COMPOSTING PROJECT IN SANTA CATARINA

Document Prepared By Sustainable Carbon – Projetos Ambientais Ltda

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1 PROJECT DETAILS

1.1 Summary Description of the Project

Sustainable Carbon - Projetos Ambientais Ltda is starting a sustainability program along with 13 swine confinement farms in Brazil, aiming to improve animal manure management systems, reduce greenhouse gases (GHG) emissions and improving the living conditions of the population on the project sites. The purpose of this project is to reduce GHG emissions associated to swine waste management and to contribute to sustainable development.

The project proposes to replace the baseline Animal Waste Management Systems (AWMS) by a lower-GHG emitting AWMS. All farms are located in the state of Santa Catarina, in the southern region of Brazil. The farms involved in the project are divided into two groups:

- Brownfield farms: in these farms, swine waste was previously treated in anaerobic lagoons with high GHG emissions. As part of the project activity, farmers have shifted their AWMS to mechanized composting units, thus avoiding methane (CH_4) emissions.
- Greenfield farms: as part of the project activity, these farmers have installed the composting unit since the beginning of their swine confinement operations. This means the composting unit was chosen instead of building anaerobic lagoons, which would be the most likely scenario in the absence of the Project Activity.

The project replaces the baseline system by an automated composting unit which will treat the swine manure in a controlled and economically sustainable manner. According to the ex-ante estimations (described in section 1.7), this shift of animal waste management systems will result in a GHG emission reduction of **126,239 tonnes of CO_2e** during the crediting period.

As part of this project, animal waste will be treated in a mechanized composting unit, where the liquid wastes are incorporated with dry solid substrate to be submitted to the mechanical stirring processes. This process mixes the liquid and solid parts, maintaining the appropriate levels of oxygen, moisture content, and temperature to ensure organic matter degradation occurs under aerobic conditions. The final compost obtained will be used to fertilize cultivated soil or sold to local consumers.

Besides reducing greenhouse gas emissions, the project activity will provide better treatment and stabilization of the organic matter for later soil application, reduction of the surface runoff risks of the waste and leaching in to the soil, odor reduction, combating vector proliferation, improved working conditions and net generation of jobs (temporary and permanent), income distribution, access to technology, capacity building of the people involved and encouraging regional integration and the development of similar projects with a view to sustainable development.

1.2 Sectoral Scope and Project Type

The project is associated to the following scope, as per UNFCCC definitions:

13 - Waste handling and disposal

This is not an AFOLU project. This is not a grouped project.

1.3 Project Proponent

Sustainable Carbon – Projetos Ambientais Ltda is the project developer and has establised partnerships with the following project proponents:

Table 1. List of Project Proponents (not including Sustainable Carbon).

Farm Name	City	Project Proponent – Direct responsible	Project Proponent - Others
Brownfield Projects			
Fazenda Sitio Pickler	Arroio Trinta	Adelmo Pickler	Rosangela Antonia Soares Pickler
Fazenda Suruvy	Concórdia	Airton Piovezan	Janete da Silva Piovesan
Fazenda Altenor	Nova Erechim	Altenor José Basso	Sônia Cassol Basso
Fazenda Helena	Vargeão	Diacir Coradi	Elenilse Saretto Coradi
Fazenda Gilmar	Rio das Antas	Gilmar José Sinigaglia	Rosicler Stüpp Sinigaglia
Fazenda Granja Silva	Concórdia	Jair da Silva	Marlice Schwingel Da Silva
Fazenda Pissaia	Arvoredo	Neimar Pissaia	-
Fazenda Andretta	Nova Itaberaba	Selvino Andretta	Carolina Andretta
Greenfield Projects			
Fazenda Ramela	Herval d'Oeste	Antônio Carlos Ramela	Lourdes Ramella brasileira
Sítio Santa Lucia	Jaborá	Belmiro Secco	Zeni Teresinha Secco
Fazenda Colônia Zuffo	Rio das Antas	Dario Marcos Zuffo	Elaine Castilhos Gatti Zuffo
Fazenda Colônia Suspiro	Nova Erechim	Nóbile Tomazi	Maria Tomazi
Fazenda Baccin	Concórdia	Renato Baccin	Leonice Oneda Baccin

Tables below provide detail on each Project Proponent.

Organization name	Sustainable Carbon – Projetos Ambientais Ltda
Contact person	Thiago de Avila Othero
Title	Technical Coordinator
Address	R. Doutor Bacelar, 368 – Conj. 131 – Vila Clementino Postal Code: 04.026-001 São Paulo – SP, Brazil
Telephone	+55 11 2649 0036
Email	thiago.othero@sustainablecarbon.com

Organization name	Fazenda Sítio Pickler
Contact person	Adelmo Pickler
Title	Farm owner
Address	Linha São Roque, S/N Arroio Trinta - SC, Brazil
Telephone	+55 49 3535-1138 +55 49 9154-3808

Email	Not available

Organization name	Fazenda Altenor
Contact person	Alterno José Basso
Title	Farm owner
Address	Linha Pinheirinho, s/n° Nova Erechim - SC, Brazil
Telephone	+55 49 3333-0122 +55 49 8804-3583
Email	Not available

Organization name	Fazenda Ramela
Contact person	Antônio Carlos Ramela
Title	Farm owner
Address	Linha Barreiros, S/N Herval d'Oeste - SC, Brazil
Telephone	+55 49 3554 0692
Email	Not available

Organization name	Sítio Santa Lucia
Contact person	Belmiro Secco
Title	Farm owner
Address	Linha Banhado Grande, S/N Jaborá, SC - Brazil
Telephone	+55 49 3525-1196
Email	Not available

Organization name	Fazenda Helena
Contact person	Diacir Coradi
Title	Farm owner
Address	Linha Santo Antônio, S/N Vargeão, SC - Brazil

Telephone	+55 49 3434-0447 +55 49 9979-8651
Email	Not available

Organization name	Fazenda Gilmar
Contact person	Gilmar José Sinigaglia
Title	Farm owner
Address	Linha Pedreira, S/N Rio das Antas, SC - Brazil
Telephone	+55 49 9134-1119
Email	Not available

Organization name	Fazenda Suruvy
Contact person	Airton Piovezan
Title	Farm owner
Address	Linha Rui Barbosa, S/N Concórdia, SC - Brazil
Telephone	+55 49 3425-8001
Email	Not available

Organization name	Fazenda Granja Silva
Contact person	Jair da Silva
Title	Farm owner
Address	Linha Gomercindo, S/N Concórdia, SC - Brazil
Telephone	+55 49 3442-8484
Email	Not available

