1990 launched the "pig Light" (AGPIC405) - actions that demonstrate the role of Agroceres to anticipate the future and create competitive advantages to the Brazilian agribusiness.

## A.4. Technical description of the small-scale project activity:

### A.4.1. Location of the small-scale project activity:

Figure A.1.: Localization of Patos de Minas (MG)[1]

[1] www.maps.google.com.br




**A.4.1.1. Host Party(ies):**

The host party for the project is Brazil.

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

The project will be located in the State of Minas Gerais.

**A.4.1.3. City/Town/Community etc.:**

Municipality of Patos de Minas

**A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:**

The state of Minas Gerais is traditionally corporate producer of pigs, one of the most important parts of the country. The Agroceres plays an important role in this direction, because it uses genetically improved breeding. Among the advantages in that process, there is a more healthy meat with more protein and lower in fat.

The farm where the biodigestors will be installed is the Granja Paraiso, localized in the road BR 365, Km 429, in the municipality of Patos de Minas. Its localization (in UTM – Universal Transversal Mercator – co-ordinates) is 18ºS 45' 00,7", 46ºW 37' 18,3", in the artesian well, in the center of the property.

The property has 505 hectares and it is divided into three clusters, which are Sítio, NEST 1 and NEST 2. In the Sítio are sows, males (boars), gilts and piglets (nursery a). In NEST 1 and 2 are the piglets from nursery (nursery b), from growing (finishing a ) and finishing (finishing b). Each animal has an identification number where all data is described, such as date of birth, weight, applied medication and nutrition. Thus, the production is traceable, ensuring their safety.

Each module is completely independent of each other and it has its own management system, composed by four anaerobic lagoons (anaerobic, facultative and polishing). The dimensions of the lagoons are 52.0 / 48.0 m (length on the surface and bottom) with 24.0 / 18.0 m (width on the surface and bottom) by 3.0 m deep in the first pond. In the other lakes, the widths and lengths do not differ, just changing the depth. In the second lagoon, the depth is 3.5 m; in the lagoon 3 to depth is 1.5 m in the fourth is 1.0 m. The quantities of effluents are 200 $m^3$/day, 220 $m^3$/day and 180 $m^3$/day in Sítio, NEST 1 and NEST 2, respectively. These are sealed by HDPE (HDPE), 1 mm of thickness.

In such scenario will be installed the biodigestor, two in parallel in each core. The animal waste will be launched directly into the biodigestor, where, later, will be released to the lagoons.

According to Lima et al (2006)[2] the most common manure management system (the baseline scenario) in Brazil is the open tank (e*sterqueira*), therefore the animal waste treatments currently used are not able to capture the biogas produced in the manure. The material is generally distributed by pumps or gravity and applied to crops and pastures.

The project technology is based on anaerobic digestion, which 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 biogas.

The digester technology consists in covered primary lagoon, where the manure originated in the barns enters on a continuous flow powered by gravity. This system is capable to provide an adequate ambient to the anaerobic digestion.

As a result of the anaerobic digestion process, the biogas is produced and stored under the biodigestor cover; the effluent is oriented to a secondary, terciary e quaternarey lagoon and then, spread aerobically on the land as a biofertilizer.

The biogas, which contains methane, is collected and then flared, generating carbon dioxide. The flare system will be enclosed, as required by the methodology, and was projected with automated burning system to guarantee a high efficiency on the methane combustion.

The GHG emission reduction is achieved by the combustion of methane content of the biogas, which is converted in $CO_2$ and other non GHG gases, therefore avoiding methane emissions.

[2] Lima, M.A., Pessoa, M.C.P.Y., Ligo, M.A.V., **Inventário Brasileiro de Emissões Antrópicas de Gases de Efeito Estufa, Emissões de metano na pecuária,** Relatório de Referência, Embrapa - Ministério da Ciência e Tecnologia 2006.

The biodigestors have a warranty against installation and manufacturing defect for ten years. The average lifetime for the biodigestor cover is about five years, according to Sansuy (provider of the service), and for the structure is about ten years, according to Top Construtura.

The fraction of methane in the biogas will be analyzed monthly with GEM 2000 gas analyzer. The biogas temperature and pressure will be measured with electronic devices and stored in a datalogger. Tests will be undertaken to assure 95% of confidence level and, if needed, the measurement frequency can be adjusted.

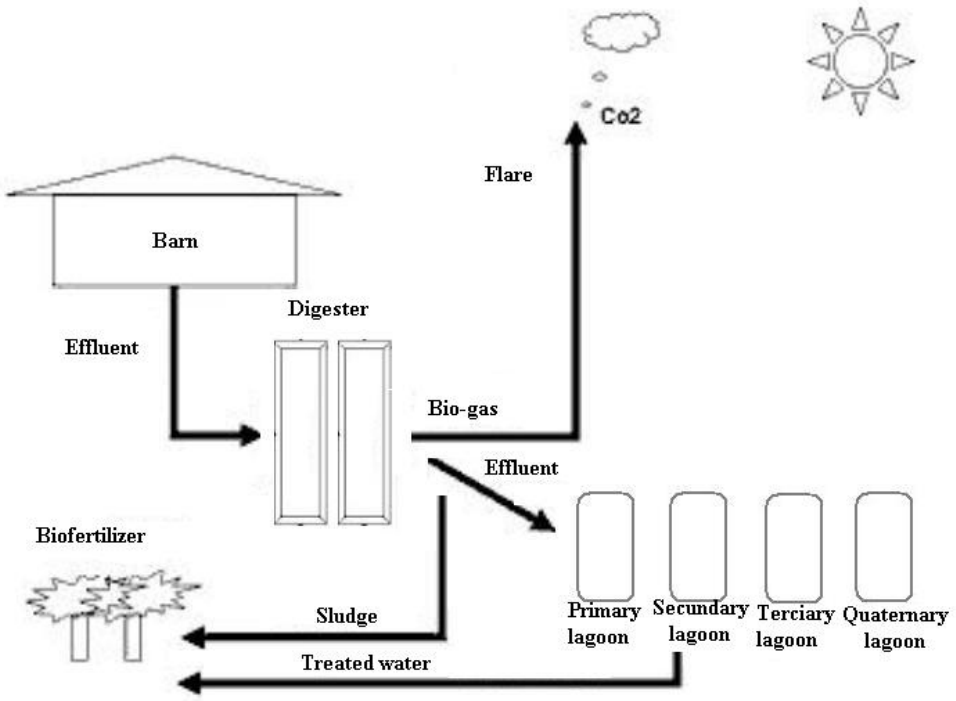
The principal characteristics about the biodigestor, the lagoons and the flare are listed bellow:

| **Biodigester Capacity ($m^3$)** | | |
|---|---|---|
| | Unit Capacity | Total Capacity |
| Sítio 01 | 2,335 | 4,670 |
| NEST 01 | 2,335 | 4,670 |
| NEST 02 | 2,335 | 4,670 |
| | | Total Capacity: 14,010 $m^3$ |

| **Biogas Capacity ($m^3$)** | | |
|---|---|---|
| | Unit Capacity | Total Capacity |
| Sítio 01 | 1,221 | 2,442 |
| NEST 01 | 1,221 | 2,442 |
| NEST 02 | 1,221 | 2,442 |
| | | Total Capacity: 7,326 $m^3$ |

| **Aerobic Lagoon Capacity ($m^3$)** | | | | | |
|---|---|---|---|---|---|
| | First | Secondary | Terciary | Quaternary | Total |
| Sítio 01 | 4,270 | 2,555 | 3,170 | 1,655 | 11,650 |
| NEST 01 | 5,760 | 3,915 | 4,870 | 2,430 | 16,975 |
| NEST 02 | 5,760 | 3,915 | 4,870 | 2,430 | 16,975 |
| | | | | | Total Capacity: 45,600 $m^3$ |
| COD in the end of Aerobic Treatment: 0.01 mg/L | | | | | |

Figure A.3: Flowchart of the system:




The external temperature and the biodigestors' hydraulic retention time play an important role in the methane conversion factor (MCF). Manure that is managed as a liquid under warm conditions for an extended period of time benefits the methane formation. The digester has been projected to allow sludge removal from its bottom without breaking the gas retention seal. The removal will happen by suction through the lateral pipe.

The technical project has been leaded by the Agroceres' engineering team, who was responsible to analyze the available technologies and define the ones to be applied in the project activity. The same team identified capable suppliers to install the biodigestors and related system's equipment. All the project implementation will be supported by that team.

**A.4.2. Type and category(ies) and technology/measure of the small-scale project activity**

According to the Appendix B[3] of the "Simplified modalities and procedures for small-scale clean development mechanism project activity", this project is classified as Type III, Category D., "*Methane recovery in agricultural and agro industrial activities*", version 14.

**A.4.3. Estimated amount of emission reductions over the chosen crediting period:**

[3] http://cdm.unfccc.int/methodologies/SSCmethodologies

| Estimated amount of Emission Reductions during the crediting period | |
|---|---|
| **Years** | **Estimation of annual emission reductions in tonnes of $CO_2$** |
| 2009 | **1,443** |
| 2010 | **17,316** |
| 2011 | **17,316** |
| 2012 | **17,316** |
| 2013 | **17,316** |
| 2014 | **17,316** |
| 2015 | **17,316** |
| 2016 | **15,873** |
| **Total estimated reductions (tonnes of $CO_2$ e)** | **121.210** |
| **Total number of crediting years** | **7** |
| **Annual average over the crediting period of estimated reductions (tones of $CO_2$ e)** | **17.316** |

**A.4.4. Public funding of the small-scale project activity:**

There is no public funding involved in this project activity.

**A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:**

This project activity can not be categorized as a debundled one, according to the definition in paragraph 2 in the "*Appendix C of the Simplified Modalities and Procedures for Small-Scale CDM project activities*"[4]. The reasons that reinforce it are listed below:

§ There isn't any registered small scale project in the same category and technology/ measure, within the previous 2 years, with the same project participants of this project;

§ The project boundaries of this project are not within 1 km of any other proposed small-scale activity at the nearest point.

[4] http://cdm.unfccc.int/EB/Meetings/007/eb7ra07.pdf

## SECTION B. Application of a baseline and monitoring methodology

### B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

a) The approved baseline methodology that applies to this project is a Type III, Other Project Activities and is referenced as **"***AMS III.D. Methane recovery in animal manure management system (Version 14*)" in *http://cdm.unfccc.int/methodologies/Tools/eb28_repan13.pdf and "AMS I.D. Grid connected renewable electricity generation – Version 13"* in http://cdm.unfccc.int/UserManagement/FileStorage/CDMWF_AM_PHPV5WESACMBTJ2YY54GAJYSIEI3HD.

b) Methodological tool used: "*Tool to calculate baseline, project and/or leakage emissions from electricity consumption – Version 01"* in *http://cdm.unfccc.int/methodologies/Tools/tool_electricity_consumption_v1.pdf and* "*Tool to determine project emissions from flaring gases containing methane" in http://cdm.unfccc.int/methodologies/Tools/eb28_repan13.pdf* .

### B.2. Justification of the choice of the project category:

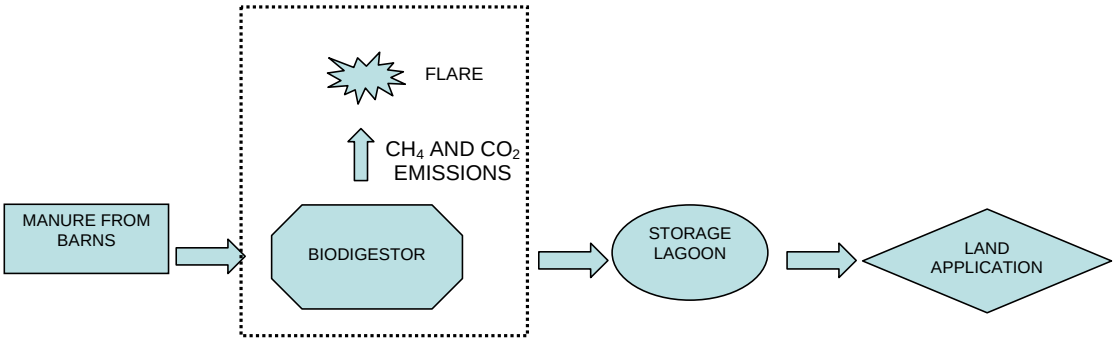
The methodology AMS III.D can be used because:

- The project activity is a modification of an anaerobic manure management system in livestock farms to achieve methane recovery and destruction by flaring.
- The livestock population in the farm is managed under confined conditions;
- Manure or the streams obtained after treatment are not discharged into natural water resources;
- The annual average temperature of baseline site is located is 22°C, higher than 5°C;
- In the baseline scenario, the retention time of manure waste in the anaerobic treatment system is greater than 1 month; considering a flow rate of 100$m^3$/day (information on RADA), the time of retention is 116 days in Sítio 1 and 169 days in NEST 01 and 02;
- In the baseline scenario, the anaerobic lagoons should have depths at least 1 m; the depths are: first lagoon – 3.0 m, second lagoon – 3.5 m, tertiary lagoon – 1.5 m, quaternary lagoon – 1.0 m.
- No methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline scenario.
- The final sludge will be handled aerobically.
- Technical measures will be used (including a flare for exigencies) to ensure that all biogas produced by the digester is used or flared.

### B.3. Description of the project boundary:

The boundary is restricted to the methane recovery facility, as stated by the small scale methodology, and then will comprise the biodigestor and the flare. In fact, this is the best model, once those are the only emissions that can effectively be measured and monitored.

Figure B.1: Project activity boundary:




The emissions sources and gases included in the project boundary are listed bellow:

| Source | | Gas | Included? | Justification/Explanation |
|---|---|---|---|---|
| Baseline | Emissions from electricity consumption | CO2 | Yes | Major emission source |
| | | CH4 | No | Not mentioned in AMS III.D |
| | | N2O | No | Not mentioned in AMS III.D |
| | Emissions from decomposition at the landfill site | CO2 | Yes | Major emission source |
| | | CH4 | Yes | Major emission source |
| | | N2O | No | Not mentioned in AMS III.D |
| Project Activity | Emissions from electricity consumption | CO2 | Yes | From power consumption by project activity |
| | | CH4 | No | Not mentioned in AMS III.D |
| | | N2O | No | Not mentioned in AMS III.D |
| | Emissions from the system | CO2 | Yes | From power consumption by project activity |
| | | CH4 | Yes | Physical leakage of biogas in project activity |
| | | N2O | No | Not mentioned in AMS III.D |

**B.4. Description of baseline and its development:**

The final draft of this baseline section was completed on 23/12/2008. The name of entity determining the baseline is PricewaterhouseCoopers Ltda, who is the project developer.