Organization name	Fazenda Colônia Suspiro
Contact person	Nóbile Tomazi
Title	Farm owner

Address	Linha Pinheirinho, s/n Nova Erechim, SC - Brazil
Telephone	(49) 8860-0650
Email	Not available

Organization name	Fazenda Colônia Zuffo
Contact person	Dário Marcos Zuffo
Title	Farm owner
Address	Linha Vista Alegre, S/N Rio das antas, SC - Brazil
Telephone	+55 49 3564-2044
Email	Not available

Organization name	Fazenda Pissaia
Contact person	Neimar Pissaia
Title	Farm owner
Address	Linha Chapada, S/N Arvoredo, SC - Brazil
Telephone	+55 49 3356-3560
Email	Not available

Organization name	Fazenda Baccin
Contact person	Renato Baccin
Title	Farm owner
Address	Linha 24 de Fevereiro, S/N Concórdia, SC - Brazil
Telephone	+55 49 9109-0087 +55 49 3442-2208
Email	Not available

Organization name	Fazenda Andretta
Contact person	Selvino Andretta

Title	Farm owner
Address	Linha Amizade, S/N Nova Itaberaba, SC - Brazil
Telephone	+55 49 3327-0076
Email	Not available

1.4 Other Entities Involved in the Project

Organization name	LPC Tecnologia Ambiental
Role in the project	LPC – Tecnologia Ambiental will be responsible to provide assistance in operation and maintenance of the composting unit and help Sustainable Carbon in the monitoring of the project. LPC Tecnologia Ambiental was the developer and idealizer of the Mechanized and Automated Composting Unit (UMAC[1]), which is used in the farms included in this project.
Contact person	Anderson Medeiros
Title	Director
Address	R Tancredo de Almeida Neves, 5199 - Bairro São Cristovão Concórdia, SC - Brazil
Telephone	+55 49 3442 2208 +55 49 3444 2686
Email	anderson@umac.com.br

1.5 Project Start Date

The starting date of the project activity is considered 21/05/2010. The start date on each farm was defined as date when the composting units became fully operational[2] on each farm. Composting units were defined to be fully operation according to one of the two criteria below:

(a) Once the composting unit was installed and farm managers received training for its operation; or

(b) Once the first batch of animals following event (a) was received.

Table below provides the project start date and the criteria used for each farm.

[1] UMAC – Unidade Mecanizada e Automatizada de Compostagem. For more information please check the website <www.umac.com.br>.

[2] Prior to this date, only tests and field settings were performed, but the composting unit was not available to properly treat animal manure.

Table 2. Start date for each farm included in the project.

Farm Name	Project Start Date	Criteria used to defined the project start date (as described above)
Brownfield farms[3]		
Fazenda Altenor	21/05/2010	(b)
Fazenda Pissaia	20/12/2010	(b)
Fazenda Sitio Pickler	27/01/2011	(b)
Fazenda Granja Silva	14/04/2011	**(a)**
Fazenda Helena	18/10/2011	(b)
Fazenda Andretta	26/10/2011	**(a)**
Fazenda Suruvy	28/11/2011	**(a)**
Fazenda Gilmar	11/01/2012	(b)
Greenfield farms		
Fazenda Ramela	21/10/2010	(b)
Sítio Santa Lucia	29/11/2010	(b)
Fazenda Colônia Zuffo	29/11/2010	**(a)**
Fazenda Colônia Suspiro	27/07/2011	(b)
Fazenda Baccin	20/09/2012	(b)

Criteira (a) was used on both farrow-to-nursery farms because these farms hold breeding animals during 365 days per year, which required farmers to start using the composting unit as soon as installation and training were performed. Criteria (a) was also used on Fazenda Colônia Zuffo, which is a Greenfield finishing unit farm because the farm received the first batch of animals on 16/11/2010 and was holding animal manure as an emergency procedure prior to installation and training of the composting unit, given the farm has no other AWMS installed. Once the composting unit became operation (on 29/11/2010) it started being used to treat animal manure.

Finally, criteria (a) was used on Fazenda Suruvy because the farm received a batch of animals on 19/10/2011 and the farm manager decided to start using the composting unit as soon as training was provided. In all other cases, farmers decided to start using the composting unit once a new batch of animals was received, to allow for a smoother transition in their animal waste management system.

This means in such cases the composting units started being fully operated (in a manner to avoid methane emissions and, thus, generate GHG emission reductions) once the first batch of animals was

[3] A definition of brownfield and greenfield farms is available on Section 1.1.

received after the installation and training of the composting units. Hence, prior to the project start date, all brownfield farms were operating with an AWMS based on anaerobic lagoons.

Since Greenfield farms started using the composting unit from the beginning of their operations, the project start date represents both the date these farms started animal confinement operations and the date of first operation of the composting units. The only exception is Fazenda Colônia Zuffo, as previously explained, which started operation on 16/11/2010 and started using the composting unit on 29/11/2010.

The Project Start Date is the earliest start date for the farms included in this project. Fazenda Altenor began reducing emissions by applying the composting unit on 21/05/2010.

1.6 Project Crediting Period

The crediting period for this project started on 01/01/2011 and ends on 31/12/2020. This date was chosen to simplify the calculation of emission reductions and to allow for the retroactive crediting of credits generated since 2011, in accordance with VCS procedures[4].

VCS project crediting period: 10 years, two times renewable.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Project Scale	
Project	X
Large project	

Years	Estimated GHG emission reductions or removals (tCO_2e)
2011	7,241
2012	11,758
2013	13,405
2014	13,405
2015	13,405
2016	13,405
2017	13,405
2018	13,405
2019	13,405
2020	13,405
Total estimated ERs	**126,239**
Total number of crediting years	**10**
Average annual ERs	**12,623**

[4] The project was originally Validated by TÜV Rheinland (China) Ltd on 21/05/2012.

1.8 Description of the Project Activity

Brazil is one of the largest swine meat producers in the world[5]. Among the factors that collaborate for this performance are investments in the development of technology which led to increasingly automated units. Unfortunately, the same technological advance observed in production process was not seen in the management of swine wastes, which is mostly based on anaerobic lagoons to store and stabilize the wastes for later soil application. Swine farmers generally consider anaerobic lagoons as simple systems, with low costs and that allows them to meet environmental requirements. However, anaerobic lagoons have a high capacity to produce methane, which is a greenhouse gas (GHG).

The project aims to reduce methane emissions and treat manure produced by small and medium swine farms in a correct manner. The project activity proposal is to install mechanized composting units instead of anaerobic lagoons on swine farms. Composting is an aerobic process producing little or no GHG. Emission reductions will occur because of the low methane emissions resulting from composting compared to the large amount of this GHG that would be released to the atmosphere if anaerobic lagoons were used to treat animal manure.

The project location is in the State of Santa Catarina, Brazil. According to the *Plano Estadual de Recursos Hídricos de Santa Catarina (Santa Catarina Water Resources Plan)*[6] the project region is one of the most vulnerable in the State, once the intensive swine production has resulted in water quality degradation in the region of Chapecó. Therefore, swine waste is an environmental concern in areas in western of the state, which concentrates around 13,000 farms each producing between 10 to 40m³ of waste per day.

Revenues from carbon credits will help farmers overcoming the barriers associated to the implementation of a composting system developed by LPC Tecnologia Ambiental, known as Mechanized and Automated Composting Unit (UMAC), which works as follows:

1 – Manure is channeled from animal barns into a storage tank, where it settles for around 24 hours.

2- Manure is pumped from the storage tank to the composting windrows which are covered with a dry substrate (e.g. shavings, sawdust, straw, etc).

3 – Simultaneously, an automated revolving machine mixes the manure with the substrate, aiming to produce a homogenized composting mass that will later mature and become compost. The automated mixing is a key feature in this composting unit to allow the aerobic decay of organic matter and avoid methane emissions. Proper mixing ensures high levels of oxygen in the composting mass.

4 – After approximately 180 to 365 days, compost reaches maturity and becomes a dry fertilizer rich in nutrients, which can be used in the farms fields or sold to local consumers.

The UMAC system performs the composting of swine waste through the action of aerobic bacteria, which breed during the fermentation process in the windrows. Swine manure is rich in nitrogen, which in contact with a dry and carbon rich substrate provides the conditions for the decaying process of organic matter in an aerobic environment. The decay of organic matter by composting naturally results in heat production, which consequently causes the heating of the composting mass.

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[5] Instituto Brasileiro de Geografia e Estatística (IBGE). Available at: <http://www.ibge.gov.br/home/presidencia/noticias/noticia_visualiza.php?id_noticia=1053>. Last visit on: 09/01/2012

[6] Plano Estadual de Recursos Hídricos. Available at: <http://www.aguas.sc.gov.br/sirhsc/biblioteca_visualizar_arquivos.jsp?idEmpresa=33&idPasta=220>. Last visit on: 09/02/2012.

According to LPC, with the higher temperature of the composting mass, the liquid fraction of the compost is retained by the substrate, being later evaporated. Water evaporation is also facilitated by solar roofs covering the composting windrows. This causes the organic matter to degrade slowly. It relies on their exposure over a long period of time at a temperature above 45 ºC. The exposure of organic matter for an extended period of time, at this temperature, also allows the elimination of almost 100% of pathogenic microorganisms, and unwanted seeds present in the compost and ensures the aerobic degradation of organic matter[7].

With the implementation of UMAC, the anaerobic lagoons will be eliminated and the swine manure will be treated in composting windrows, in an aerobic environment that inhibits the proliferation of methanogenic bacteria. This process will result is an aerobic decaying of manure, the avoidance of methane emissions and the generation of a solid compost, with high-quality, for later use in the farms fields.

The automated composting system is a new concept in the treatment of swine manure. It favors a clean and sustainable production and reduces environmental risks associated to manure management. This system diverges significantly from the common practice in the project region.

Besides being an innovative technology, the project also adopts the SOCIALCARBON® Methodology, an innovative concept developed by the Ecológica Institute to measure the contribution of carbon projects to sustainability. The Methodology is based in six main pointers: Technology; Natural; Financial; Human; Social and Carbon Resources[8].

The emission reductions due to the switching of anaerobic lagoons to composting units is expected to result in **126,239 tCO_2e** during the crediting period from 01/01/2011 to 31/12/2020.

1.9 Project Location

The project activity will be implemented in the municipalities of *Arroio Trinta, Nova Erechim, Herval d'Oeste, Jaborá, Vargeão, Rio das Antas, Concórdia, Arvoredo* and Nova Itaberaba, as showed in the Figure.1 below:

[7] According to EMBRAPA publication ISSN 0101-6245 (Composting unit for the treatment of swine manure), such conditions ensure the aerobic degradation of manure in composting units. The UMAC system is design to ensure frequent mixing, high temperature and controlled moisture, as explained on Section 1.8.

[8] More information on SOCIALCARBON is available at: <http://www.socialcarbon.org>. Last visit on 22/03/2011.

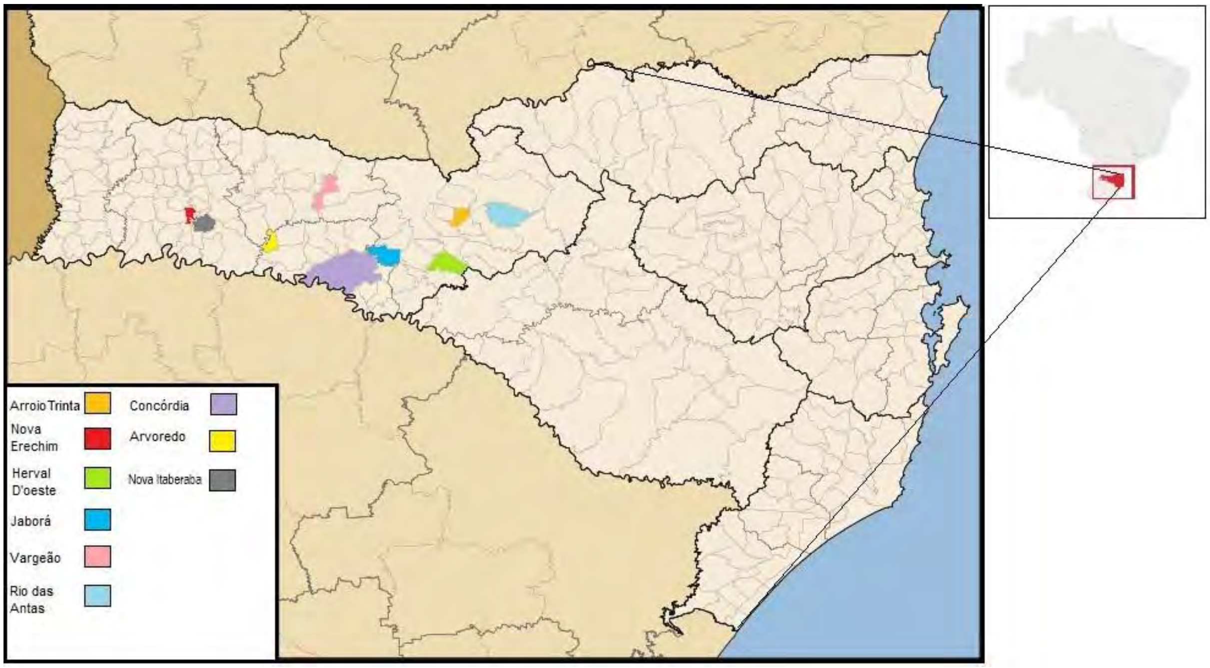

Figure 1. Location of the farms participating in the project activity.