As reported in section A.4.3, the most common manure management system in use in Brazil (and therefore a plausible baseline scenario) is the open tank (*esterqueira*) where the manure is stored, stabilized and finally daily distributed as fertilizer (daily spread). This system advantages are its low implementation cost and easy operation. The disadvantages are the significant physical area wich is required, the need to remove the accumulated sludge (each 3/5 years) and low nitrogen removal efficiency.

The baseline emissions calculation are done by obtaining data *ex ante* from organic substance which should have suffered an anaerobic digestion process in the absence of this project. To calculate the scenario which best represents the reality and attends to IPCC Tier 2 specific information, animal sub-categories description is the first step.

Table B.1. Swine production weight categorization in Brazil:

| ANIMAL CATEGORY | Weight (kg/ animal) | |
|---|---|---|
| | Livestock (Brazil) [5] | IPCC Default Values[6] |
| Sows | 240 | 198 |
| Gilts | 120 | 198 |
| Boars | 250 | 198 |
| Nursery[a] | 4 | 50 |
| Nursery[b] | 18.25 | 50 |
| Finishing[a] | 48 | 50 |
| Finishing[b] | 87 | 50 |

The **$B_o$** (maximum methane producing potential of the volatile solids) and the **VS** default (volatile solids) values are presented in table B.2.

Table B.2. IPCC default values of $B_o$ and VS for the swine production:

| ANIMAL CATEGORY | $B_o$ ($m^3$ $CH_4$/ kg VS) | VS (kg/ head/day) |
|---|---|---|
| Sows | 0.45 | 0.46 |
| Gilts | 0.45 | 0.46 |
| Boars | 0.45 | 0.46 |
| Nursery[a] | 0.45 | 0.30 |
| Nursery[b] | 0.45 | 0.30 |
| Finishing[a] | 0.45 | 0.30 |
| Finishing[b] | 0.45 | 0.30 |

The parameters presented above correspond to those of Western Europe type. The Agroceres is itself the producer of the genetic source *PIC Agroceres*[7] (British origin). The genetic combined with a rigorous nutrition control assure a production compared to those obtained in the European countries.

The other default values used in the baseline calculation are presented in the table below:

Table B.3. Baseline parameters used in the estimation:

| Parameter | Value | Unit | Source[8] | Commentary |
|---|---|---|---|---|
| Density $CH_4$ | 0.67 | Kg/ $m^3$ | Page 10.42 | This value is used to estimate the emission reduction *ex ante*. During the project activity, another density value will be estimated, at the temperature and pressure of the measured biogas |
| MCF | 78% | N/A | Page 10.45, Table 10.17 | The baseline manure treatment system is an uncovered anaerobic lagoon. Patos de Minas (Minas Gerais): average ambient temperature: 22°C. |
| GWP | 21 | N/A | Global | - |

[5] The annual average weight data from Agroceres' swine production.
[6] From "**2006 IPCC Guidelines for National Greenhouse Gas Inventories- Volume 4, Chapter 10**, Table 10A- 7 and 10A- 8, pages 10.80 and 10.81.
[7] http://www.agrocerespic.com.br
[8] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10 in http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_10_Ch10_Livestock.pdf

| | | | | |
|---|---|---|---|---|
| | | | Warming Potential | |

**B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:**

B.5.1 Timeline project:

The following sections show that the CDM was considered for the development of the project activity. The CDM is being considered through the project development as can be evidenced by the relationship with different stakeholders such as service providers.

On 11/07/2008 occurred a meeting from Agroceres direction board to discuss CDM projects.

On 01/09/2008 was signed the contract with Baltazar Reis de Mendonça - ME in order to construct the biodigestors.

On 21/11/2008 was sent the first proposal by PwC to support Agroceres on the CDM process.

On 27/04/2009 was finished the first PDD version.

B.5.2 Assessment of Barriers:

The swine raising is an activity historically developed in Brazil and, as stated before, when not undertaken in an adequate way can cause damages to soil and water. The manure treatment, presently, is better than used to be, concern with the effluents disposal has grown and the legislation has been restricted as well. Thus, the manure treatment systems have improved, but there are several barriers to the adoption of this project activity on a national level.

B.5.3 Investment Barriers:

The employ of biodigestors to the waste treatment is not a recent practice. However, the investment demanded to implement such a system is very high to the majority of the potential users. The construction of a biodigestor would be most unlikely once; despite of improving the environmental and social condition, it would not add value to the production and thus would not increase the activity income. Additionally, as will be discussed in section B.5.4, there is no legislation demanding this kind of treatment.

A simple cost analysis was elaborated to compare the investment made in earthwork and construction of the anaerobic lagoons (baseline scenario) and the construction and the structure needed in the biodigestors to attend the UNFCCC's requirements. The table below reveals that the costs to accomplish the biodigestors' structure are, approximately, six times higher than the costs to implement the anaerobic lagoons.

Table B.4 Simple cost analysis

| Simple cost analysis - Anaerobic lagoons and biodigestors | | | |
|---|---|---|---|
| **Anaerobic lagoons** | | | |
| **Action** | **Supplier** | **Value** | |
| Earthwork and construction NEST I and NEST II | Falk Construtora Ltda | R$ | 135,000.00 |
| Earthwork and construction NEST I and NEST II | Falk Construtora Ltda | R$ | 40,000.00 |
| | **Total** | **R$** | **175,000.00** |
| **Biodigestors*** | | | |
| Biodigestor cover | Sansuy S/A Indústria de Plásticos | R$ | 322,500.00 |
| Plateau and cells | Baltazar Reis de Mendonça ME | R$ | 213,000.00 |
| Vinibiodigestors execution | Top Construtora | R$ | 130,000.00 |
| Civil construction | Vieira Borges Engenharia Ltda | R$ | 130,000.00 |
| Skid+flare | TEC Tecnologia em Calor Ltda | R$ | 200,000.00 |
| Methane analyser | Landtec Produtos e Serviços Ambientais Ltda | R$ | 23,133.60 |
| | **Total** | **R$** | **1,018,633.60** |

* The values are related to the three clusters

Correcting the cost of the anaerobic lagoons with the IGP-M (General Price Index) in 07/2000 to 09/2008 (starting date of the project activity) period, using a Brazilian Central Bank[9] tool to monetary conversion, there is a percentual value related of 121% so it increases to R$387,127.67. Still the biodigestors costs are almost three times higher.

Regarding the biogas power generation, another possible source of income, besides the high investment demanded, the technology applied to small scale use is not yet reliable and the equipment durability is not yet satisfactory, preventing its large use. Moreover, Brazilian system does not stimulate biogas power generation, since its implementation requires high investment compared to current electricity prices.

According to the stated above can be concluded that the CDM incentive is crucial to the decision of undertaking the project activity.

B.5.4 Legal constraints:

The existing legislation in Brazil, in order to protect water sources from contamination, establishes water quality parameters required to lagoons and rivers, 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 and GHG emission control through biodigestors. Based on that, the proposed project activity clearly exceeds current Brazilian regulations for swine waste treatment.

## B.6. Emission reductions:

### B.6.1. Explanation of methodological choices:

The baseline emissions estimation was done according to the methodology III.D, and will be described below.

***Baseline emissions***

$$BE_y = GWP_{CH4} * D_{CH4} * UF_b * \sum_{i\ LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{BI,j}$$

[9] Brazilian Central Bank (http://www4.bcb.gov.br/Pec/Correcao/corrige.asp?idpai=correcao)

**Excluído:** B.5.4 Technological 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, because the effluent is lower. Furthermore, consideration should be made on maintenance requirements regarding this technology (to assure optimal operation conditions) including a performance level monitoring program. The enclosed flare system and the monitoring scheme to assure its efficiency have increased substantially the project costs and, once it is not demanded by Brazilian legislation, as will be stated on the next topic, it would be unlikely to put it in place such a system in the absence of the project activity.¶
¶
The technology used to burn the biogas as well as to energy generation is still in development in this scale of use. The technology is dominated and largely used in industrial level, but requires adaptation to this kind of application. The enclosed flares applicable to this use are still being improved, once it has to be adapted to a low cost but efficient reality. The biogas aggressiveness is another obstacle, once the combustion engines, generators, compressors and pumps have lower durability. ¶

**Excluído:** 5

CDM – Executive Board

Where:

$BE_y$ = Baseline emissions in year "y" ($tCO_2e$)
$GWP_{CH4}$ = Global Warming Potential (GWP) of $CH_4$
$D_{CH4}$ = $CH_4$ density
LT = Index for all types of livestock
j = Index for animal waste management system
$MCF_j$ = Annual methane conversion factor (MCF for the baseline animal waste management system "j")
$B_{0,LT}$ = Maximum methane producing potential of the volatile solid generated for animal type "LT" ($m^3$ $CH_4$/kg dm)
$N_{LT,y}$ = Annual average number of animal of type "LT" in year "y"
$VS_{LT,y}$ = Volatile solids for livestock "LT" entering the animal manure management system in year "y" (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j}$ = Fraction of manure handled in baseline animal manure management system "j"
$UF_b$ = Model correction factor to account for model uncertainties

***Baseline emissions – Volatile Solids calculation***

$$VS_{LT,y} = \left( \frac{W_{site}}{W_{default}} \right) * VS_{default} * nd_y$$

Where:

$W_{site}$ = Average animal weight of a defined livestock population at the project site (kg)
$W_{default}$ = Default average animal weight of a defined population
$VS_{default}$ = Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day)
$nd_y$ = number of days in year "y" where the treatment plant was operational

***Project Activity Emissions - PE leakage***

$$PE_{PL,y} = 0.10 * GWP_{CH4} * D_{CH4} * \sum_{i,LT} B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y}$$

Where:

$MS\%_{i,y}$ = Fraction of manure handled in system "i" in year "y"

***Project Activity Emissions - PE flare***

According to the methodology III.D, project emissions from flaring are estimated using the procedures described in the "Tool to determine project emission from flaring gases containing methane".

$$PE_{flare} = BE_y * (1 - \eta_{flare})$$

Where:

$\eta_{flare}$ = Flare efficiency

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***Project Activity Emissions - PE power***

According to the methodology III.D, project emissions from electricity use are estimated using the procedures described in the methodology AMS I.D.

$$PE_{power} = EL * CEF_{electricity}$$

Where:

EL = Electricity consumption (MWh)
CEF*electricity* = Combined Emission Factor from electricity ($tCO_2e/MWh$)

***Project Activity Emissions - PE power – Combined Emission Factor***

Despite having a big potential of energy generation in sustainable and diversified way, the composition of the brazilian energetic source is changing to the use of fossil combustible. The determinate information of the baseline is: the electric system in Brazil was historically divided in two systems: North/Northeast and South/South east/Central West. That configuration is a reflex of the historical physical evolution of the systems, that were naturally developed next to the big center consumers of the country.

The evolution of the systems reveals that the integration of them was a natural tendency in the grid of national supply. In 1998, the brazilian government announced the first phase of the connection, integrating the North/Northeast lines with the South/South East/Central West lines. With investment nearly to US$ 700 millions, the connection had as mainly objective helps to resolve the electric problems in the country. That way, the energy production is able to supply energy to any of the systems.

In the composition of emission factor of the SIN was used values of Operating Margin and Build Margin more updated available by MCT (www.mct.gov.br – Menu Theme – Climate Change - PPA), as allowed by the methodology AMS I.D., "calculation must be based on data from an official source (where available) and made publicly available".

To calculate the average of the Operation Margin was used the values referents to 2007. The parameters used in calculation are published by Ministry of Science and Technology (MST)[10]. According to the site of MST, the methodological tool "Tool to calculate the emission factor for an electricity system" is used to calculate BM and OM.

The emission factor of the interconnected system is a combination of emission factor of OM, which reflects the intensity of $CO_2$ emissions of the energy dispatch in the grid, and emission factor of BM, which reflects the intensity of $CO_2$ emissions of the last five plants constructed.

The emission factor from Combined Margin (CM) is calculated as follows:

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$$

Where:

$EF_{grid,BM,y}$ = Build Margin (BM) $CO_2$ emission factor for grid connected power generation in year y
$EF_{grid,OM,y}$ = Operating margin (OM) $CO_2$ emission factor for grid connected power generation in year y

[10] MST (http://www.mct.gov.br/index.php/content/view/74689.html)

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$W_{OM}$ = Weighting of operating margin emissions factor (%)
$W_{BM}$ = Weighting of build margin emissions factor (%)

The following default values should be used for $W_{OM}$ and $W_{BM}$: $W_{OM}$ = 0.5 e $W_{BM}$ = 0.5 for the first crediting period, and $W_{OM}$ = 0.25 e $W_{BM}$ = 0.75 for the second and third crediting period, unless otherwise in the approved methodology by the methodological tool "Tool to calculate the emission factor in an electricity system" version 01.1.

Alternative weights can be proposed, as long as $W_{OM}+W_{BM} = 1.0$ and that be presented evidence that the data are representative of the system.

***Project Activity Emission***

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y}$$

Where:

$PE_y$ = Project emissions in year "y" ($tCO_2e$)
$PE_{PL,y}$ = Emission due to physical leakage of biogas stream in the year "y" ($tCO_2e$)
$PE_{flare,y}$ = Emissions from flaring or combustion of the biogas stream in the year "y" ($tCO_2e$)
$PE_{power,y}$ = Emission from the use of fossil fuel or electricity for the operation of the installed facilities in the year "y" ($tCO_2e$)

***Estimated emissions reductions***

$$ER_{y,estimated} = BE_{CH4} - PEy$$

**B.6.2. Data and parameters that are available at validation:**

Agroceres' is the entity responsible for data storage and availability at the time of validation. It is also responsible for guarantee a Quality Control and Assurance of the data.