Table 3. Location of the farms participating in the project activity.

State	City	Participating Farm
Santa Catarina	Arroio Trinta	Fazenda Sitio Pickler
	Arvoredo	Fazenda Pissaia
	Concórdia	Fazenda Granja Silva
		Fazenda Baccin
		Fazenda Suruvy
	Herval d'Oeste	Fazenda Ramela
	Jaborá	Sítio Santa Lucia
	Nova Erechim	Fazenda Altenor
		Fazenda Colônia Suspiro
	Nova Itaberaba	Fazenda Andretta
	Rio das Antas	Fazenda Colônia Zuffo
		Fazenda Gilmar
	Vargeão	Fazenda Helena

The precise location of farms is identified by means of global positioning system as seen on Table 4 below:

Table 4. Farms location and contact information

ID	Farm Name	Property	Address	Town	Contact	Phone	Global Positioning System*	
							S	W
1	Fazenda Sitio Pickler	Adelmo Pickler	Linha São Roque, S/N	Arroio Trinta	Adelmo Pickler	(49) 3535-1138 (49) 9154-3808	-26.905787°	-51.302095°
2	Fazenda Altenor	Altenor José Basso	Linha Pinheirinho, S/N	Nova Erechim	Altenor José Basso	(49) 3333-0122 (49) 8804-3583	-26.913729°	-52.932355°
3	Fazenda Ramela	Antônio Carlos Ramela	Linha Barreiros, S/N	Herval d'Oeste	Antônio Carlos Ramela	(49) 3554 0692	-27.187098°	-51.395069°
4	Sítio Santa Lucia	Belmiro Secco	Linha Banhado Grande, S/N	Jaborá	Clodoaldo Secco	(49) 3525-1196	-27.128526°	-51.688554°
5	Fazenda Helena	Diacir Coradi	Linha Santo Antônio, S/N	Vargeão	Diacir Coradi	(49) 3434-0447 (49) 9979-8651	-26.905891°	-52.145477°
6	Fazenda Gilmar	Gilmar José Sinigaglia	Linha Pedreira, S/N	Rio das Antas	Gilmar José Sinigaglia	(49) 9134-1119	-26.916379°	-51.083891°
7	Fazenda Suruvy	Airton Piovezan	Linha Rui Barbosa, S/N	Concórdia	Gilmar Piovezan	(49) 3425-8001	-27.308228°	-52.068764°
8	Fazenda Granja Silva	Jair da Silva	Linha Gomercindo, S/N	Concórdia	Jair da Silva	(49) 3442-8484	-27.293422°	-51.900758°
9	Fazenda Colônia Suspiro	NóbileTomazi	Linha Pinheirinho, S/N	Nova Erechim	LenizeTomazi	(49) 8860-0650	-26.903279°	-52.931321°
10	Fazenda Colônia Zuffo	Dario Marcos Zuffo	Linha Vista Alegre, S/N	Rio das Antas	Dario Marcos Zuffo	(49) 3564-2044	-26.974623°	-51.068915°
11	Fazenda Pissaia	Neimar Pissaia	Linha Chapada, S/N	Arvoredo	Neimar Pissaia	(49) 3356-3560	-27.108491°	-52.411704°
12	Fazenda Baccin	Renato Baccin	Linha 24 de Fevereiro, S/N	Concórdia	Renato Baccin	(49) 9109-0087 (49) 3442-2208	-27.169646°	-52.103517°
13	Fazenda Andretta	Selvino Andretta	Linha Amizade, S/N	Nova Itaberaba	Fabiana Andretta	(49) 3327-0076	-26.934749°	-52.833069°

*All GPS coordinates were taken on the location where the composting machines are installed. All coordinates are using SAD69 datum.

1.10 Conditions Prior to Project Initiation

According to the First Brazilian Inventory of anthropogenic GHG emissions from the Ministry of Science and Technology and EMBRAPA[9], the Brazilian swine manure systems can be divided into two distinct groups. The first group (occurring mainly in the states of São Paulo, Goiás and Mato Grosso) consisting of large farms, over one thousand swine and usually treatment systems that involve a series of stabilization tanks and, in some cases, partly digested waste spray. And the second group (occurring mainly in the west of the State of Santa Catarina, State of Paraná and northwest of the State of Rio Grande do Sul), consisting of small farms, distributed as follows: small (up to 100 swine), medium (100 to 300 swine) and large (over 300 swine).

The most commonly used treatment system is the open tank (single anaerobic lagoon), with a retention time that varies from 20 to 90 days. After that period it's applied to the soil on site or in neighbouring areas.

As described above, it is possible to conclude that the usual technology applied to Brazilian swine confinement farms is based on anaerobic lagoon. Therefore the project activity, which consists on composting units, is not similar to what can be commonly found in Brazil.

According to the law, known as Normative Instruction nº 11 (IN 11) of FATMA[10] (*Fundação do Meio Ambiente*), the environmental authority in the State of Santa Catarina, swine manure must be stored for at least 120 days in anaerobic lagoon, in farms where there is no other waste treatment system. Following the applicable law, swine farms are not obligated to change their current swine manure system.

As demonstrated previously, it can be concluded that the project faces difficulties concerning both the current lack of more rigorous legislation and the common practices in the region. Therefore, without the incentive of carbon credits, the farms involved in the project would either install anaerobic lagoon (in the case of greenfield farms) or maintain existing anaerobic lagoon (in the case of brownfield farms) to treat manure, instead of installing a mechanized composting system. This scenario would ensure compliance with local regulations, but would result in higher GHG emissions.

Anaerobic lagoons are significantly more economically attractive than the AWMS proposed by the project activity and were built in accordance with Santa Catarina environmental law on brownfield farms. Even in cases where there is need for further investments, anaerobic lagoons would be more economically attractive, since the investment is lower than the cost of a new AWMS.