| **Data / Parameter:** | **$D_{CH4}$** |
|---|---|
| Data unit: | Kg/ $m^3$ |
| Description: | Methane density |
| Source of data used: | 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10 |
| Value applied: | 0.67 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Default value |
| Any comment: | - |
| **Data / Parameter:** | **Density $CH_4$** |
| Data unit: | Kg/ $m^3$ |
| Description: | Methane density |
| Source of data used: | 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10 |
| Value applied: | 0,67 |
| Justification of the choice of data or description of measurement methods | Default value |

| | |
|---|---|
| and procedures actually applied : | |
| Any comment: | - |

| **Data / Parameter:** | **GWP CH4** |
|---|---|
| Data unit: | $tCO_2$ / t $CH_4$ |
| Description: | Global Warming Potential of Methane, valid for the relevant commitment period. |
| Source of data used: | Intergovernmental Panel on Climate Change, Climate Change 1995: The Science of Climate Change (Cambridge, UK: Cambridge University Press, 1996) |
| Value applied: | 21 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol) |
| Any comment: | - |

| **Data / Parameter:** | **VS** |
|---|---|
| Data unit: | kg/head/day |
| Description: | Volatile solids excreted for animal type |
| Source of data used: | Obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10, Annex 10A.2, Tables 10A-7 and 10A-8, p. 10.80 and 10.81. |
| Value applied: | Breeding swine: 0.46<br>Market swine: 0.30 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Once the Agroceres' genetic source has an English origin, the Western Europe animal type parameters were used |
| Any comment: | - |

| **Data / Parameter:** | **Bo** |
|---|---|
| Data unit: | $m^3$ $CH_4$/Kg of VS |
| Description: | Maximum methane producing capacity for manure produced by animal type |
| Source of data used: | Obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 10, Annex 10A.2, Tables 10A-7 and 10A-8, p. 10.80 and 10.81. |
| Value applied: | Market swine: 0.45<br>Breeding swine: 0.45 |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Once the Agroceres' genetic source has an English origin, the Western Europe animal type parameters were used |
| Any comment: | - |

| **Data / Parameter:** | **MCF** |
|---|---|
| Data unit: | % |
| Description: | Methane conversion factor |
| Source of data used: | Obtained from 2006 IPCC Guidelines for National Greenhouse Gas |

| | |
|---|---|
| | Inventories, Volume 4, Chapter 10, Page 10.45, Table 10.17. |
| Value applied: | 78% for uncovered anaerobic lagoon |
| Justification of the choice of data or description of measurement methods and procedures actually applied : | Based on the regional temperature (22ºC), determinate by INMETRO (Instituto Nacional de Meteorologia). |
| Any comment: | A conservativeness factor should be applied by multiplying MCF values (estimated as per above bullet) with a value of 0.94, to account for the 20% uncertainty in the MCF values as reported by IPCC 2006. |

**B.6.3 Ex-ante calculation of emission reductions:**

The baseline emissions are calculated through an MSExcel spreadsheet developed by the project developer. This spreadsheet will be available to the DOE at the time of project activity validation. The values calculated for each cluster are presented in the annex 3.

***Baseline emissions - Volatile solids calculation***

$$VS_{LT,y} = \left( \frac{W_{site}}{W_{default}} \right) * VS_{default} * nd_y$$

| | VALUES | | | | | | |
|---|---|---|---|---|---|---|---|
| UNIT | Boars* | Sows* | Gilts* | Nursery[a] | Nursery[b] | Finishing[a] | Finishing[b] |
| kg | 250 | 240 | 120 | 4 | 18,25 | 48 | 87 |
| kg | 198 | 198 | 198 | 50 | 50 | 50 | 50 |
| kg/head/day | 0,46 | 0,46 | 0,46 | 0,3 | 0,3 | 0,3 | 0,3 |
| kg/head/year | 211,9949 | 203,5152 | 101,7576 | 8,7600 | 39,9675 | 105,1200 | 190,5300 |

***Baseline emissions***

$$BE_y = GWP_{CH4} * D_{CH4} * UF_b * \sum_{i\ LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j}$$

| | | |
|---|---|---|
| $BE_y$ = | 22,868 | t $CO_2e$ |

***Project Activity Emissions - PE leakage***

$$PE_{PL,y} = 0.10 * GWP_{CH4} * D_{CH4} * \sum_{i,LT} B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y}$$

| | | |
|---|---|---|
| $PE_{PL,y}$ = | 3,119 | t$CO_2e$ |

***Project Activity Emissions - PE flare***

$$PE_{flare} = BE_y * (1 - \eta_{flare})$$

| $Pe_{flare}$ = | 2,287 | $tCO_2e$ |
|---|---|---|

***Project Activity Emissions - PE power – Combined Emission Factor***

$$EF_{grid,CM,y} = EF_{grid,OM,y} * W_{OM} + EF_{grid,BM,y} * W_{BM}$$

| Operating Margin[1] | January | February | March | April | May | June | |
|---|---|---|---|---|---|---|---|
| | 0.2292 | 0.1954 | 0.1948 | 0.1965 | 0.1606 | 0.2559 | |
| | July | August | September | October | November | December | Average |
| | 0.3096 | 0.3240 | 0.3550 | 0.3774 | 0.4059 | 0.4865 | 0.2054 |

| Build | 2007 |
|---|---|
| Margin[1] | 0.0775 |

| Weight | Default |
|---|---|
| $(W_{om}/W_{bm})^2$ | 0.5 |

| Emission | 2007* |
|---|---|
| Factor (EF) | (0.2054 * 0.5) + (0.0775 * 0.5) = 0.1842 $tCO_2e/MWh$ |

1 Default values – MCT (www.mct.gov.br)

2 Default value - UNFCCC

* Was used a 2007's value because it was the most updated data available at the validation beginning.

***Project Activity Emissions - PE power – Electricity consumption***

Each cluster have: two biodigesters, a compressor set (7.5 cv) and two motors (15 cv each).

| | Potency (cv) | Potency (HP) | Consumption |
|---|---|---|---|
| Compressor set | 7.5 cv | 7.397 HP | 5.516 kWh |
| Motor set | 30 cv | 29.589 HP | 22.064 kWh |
| | | | 27.580 kWh |
| | | | **0.0276 MWh** |

| Convertion factor cv to HP | 0.9863 |
|---|---|
| Convertion factor HP to kWh | 0.74569 |

***Project Activity Emissions - PE power***

$$PE_{power} = EL * CEF_{electricity} * (24 * 365)$$

$Pe_{power}$ = 0.0276 * 0.1842 = 45 $tCO_2e$ per cluster

$Pe_{power}$ = 134 $tCO_2e$ in the farm

According to the methodology AMS III.D, version 14, a plus of 10% should be assumed to account for distribution losses, in absence of monitoring. That way, the $PE_{power}$ is 47 $tCO_2e$ per cluster and 147 $tCO_2e$ in the farm.

***Project Activity Emission***

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y}$$

$$PEy = 3,119 + 2,287 + 147 = 5,553\ tCO_2e$$

***Estimated emissions reductions***

$$ER_{y,estimated} = BE_{CH4} - PEy$$

$$ER_{y,estimated} = 22,868 – 5,553 = 17,316\ tCO_2e$$

**B.6.4 Summary of the ex-ante estimation of emission reductions:**

| Year | Estimation of project activity emissions ($tCO_2e$) | Estimation of baseline emissions ($tCO_2e$) | Estimation of leakage ($tCO_2e$) | Estimation of overall emissions reductions ($tCO_2e$) |
|---|---|---|---|---|
| **2009** | **2,776** | **11,434** | **0** | **1,443** |
| **2010** | **5,553** | **22,868** | **0** | **17,316** |
| **2011** | **5,553** | **22,868** | **0** | **17,316** |
| **2012** | **5,553** | **22,868** | **0** | **17,316** |
| **2013** | **5,553** | **22,868** | **0** | **17,316** |
| **2014** | **5,553** | **22,868** | **0** | **17,316** |
| **2015** | **5,553** | **22,868** | **0** | **17,316** |
| **2016** | **2,776** | **11,434** | **0** | **15,873** |
| **Total (tonnes of $CO_2e$)** | **38,870** | **160,077** | **0** | **121,210** |