Before the project, manure was disposed of in anaerobic lagoons over 1 meter deep, emitting methane into the atmosphere due to the anaerobic decay of the organic matter. This occurred in all brownfield farms and is considered the baseline scenario for all greenfield farms, as further explained in Section 2.4. This means it is reasonable to consider that anaerobic lagoons would be installed on greenfield farms in the absence of the Project Activity. This statement is deemed reasonable given the following arguments, which are further discussed in Sections 2.4 and 2.5:

- Anaerobic lagoons are the most common practice for the treatment of swine manure in the project region;
- Anaerobic lagoons comply with local regulations and face no other restrictions for their installation

[9] First Brazilian Inventory of anthropogenic GHG emissions. Ministry of Science and Technology and EMBRAPA. Available at: <http://www.mct.gov.br/upd_blob/0005/5206.pdf>. Last visit on: 05/01/2012.
[10] Normative instruction available at: <http://www.fatma.sc.gov.br/images/stories/Instrucao%20Normativa/IN%2011/in_11.pdf>. Last visit on 22/03/2012.

- Anaerobic lagoons are the most economically attractive choice for treating animal manure, as they require the lowest investment and maintenance costs.

Eight swine farms involved in the project are considered brownfield sites, since they operated prior to the project using anaerobic lagoons to treat animal manure. Anaerobic lagoons were used since they are less expensive systems and easier to maintain and operate. The other five farms are considered greenfield projects, which means that they have installed mechanized composting unit instead of anaerobic lagoon as part of the project activity, which would be the most likely scenario in the absence of the Project Activity.

A definition of brownfield and greenfield farms is available on Section 1.1. Table 1 (Section 1.3) describes which farms are brownfield and which are greenfield farms. A description of each farm involved in the project follows below:

1. Fazenda Sítio Pickler: This is a finishing unit farm owned by Mr. Adelmo Pickler. It is located in Arroio Trinta, Santa Catarina. Farm livestock consists of 1,132 animals. Animal waste was sent from anaerobic lagoons by flushing and scrapping. Manure was disposed of through irrigation on his own fields. Irrigation was done by tractors. No additional pumping or consumption of fossil fuels was necessary due to the project activity. Carbon credits are not claimed for the entire animal population, since waste from one barn that holds 300 animals is not sent to the composting unit, being treated in an anaerobic lagoon. Hence, the animal population for the calculation of emission reductions is considered as 832 (1,132 minus 300).

2. Fazenda Altenor: This is a Finishing Unit farm owned by Mr. Altenor José Basso. It is located in Nova Erechim, Santa Catarina. Farm livestock is of approximately 2,435 animals. Animal waste was sent from anaerobic lagoons by flushing and scrapping. Manure was disposed of through irrigation on his own fields and on neighboring fields. Irrigation was done by tractors. No additional pumping or consumption of fossil fuels was necessary due to the project activity. The carbon credits are claimed for the entire animal population, since all waste in the farm is sent to the composting unit.

3. Fazenda Ramela: This is a greenfield finishing unit farm owned by Mr. Antônio Carlos Ramela. It is located in Herval d'Oeste, Santa Catarina. Farm livestock consists of 1,753 animals. This is considered a Greenfield Project, because the farm started to operate with a composting unit instead of using an anaerobic lagoon, which would be the most likely scenario in the absence of the Project Activity. In the same way, the baseline scenario is considered the installation of anaerobic lagoons. No consumption of fossil fuels is necessary due to the project activity. Carbon credits are claimed for the entire animal population, since all farm waste is sent to the composting unit.

4. Sítio Santa Lucia: This is a greenfield Finishing Unit farm owned by Mr. Belmiro Secco. It is located in Jaborá, Santa Catarina. Farm livestock consists of 1,688 animals. This is considered a Greenfield Project, because the farm started to operate with a composting unit instead of an anaerobic lagoon, which would be the most likely scenario in the absence of the Project Activity. For the same reason, the baseline scenario is considered the installation of anaerobic lagoons. No consumption of fossil fuels is necessary due to the project activity. Carbon credits are claimed for the entire animal population, since all farm waste is sent to the composting unit.

5. Fazenda Helena: This is a finishing unit farm owned by Mr. Diacir Coradi. It is located in Vargeão, Santa Catarina. Farm livestock consists of 2,375 animals. Animal waste was sent to anaerobic lagoons by flushing and scrapping. Manure was disposed of through irrigation of his own and neighboring fields. Irrigation was done by tractors. No additional pumping or consumption of fossil fuels was necessary due to the project activity. Carbon credits are not claimed for the entire animal population, since waste from one barn that holds 600 animals is not sent to the composting unit, being treated in an anaerobic lagoon. Hence, animal population for the calculation of emission reductions is considered as 1,775 (2,375 minus 600).

6. Fazenda Gilmar: This is a finishing unit farm owned by Mr. Gilmar José Sinigaglia. It is located in Rio das Antas, Santa Catarina. Farm livestock consists of 1,524 animals. Animal waste was sent to anaerobic lagoons by flushing and scrapping. Manure was disposed of through irrigation of his own and neighbouring fields. Irrigation was carried out by tractors. No additional pumping or consumption of fossil fuels was necessary due to the project activity. The carbon credits are claimed for the entire animal population, since all farm waste is sent to the composting unit.

7. Fazenda Suruvy: This is a finishing unit farm owned by Mr. Gilmar Piovezan. It is located in Concórdia, Santa Catarina. Farm livestock consists of 848 animals. Animal waste was sent to anaerobic lagoons by flushing and scrapping. Manure was disposed of through irrigation of his own and neighbouring fields. Irrigation was carried out by tractors. No additional pumping or consumption of fossil fuels was necessary due to the project activity. Carbon credits are claimed for the entire animal population, since all waste in the farm is sent to the composting unit.

8. Fazenda Granja Silva: This is a farrow-to-nursery unit farm owned by Mr. Jair da Silva. It is located in Concórdia, Santa Catarina. Farm livestock consists of 350 breeding animals on site. Animal waste was sent to anaerobic lagoons by flushing and scrapping. Manure was disposed of through irrigation of his own fields. Irrigation was carried out by tractors. No additional pumping or consumption of fossil fuels was necessary due to the project activity. Carbon credits are claimed for the entire animal population, since all farm waste is sent to the composting unit.

9. Fazenda Colônia Suspiro: This is a greenfield wean-to-finish farm owned by Mr. Nobile Tomazi. It is located in Nova Erechim, Santa Catarina. Farm livestock is of 3,979 animals on site. It is located in Jaborá, Santa Catarina. Farm livestock is of 3,979 animals. This is considered a Greenfield Project, because the farm started to operate with a composting unit instead of using an anaerobic lagoon, which would be the most likely scenario in the absence of the Project Activity. In the same way, the baseline scenario is considered the installation of anaerobic lagoons. No consumption of fossil fuels is necessary due to the project activity. Carbon credits are claimed for the entire animal population, since all farm waste is sent to the composting unit.

10. Fazenda Colônia Zuffo: This is a greenfield finishing unit farm owned by Mr. Dário Marcos Zuffo. It is located in Rio das Antas, Santa Catarina. Farm livestock consists of 1,091 animals. This is considered a greenfield project, because the farm started to operate with a composting unit instead of using an anaerobic lagoon, which would be the most likely scenario in the absence of the Project Activity. For the same reason, the baseline scenario is considered the installation of anaerobic lagoons. No consumption of fossil fuels is necessary due to the project activity. Carbon credits are claimed for the entire animal population, since all farm waste is sent to the composting unit.

11. Fazenda Pissaia: This is a finishing unit farm owned by Mr. Neimar Pissaia. It is located in Arvoredo, Santa Catarina. Farm livestock consists of 1,600 animals on site. Animal waste was sent to anaerobic lagoons by flushing and scrapping. Manure was disposed of through irrigation of his own and neighboring fields. Irrigation was carried out by tractors. No additional pumping or consumption of fossil fuels was necessary due to the project activity. Carbon credits are claimed for the entire animal population, since all farm waste is sent to the composting unit.

12. Fazenda Baccin: This is a greenfield finishing unit farm owned by Mr. Renato Baccin. It is located in Concórdia, Santa Catarina. Farm livestock is of 4,000 animals on site. This is considered a Greenfield Project, because the farm started to operate with a composting unit instead of using an anaerobic lagoon, which would be the most likely scenario in the absence of the Project Activity. In the same way, the baseline scenario is considered the installation of anaerobic lagoons. No consumption of fossil fuels is necessary due to the project activity. Carbon credits are claimed for the entrie animal population, since all farm waste is sent to the composting unit.

13. Fazenda Andretta: This is a farrow-to-nursery farm owned by Mr. Selvino Andretta. It is located in Nova Itaberaba, Santa Catarina. Farm livestock consists of 480 breeding animals on site. Animal waste was sent to anaerobic lagoons by flushing and scrapping. Manure was disposed of through irrigation on his own fields. Irrigation was carried out by tractors. No additional pumping or consumption of fossil fuels was necessary due to the project activity. Carbon credits are claimed for the entire animal population, since all farm waste is sent to the composting unit.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

According to Normative Instruction nº 11 (IN 11) of FATMA, to obtain the environmental license it is necessary to present a technical project for an Animal Waste Management System with 120 days of storage capacity (open pit, biomanure pit, lagoons, etc.). Such project must be developed by a licensed technical professional, but it is not necessary to perform any environmental impact study. All the farms involved in the project activity have already obtained the licenses from FATMA. The automated composting system itself facilitates the process to obtain the environmental licences.

1.12 Ownership and Other Programs

1.12.1 Right of Use

Swine Farm's article of incorporation and the contract between Sustainable Carbon – Projetos Ambientais Ltda and each farmer will proof the title, demonstrating the rights to the GHG emissions reductions and the ownership of the project. These proofs of title are available for the validation team for consultation.

1.12.2 Emissions Trading Programs and Other Binding Limits

The project activity is not included in an emission trading program or any other mechanism that includes GHG allowance trading.

1.12.3 Other Forms of Environmental Credit

The project is not creating any other form of environmental credit under any specific program. SOCIALCARBON® Methodology is being applied only as a Sustainability tool in association with VCS.

SOCIALCARBON Methodology was developed by *Instituto Ecológica* (www.ecologica.org.br). It was founded on the principle that transparent assessment and monitoring of the social and environmental performance of projects improves their long-term effectiveness. The methodology uses a set of analytical tools that assess the social, environmental and economic conditions of communities affected by the project, and demonstrates through continuous monitoring the project's contribution to sustainable development.

1.12.4 Participation under Other GHG Programs

This project has not been registered or is seeking registration under any formal GHG reduction or removal program.

1.12.5 Projects Rejected by Other GHG Programs

This project was not rejected under any formal GHG reduction or removal program. The project report was produced to make the project public and available to voluntary measures or other opportunities of the carbon market.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

Not applicable. This is not a grouped project. This is a bundled project of 13 swine farms located in Santa Catarina.

Leakage Management

Not applicable. The methodology AMS-III.F, version 10, does not require calculating the leakage.

Commercially Sensitive Information

No information disclosed to the validation team is to be withheld from the public version of this Project Description.

Further Information

The project is eligible according to:

• Legislative: the project attends all legal requirements related to the project activity;

• Technical: alterations/adaptations required are technically feasible;

• Sectoral: incentive of good practices to the sector;

• Social: SOCIALCARBON methodology is applied, which will improve long-term sustainability. The culture of using anaerobic lagoons will be gradually mitigated;

• Environmental: the project attends all legal requirements and no environmental impacts are predicted;

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The emission reductions were determined according to:

- **Category AMS-III.F. – "Avoidance of methane emissions through composting", version 10.**

Calculation of baseline emissions were determined using relevant sections of:

- **Category AMS-III.D. – "Methane recovery in animal manure management systems", version 18.**

Procedures for the emission calculation from electricity consumption were determined according to:

- **Tool to calculate baseline, project and/or leakage emissions from electricity consumption, version 01**[11].

2.2 Applicability of Methodology

The methodology AMS-III.F.is applicable to project activity because it meets all the applicability criteria; More details are provided on table below:

Table 5. Assessment of the project compliance to eligibility criteria.

Nº	Applicability criteria	Conditions of the proposed Project Activity
1	This methodology comprises measures to avoid the emissions of methane to the atmosphere from biomass or other organic matter that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS), or in an animal waste management system (AWMS), or in a wastewater treatment system (WWTS). In the project activity, controlled aerobic treatment by composting of biomass is introduced.	The project activity proposed consists of measures to avoid methane emissions to the atmosphere from manure that, absent the project, would be decomposed anaerobically in lagoons. In the proposed project activity, a controlled aerobic treatment of these wastes is introduced, by installing a mechanized composting system.
2	The project activity does not recover or combust landfill gas from the disposal site (unlike AMS-III.G. "Landfill methane recovery"), and does not undertake controlled combustion of the waste that is not treated biologically in a first step (unlike AMS-III.E. "Avoidance of methane production from decay of biomass through controlled combustion, gasification or mechanical/thermal treatment"). Project activities that recover biogas from wastewater treatment shall use methodology AMS-III.H. "Methane recovery in wastewater treatment". Project activities involving co-digestion of organic matters shall apply methodology AMS-III.AO. "Methane recovery through controlled anaerobic digestion".	The proposed project activity does not recover or combust landfill gases and does not undertake controlled combustion of waste.
3	Measures are limited to those that result in emission reductions of less than or equal to 60kt CO_2 equivalent annually.	The project emission reductions will not be greater than 60kt CO_2e in any year of the crediting period.
4	This methodology is applicable to the composting of the organic fraction of municipal solid waste and biomass waste from agricultural or agro-industrial activities	Composting of animal manure is the sole activity of the proposed project activity.