**B.7 Application of a monitoring methodology and description of the monitoring plan:**

**B.7.1 Data and parameters monitored:**

| **Data / Parameter:** | **Feed rations** |
|---|---|
| Data unit: | - |
| Description: | Formulated feed rations |
| Source of data used: | Agroceres data files |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | British origin, section B.4 |
| Description of measurement methods and procedures to be applied: | Nutritional tables |

| | |
|---|---|
| QA/QC procedures to be applied: | The audit process will assure that the correct swine manure treatment is being done |
| Any comment: | - |
| **Data / Parameter:** | **Genetic source** |
| Data unit: | - |
| Description: | Genetic source of the livestock population |
| Source of data used: | Agroceres data files |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | British origin, section B.4 |
| Description of measurement methods and procedures to be applied: | By an animal health certification for imports issued by the Ministry of Agriculture, Livestock and Supply |
| QA/QC procedures to be applied: | The audit process will assure that the correct swine manure treatment is being done |
| Any comment: | - |

| | |
|---|---|
| **Data / Parameter:** | **$n_{(T)}$** |
| Data unit: | Number of days of operation |
| Description: | Days in which animals are resident in the system per year |
| Source of data used: | Agroceres data files |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 365 |
| Description of measurement methods and procedures to be applied: | Data is stored digitally using PigChamp software. |
| QA/QC procedures to be applied: | The audit process will assure that the correct swine manure treatment is being done |
| Any comment: | - |

| | |
|---|---|
| **Data / Parameter:** | **MS%** |
| Data unit: | Percentage |
| Description: | Percent of animal effluent used in system. |
| Source of data used: | Agroceres management system |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 100% |
| Description of measurement methods and procedures to be applied: | The monitoring is automatic. There is no effluent that is not treated because of the engineering used in the construction planning. |
| QA/QC procedures to be applied: | The audit process will assure that the correct swine manure treatment is being done |
| Any comment: | - |

| | |
|---|---|
| **Data / Parameter:** | **$W_{SITE}$** |
| Data unit: | kg |
| Description: | Average weight of the livestock |
| Source of data to be used: | Agroceres data files |
| Value of data applied for the purpose of calculating | Sows – 240<br>Gilts – 120 |

| | |
|---|---|
| expected emission reductions in section B.5 | Boars – 250<br>Nursery[a] – 4<br>Nursery[b] – 18.25<br>Finishing[a] – 48<br>Finishing[b] – 87 |
| Description of measurement methods and procedures to be applied: | Agroceres performs regular monitoring of livestock. Data is stored digitally using PigChamp software. Historical records were used to determine weight of animals. |
| QA/QC procedures to be applied: | Data will be verified on site routine inspections by a responsible person. |
| Any comment: | The consistency between the data acquired at the monitoring will be assessed by the records of food purchases |

| **Data / Parameter:** | $N_{LT,y}$ |
|---|---|
| Data unit: | Heads |
| Description: | Livestock Population |
| Source of data to be used: | Agroceres data files |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Sows – 4,000<br>Gilts – 166<br>Boars – 10<br>Nursery[a] – 6,000<br>Nursery[b] – 11,046<br>Finishing[a] – 14,556<br>Finishing[b] – 10,853 |
| Description of measurement methods and procedures to be applied: | Agroceres performs regular monitoring of livestock. Data is stored digitally using PigChamp software. Historical records were used to determine number of animals. |
| QA/QC procedures to be applied: | Data will be verified on site routine inspections by a responsible person. |
| Any comment: | The consistency between the data acquired at the monitoring will be assessed by the records of food purchases |

| **Data / Parameter:** | $BG_{burnt}$ |
|---|---|
| Data unit: | $m^3$ |
| Description: | Biogas burned (cumulative) |
| Source of data to be used: | Monitoring parameters spreadsheet |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | A value calculated 4,433,501.995 $m^3$ biogas/year was used |
| Description of measurement methods and procedures to be applied: | A flow meter will continuously measure the biogas flow and the data will be stored in the datalogger |
| QA/QC procedures to be applied: | Preventive maintenance will be conducted in accordance with manufacturer's recommendations, as stated in the monitoring plan, and will be assured by the audit in the monitoring process |
| Any comment: | Data will be archived electronically and kept for the duration of the crediting period plus 2 years |

| **Data / Parameter:** | $w_{CH4}$ |
|---|---|
| Data unit: | % |
| Description: | Fraction of the methane content in the biogas produced during the anaerobic digestion |
| Source of data to be used: | Monitoring parameters spreadsheet |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 50% |
| Description of measurement methods and procedures to be applied: | The fraction of methane in the biogas will be measured monthly, with a GEM 2000 gas analyzer. The biogas temperature and pressure will be measured with electronic devices and stored in a datalogger. Tests will be undertaken to assure 95% of confidence level and, if needed, the measurement frequency can be adjusted |
| QA/QC procedures to be applied: | The equipments used to measure methane content will be properly calibrated periodically and it will be assured by the audit process |
| Any comment: | The value used is conservative, using has source CETESNET, an official site about biogas of CETESB, in http://homologa.ambiente.sp.gov.br/biogas/biogas.asp, accessed April 6th, 2009<br>Data will be archived electronically and kept for the duration of the crediting period plus 2 years |

| **Data / Parameter:** | $T_{flare}$ |
|---|---|
| Data unit: | ºC |
| Description: | Flare temperature |
| Source of data to be used: | Manufacturer's specifications |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Above 500ºC |
| Description of measurement methods and procedures to be applied: | Continuous check of compliance with the manufacturer's specification by monitoring parameters spreadsheet |
| QA/QC procedures to be applied: | Preventive maintenance will be conducted and it will assured by the audit process. The data will be stored in the datalogger |
| Any comment: | Data will be archived electronically and kept for the duration of the crediting period plus 2 years |

| **Data / Parameter:** | $p_{flare}$ |
|---|---|
| Data unit: | atm |
| Description: | Flare pressure |
| Source of data to be used: | Manufacturer's specifications |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | |
| Description of measurement methods and | Continuous check of compliance with the manufacturer's specification by monitoring parameters spreadsheet |

| | |
|---|---|
| procedures to be applied: | |
| QA/QC procedures to be applied: | Preventive maintenance will be conducted and it will assured by the audit process. The data will be stored in the datalogger |
| Any comment: | Data will be archived electronically and kept for the duration of the crediting period plus 2 years |

| **Data / Parameter:** | **Biogas flow rate** |
|---|---|
| Data unit: | Nm3 |
| Description: | Biogas flow rate |
| Source of data to be used: | Manufacturer's specifications |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | |
| Description of measurement methods and procedures to be applied: | Continuous check of compliance with the manufacturer's specification by monitoring parameters spreadsheet |
| QA/QC procedures to be applied: | Preventive maintenance will be conducted and it will assured by the audit process. The data will be stored in the datalogger |
| Any comment: | Data will be archived electronically and kept for the duration of the crediting period plus 2 years |

| **Data / Parameter:** | **$\eta_{flare}$** |
|---|---|
| Data unit: | % |
| Description: | Efficiency of flaring process |
| Source of data to be used: | Default value |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 90% |
| Description of measurement methods and procedures to be applied: | Continuous check of compliance with the manufacturer's specification of the flare device (temperature, biogas flow rate) will be done. If in any specific hour any of the parameters is out of the range of specifications, 50% of default value should be used for this specific hour |
| QA/QC procedures to be applied: | Preventive maintenance will be conducted and it will assured by the audit process |
| Any comment: | Data will be archived electronically and kept for the duration of the crediting period plus 2 years |