[11] Tool available at: <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf>. Last visited on 04/11/2013.

Nº	Applicability criteria	Conditions of the proposed Project Activity
	including manure.	
5	This methodology includes construction and expansion of treatment facilities as well as activities that increase capacity utilization at an existing facility. For project activities that increase capacity utilization at existing facilities, project participant(s) shall demonstrate that special efforts are made to increase the capacity utilization, that the existing facility meets all applicable laws and regulations and that the existing facility is not included in a separate CDM project activity. The special efforts should be identified and described.	Project activity does not include expansion of existing composting units. The project activity consists on the construction of new mechanized composting systems for manure management on existing farms (brownfield projects) and new farms (Greenfield farms), as explained on Section 1.1.
6	This methodology is also applicable for co-composting wastewater and solid biomass waste, where wastewater would otherwise have been treated in an anaerobic wastewater treatment system without biogas recovery. The wastewater in the project scenario is used as a source of moisture and/or nutrients to the biological treatment process e.g. composting of empty fruit bunches (EFB), a residue from palm oil production, with the addition of palm oil mill effluent (POME) which is the wastewater co-produced from palm oil production.	Not applicable. The project activity consists of composting manure that, in the absence of the project activity, would be treated anaerobically in anaerobic lagoons, without methane recovery.
7	In case of co-composting, if it cannot be demonstrated that the organic matter would otherwise been left to decay anaerobically, baseline emissions related to such organic matter shall be accounted for as zero, whereas project emissions shall be calculated according to the procedures presented in this methodology for all co-composted substrates.	Not applicable. The project activity consists of composting manure that, in the absence of the project activity, would be treated anaerobically in the anaerobic lagoons, without methane recovery.
8	The location and characteristics of the disposal site of the biomass, animal manure and co-composting wastewater in the baseline condition shall be known, in such a way as to allow the estimation of its methane emissions, using the provisions of AMSIII. G., AMS-III.E. (concerning stockpile), AMS-III.D, methane recovery in animal manure management systems or AMS-III.H. respectively. Project activities for composting of animal manure shall also meet the requirements under paragraphs 1, and 2 (c) of AMS-III.D. Further no bedding material is used in the animal barns or intentionally added to the manure stream in the baseline. Blending materials may be added in the project scenario to increase the efficiency of the composting process (e.g. to achieve a desirable C/N ratio or free air space value), however, only monitored	Under the baseline conditions, the manure would all be disposed of in anaerobic lagoons over 1 meter deep. The project activity, which involves composting animals wastes: (i) meets all criteria of paragraphs 1 and 2 (c) of AMS-III.D. (see text below at the end of this table); (ii) the project does involve the use of any bedding material in the feedlots, or intentionally adds such material to the baseline wastes and (iii) It adds blending material (substrate) to the project activity in order to increase the efficiency of the composting process (C/N ratio). Emission reductions are claimed exclusively for the amount of animal manure that is treated in the composting units.

Nº	Applicability criteria	Conditions of the proposed Project Activity
	quantity of solid waste or manure or wastewater diverted from the baseline treatment system is used for emission reduction calculation.	
8 (a)	Establish that identified landfill(s)/stockpile(s) can be expected to accommodate the waste to be used for the project activity for the duration of the crediting period; or	The project activity involves only the treatment of animal manure. Baseline conditions for the animal manure are discussed on item 8 (above) and on Section 2.4 of the VCS PD. No solid wastes are treated, hence this item is not applicable to the project.
8 (b)	(b) Establish that it is common practice in the region to dispose off the waste in solid waste disposal site (landfill)/stockpile(s).	Not applicable, as the project does not involve the treatment of solid waste.
9	The project participants shall clearly define the geographical boundary of the region, and document it in the CDM-PDD. In defining the geographical boundary of the region, project participants should take into account the source of the waste i.e. if waste is transported up to 50 km, the region may cover a radius of 50 km around the project activity. In addition, it should also consider the distance to which the final product after composting will be transported. In either case, the region should cover a reasonable radius around the project activity that can be justified with reference to the project circumstances but in no case it shall be more than 200 km. Once defined, the region should not be changed during the crediting period(s).	The project boundary covers a radius of 150km around each project site. The project does not involve the transportation of waste or animal manure. Most of produced compost will be used onsite (on each farm) or in the neighboring region. However, a fraction of the compost can be sold for more distant consumers. The project boundary includes the itinerary between each farm and the final consumer of the compost.
10	In case produced compost is handled aerobically and submitted to soil application, the proper conditions and procedures (not resulting in methane emissions) must be ensured.	The compost produced will be used as fertilizer for the soil. The compost will be applied to the soil similarly to the way used for chemical fertilizers. The low agglutination of the compost and the short time needed to apply it ensure that there is not enough time available to develop anaerobic conditions. The compost is not subject to anaerobic conditions inside the composting windrows, as frequent mixing, low moisture and high temperatures ensure the aerobic degradation of organic matter[12]. Farmers received training on the project monitoring plan that included information on how to ensure the compost is handled aerobically. Also, farmers apply the compost following recommendations from agricultural technicians. Additionally, annual verifications will be carried out by a technician on the

[12]According to EMBRAPA publication ISSN 0101-6245 (Composting unit for the treatment of swine manure), such conditions ensure the aerobic degradation of manure in composting units. The UMAC system is design to ensure frequent mixing, high temperature and controlled moisture, as explained on Section 1.8.

Nº	Applicability criteria	Conditions of the proposed Project Activity
		compost application sites in a sample of users.
11	In case produced compost is treated thermally/mechanically, the provisions in AMS-III.E. related to thermal/mechanical treatment shall be applied.	Not applicable. The compost produced is not treated thermally/mechanically.
12	In case produced compost is stored under anaerobic conditions and/or delivered to a landfill, emissions from the residual organic content shall to be taken into account and calculated as per the latest version of the "Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site".	Not applicable. The compost produced is not stored under anaerobic conditions and/or disposed off in landfill. All compost produced shall be destined for soil application, as described under item 10 (above). Prior to soil application, the compost usually remains on the composting unit being subject low humidity, frequent mixing and high temperatures (due to insulation and microbial activity). This means farmers usually remove the compost "on demand", as the UMAC system allows the compost to remain on-site as long as it is desired. Eventually, some farmers store the compost for short periods of time (less than a month), following recommendations from LPC and Sustainable Carbon in order to avoid anaerobic storage or disposal. Hence, the technical aspects of the composting units avoid anaerobic conditions, as seen on validation and verification site visits.