| **Data / Parameter:** | **Sludge's disposition** |
|---|---|
| Data unit: | Number of events |
| Description: | The monitoring of produced sludge disposition |
| Source of data to be used: | The sludge's monitoring data will be recorded in the monitoring parameters spreadsheet |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | Not available |
| Description of | A correct disposition of the sludge produced during the waste treatment |

| | |
|---|---|
| measurement methods and procedures to be applied: | will be done after its removing |
| QA/QC procedures to be applied: | The audit process will assure that the correct disposition is being done |
| Any comment: | Data will be archived electronically and kept for the duration of the crediting period plus 2 years |

| **Data / Parameter:** | **$EF_y$** |
|---|---|
| Data unit: | $tCO_2/MWh$ |
| Description: | Emission factor of the grid |
| Source of data to be used: | ONS (Nacional Operator of the Electric System) |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | 0.1842 |
| Description of measurement methods and procedures to be applied: | A baseline emission factor ($EF_y$) is calculated as a combined margin (CM), that is a combination of the operating margin (OM) and build margin (BM). The CM calculation was made based on official data (ONS). Ex-ante data calculated and monitored in validation and during the creditation period of the project |
| QA/QC procedures to be applied: | The value will be followed annually in MCT site, where the publications are made (www.mct.gov.br) |
| Any comment: | The value will be updated annually |

| **Data / Parameter:** | **Electricity** |
|---|---|
| Data unit: | MWh |
| Description: | Electricity consumed by the project activity |
| Source of data to be used: | The Nominal Power sourced by the biogas blower producer and monitoring parameter spreadsheet |
| Value of data applied for the purpose of calculating expected emission reductions in section B.5 | The compressor set has 7.5 cv potency and the set of motor has 15 cv potency, for each production site |
| Description of measurement methods and procedures to be applied: | The nominal power sourced by the biogas blower producer times the equipment operating time in a daily basis |
| QA/QC procedures to be applied: | Preventive maintenance will be conducted in accordance with manufacturer's recommendations and will be assured by the audit in the monitoring process |
| Any comment: | Data will be archived electronically and kept for the duration of the crediting period plus 2 years |

| **Data / Parameter:** | **$ER_{y,estimated} - E_{y,\ calculated}$** |
|---|---|
| Data unit: | tCO2e / year |
| Description: | Comparison of the yearly methane generation potential with the actual emission reduction |
| Source of data to be used: | PDD (estimated) and the monitoring parameters spreadsheet (calculated) |
| Value of data applied for the purpose of calculating | The estimated value is 17,316 t $CO_2e$/year |

| | |
|---|---|
| expected emission reductions in section B.5 | |
| Description of measurement methods and procedures to be applied: | The estimated value was calculated according to the methodological tool During the monitoring this value will be calculated based on the monitoring spreadsheets |
| QA/QC procedures to be applied: | The equipments used to measure methane content will be properly calibrated periodically and it will be assured by the audit process |
| Any comment: | The maximal emission reduction in any year is limited to the yearly methane generation potential calculated in the project design document for that year<br>If (**$ER_{y,estimated} - E_{y,\ calculated}$) <0, $ER_{y,estimated}$** shall be used as the actual emission reduction |

The actual emission reduction achieved by the project will be calculated through the formula presented below:

$$ER_{y,ex\text{-}post} = \min [(BE_{y,ex\text{-}post} - PE_{y,ex\text{-}post}), (MD_y - PE_{power,y,ex\text{-}post})]$$

Where:

$ER_{y,ex\text{-}post}$ = Emission reduction achieved by the project activity based on monitored values for year "y" ($tCO_2e$)
$BE_{y,ex\text{-}post}$ = Baseline emissions calculated using formula 1 using ex post monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$
$PE_{y,ex\text{-}post}$ = Project emissions calculated using formula 4 using ex post monitored values of $N_{LT,y}$, $MS\%_{i,y}$ and if applicable $VS_{LT,y}$
$MD_y$ = Methane captured and destroyed or used gainfully by the project activity in year "y" ($tCO_2e$)
$PE_{power,y,ex\text{-}post}$ = Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year "y" ($tCO_2e$)

The project activity uses flaring/combustion, so $MD_y$ will be measured using the conditions of the flaring process:

$$MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP_{CH4}$$

Where:
$BG_{burnt,y}$ = Biogas flared or combusted in year "y" ($m^3$)
$w_{CH4,y}$ = Methane content in biogas in the year "y" (mass fraction)
FE = Flare efficiency in the year "y" (fraction)

Biogas and methane content measurement shall be on the same basis (wet or dry).

The biogas flow will only exist when the flare is burning, then the $BG_{burnt}$ will correspond to the biogas that passed through the flow meter.

### B.7.2 Description of the monitoring plan:

A monitoring procedure has been carefully created and covers all the parameters required by the methodology. It establishes the quality standards to assure that all the information will be adequately obtained and stored.

Regarding the monitoring equipment, used for metering, recording and processing the data obtained, the Agroceres' engineering has conducted a market research to try to reach a good cost/benefit ratio, using

equipments with an adequate confidence level and a good durability as well. Calibration will be performed by an accredit firm in the periodicity required by the manufacturer.

Agroceres will provide a training program to the responsible for the monitoring, explaining their responsibilities and roles in the project. All the people involved in the project will be trained before the starting date of the crediting period.

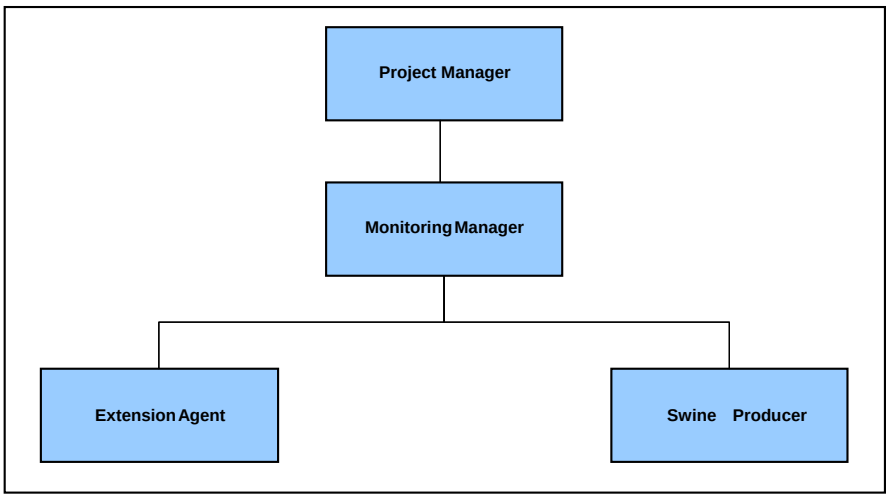
To safety issues and emergency preparedness in flare, prior to performing any maintenance on the flare system, the gas flow must be turned off. Care should be exercised when working around the flare system as components can be extremely hot. The preventive maintenance shall be conduced by the manufacturer's recommendations.

For control of unintended emissions, the variables burn temperature and biogas volume will be controlled by a datalogger.

The genetic source will be monitored by an animal health certification for imports issued by the Ministry of Agriculture, Livestock and Supply.

The formulated feed rations will be monitored by nutritional tables made by a nutritionist responsible.

The persons involved in the monitoring are demonstrated bellow:




**B.8 Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)**

The version 01 of the application of the baseline and monitoring methodology was concluded in 06/04/2009 and was elaborated by PricewaterhouseCoopers LTDA. The responsible for the project is Ernesto Cavasin, and can be contacted by phone +55 11 3674-2333.

## 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 01/09/2008. On that date the contract was signed with Baltazar Reis de Mendonça – ME in order to construct the biodigestors. The contract is available has evidence with that date.

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

The expected operational lifetime of some materials (like the biodigestor cover) is expected to be 10 years but they will be reformed in order to provide a longer lifetime (21 years) with the same technology described along the PDD.

### 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:

01/12/2009 or the project activity's registration date.

##### C.2.1.2. Length of the first crediting period:

The length of the first crediting period is 7 years.

#### C.2.2. Fixed crediting period:

##### C.2.2.1. Starting date:

01/12/2009 or the project activity's registration date.

##### C.2.2.2. Length:

The length of the fixed crediting period is 21 years.

## SECTION D. Environmental impacts

**D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:**

An environmental impact analysis is not required to this kind of project.

The manure waste treatment proposed by the project will provide several environmental benefits. The project contributes to the sustainable development while promoting the greenhouse gases emission reduction. The anaerobic digester reduces the organic load of the wastewater in comparison to the anaerobic open 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 project will hugely improve the standards of living in the farms and its surroundings. In most cases, the neighborhood is breathing continuously the characteristic odor spread out by the lagoons around the region. The smell also attracts flies, which disturb a lot as well. The project activity will cease both of them. Environmentally speaking, after the biodigestion the effluent has a lower organic load and then, is more adequate to the agricultural use.

The environment licenses of farm were presented to the DOE at the time of validation.

**D.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:**

No actions are required.

## SECTION E. Stakeholders' comments

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

The stakeholders' invitation followed the procedures of the Brazilian "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 reports are available upon request.

In relation to the project development with the standards set by the UNFCCC, the Designated National Authority, and in the highest standards of transparency with the society that Agroceres maintains, was performed a specific public consultation on the Project of Clean Development Mechanism (CDM) about Granja Paraiso. The community can answer its questions in relation to the Kyoto Protocol, the CDM and the impact of this project in the region.

In addition to the comments of the stakeholders required for environmental license, the Brazilian Designated National Authority (AND), the Interministerial Commission for Global Climate Change, requires reviews of local stakeholders based on a transliterated version of the PDD, and the validation report issued by a DOE in accordance with Resolution no.1 edited on September 11, 2003, to provide the letter of approval.

The stakeholders who received the invite are listed bellow:

- City Hall of Patos de Minas;
- City Council of Patos de Minas;
- Economical Development Secretary of Patos de Minas (municipal environmental entity);
- Environment and Sustainable Development Secretary of Minas Gerais;
- Brazilian Forum of NGOs and Environmental and Development Social Movements – FBOMS;
- Community associations;
- State Prosecutors Office of Minas Gerais state;
- National Prosecutors Office.

### E.2. Summary of the comments received:

Two comments were received, coming from City Hall of Minas Gerais and National State Prosecutors Office. The institutions reported receiving and congratulated the project.

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

No action required.

**Annex 1**

**CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY**

| | |
|---|---|
| Organization: | Agroceres Genética e Nutrição Animal LTDA |
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| URL: | www.agroceres.com.br |
| Represented by: | Vitor Vanetti de Araujo |
| Title: | Mr. |
| Salutation: | |
| Last Name: | Araujo |
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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 ex-ante baseline calculation for each farm is presented below:

| **Granja Paraiso – Cluster: Sítio** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Category** | **N** | **W Livestock (kg)** | **W Default (kg)** | **VS Default*** | **VS Calculated*** | **n** | **Emission Factor ($kgCH_4$/head/day)** |
| **Boars** | **10** | **250** | **198** | **0.46** | **0.5808** | **365** | **0.1366** |
| **Sows** | **4,000** | **240** | **198** | **0.46** | **0.5576** | **365** | **0.1311** |
| **Gilts** | **166** | **120** | **198** | **0.46** | **0.2788** | **365** | **0.0656** |
| **Nursery[a]** | **6,000** | **4** | **198** | **0.3** | **0.0240** | **365** | **0.0056** |
| **Nursery[b]** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Finishing[a]** | - | - | - | - | - | - | - |
| **Finishing[b]** | - | - | - | - | - | - | - |

| | |
|---|---|
| Baseline emissions $tCO_2$/ano | 4,111 |
| Project emissions $tCO_2$/ano | 1,021 |
| **Emissions reduction $tCO_2$/ano** | **3,091** |

* Kg dry matter of volatile solids/head/day
$B_0$ = 0,45 $m^3$ CH4/kg VS for all swine categories

| **Granja Paraiso – Cluster: NEST 1** | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Category** | **N** | **W Livestock (kg)** | **W Default (kg)** | **VS Default*** | **VS Calculated*** | **n** | **Emission Factor ($kgCH_4$ /cabeça/dia)** |
| **Boars** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Sows** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Gilts** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Nursery[a]** | **-** | **-** | **-** | **-** | **-** | **-** | **-** |
| **Nursery[b]** | **5,720** | **18.25** | **50** | **0.3** | **0.1095** | **365** | **0.0258** |
| **Finishing[a]** | **7,183** | **48** | **50** | **0.3** | **0.2880** | **365** | **0.0677** |
| **Finishing[b]** | **4,970** | **87** | **50** | **0.3** | **0.5220** | **365** | **0.1228** |

| | |
|---|---|
| Baseline emissions $tCO_2$/ano | 8,962 |
| Project emissions $tCO_2$/ano | 2,168 |
| **Emissions reduction $tCO_2$/ano** | 6,795 |

* Kg dry matter of volatile solids/head/day
$B_0$ = 0,45 $m^3$ CH4/kg VS for all swine categories

| Granja Paraiso – Cluster: NEST 1 | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Category** | **N** | **W Livestock (kg)** | **W Default (kg)** | **VS Default*** | **VS Calculated*** | **n** | **Emission Factor ($kgCH_4$ /cabeça/dia)** |
| **Boars** | - | - | - | - | - | - | - |
| **Sows** | - | - | - | - | - | - | - |
| **Gilts** | - | - | - | - | - | - | - |
| **Nursery[a]** | - | - | - | - | - | - | - |
| **Nursery[b]** | **5,326** | **18.25** | **50** | **0.3** | **0.1095** | **365** | **0.0258** |
| **Finishing[a]** | **7,383** | **48** | **50** | **0.3** | **0.2880** | **365** | **0.0677** |
| **Finishing[b]** | **5,883** | **87** | **50** | **0.3** | **0.5220** | **365** | **0.1228** |

| | |
|---|---|
| Baseline emissions $tCO_2$/ano | 9,794 |
| Project emissions $tCO_2$/ano | 2,364 |
| **Emissions reduction $tCO_2$/ano** | 7,430 |

* Kg dry matter of volatile solids/head/day
$B_0$ = 0,45 $m^3$ CH4/kg VS for all swine categories

**Annex 4**

**MONITORING INFORMATION**

The monitoring plan is described in the item **B.7.2.**