Further information on applicability condition (8) is provided below:

The project activity also meets the requirements of paragraph 1 and 2 (c) from methodology AMS-III.D. - "*Methane recovery in animal manure management systems"*, version 18, as below:

1. (a) At all farms the animals on the farm are managed under confined conditions; (b) the manure and the final compost obtained after treatment are not discharged into natural water resources; (c) the annual average temperature of the baseline is higher than 5ºC (FIGURE 2); (d) in the baseline the retention time of manure in the anaerobic treatment system would be greater than 1 month, and in case of anaerobic lagoons, their depths are at least 1 m.; (e) no methane recovery and destruction by flaring, combustion or gainful use takes place in the baseline.

2. (c) The retention time of the wastes after they are removed from the feedlots, including transport, would not exceed 45 days before being fed into the treatment system. In the project activity in all farms the wastes are sent directly from the feedlots to the composting unit.

Applicability conditions 3 to 6 of AMS-III.D version 18 are not applicable to this project, since they do not relate to baseline methane emissions from animal manure. Finally, the project complies to condition 7 of AMS-III.D version 18 since emission reductions will not be greater than 60kt CO_2e in any year of the crediting period.

Figure 2 below shows the annual average temperature range in Santa Catarina, especially in the project region, where annual average temperature is around 18ºC.

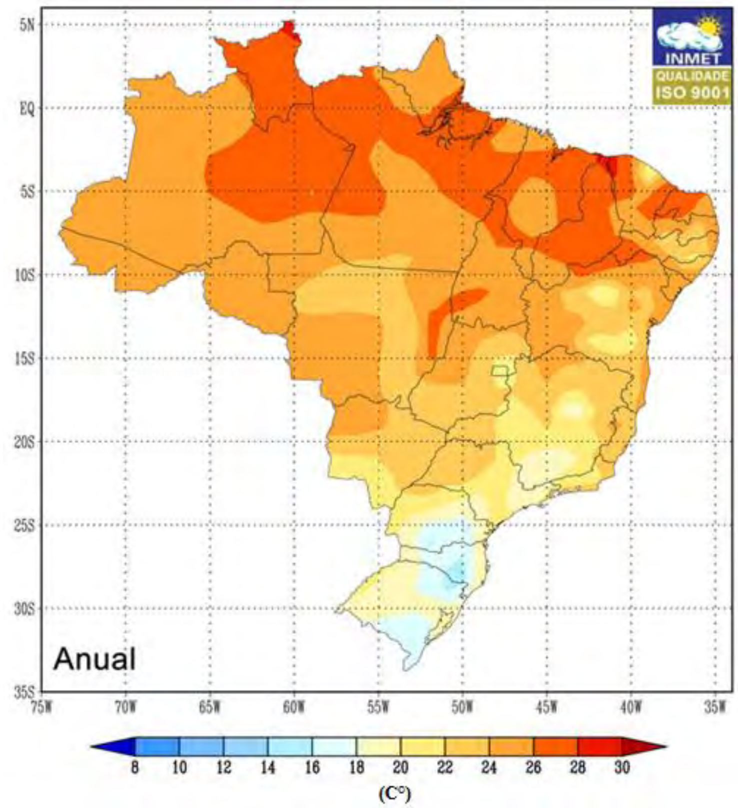

Figure 2 – Annual average temperature at the project region. Source: National Institute of Meteorology[13]

2.3 Project Boundary

According methodology AMS-III.F., version 10, the project boundary applicable to the proposed project activity is the physical geographical site:

i. Where the manure would have been disposed and the methane emission occurs in absence of the proposed project activity;

ii. Where the treatment of manure through composting takes place;

iii. Where the products from composting (compost) is handled, disposed, submitted to soil application, or treated thermally/mechanically;

[13] INMET – Instituto Nacional de Meteorologia. Available at: <http://www.inmet.gov.br/html/clima/mapas/?mapa=tmed>. Last visit on: 28th December, 2012

iv. The itineraries between i, ii e iii, where the transportation of manure and the product of treatment (compost) occurs.

According the definitions of methodology AMS-III.F., version 10, the project activity boundary for each farm consists of the site where it is inserted: (i) and (ii) the waste treatment system, including the shed and the composting unit; (iii) the site(s) where the compost produced is applied to the soil or sold; and (iv), the itinerary(ies) travelled to transport the compost between (i), (ii) and (iii). As required by AMS-III.D, version 18, the project boundary also includes:

(a) The livestock;

(b) Animal Manure Management Systems

(c) Facilities which recover and flare/combust or use methane

Hence, the project boundary also includes the confinement barns, as required by item (a) of AMS-III.D, version 18. Item 8(b) is already included in the project boundary since the composting units are the only type of AWMS present in the farms. As the project does not produce methane, but avoid its formation due to aerobic treatment, item (c) is not applicable.

For Greenfield projects, the site where the wastes would be disposed of in the baseline in the absence of project activity, (i.e., the site of the baseline anaerobic lagoons) is the same site where the wastes are treated by composting. Items (i) and (ii) occur in the same place. In this case, there is no incremental distance between the site where the emissions would occur in the absence of project activity and the site where composting occurs.

For Brownfield projects, the site where the wastes would be disposed of in the baseline in the absence of project activity is located within 1km or less from the site where the wastes are treated by composting. Therefore, incremental distances are considered to be insignificant and emissions from incremental transportation are neglected.

The project boundary shall include an area covering a radius of 150km around each farm, to include the site where compost is applied to the soil and the itineraries between these sites and the farms.

Source		Gas	Included?	Justification/Explanation
Baseline	Anaerobic lagoons	CO_2	No	Excluded for simplification. This emission source is assumed to be very small.
		CH_4	Yes	The major source of emissions in the baseline.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
Project	Emissions due to the incremental transportation distances	CO_2	Yes	Emissions caused by incremental transportation distances will be monitored but will not be applied to the project activity. There was no increasing in the distances between the composting machine where the compost is produced and its final destination.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions	CO_2	Yes	Emissions from the consumption of electricity to

Source		Gas	Included?	Justification/Explanation
	from electricity consumption by the project activity facilities			operate the mechanized composting units and motor-pumps for pumping have to be measured.
		CH_4	No	Excluded for simplification. This emission source is assumed to be very small.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions during waste composting process	CO_2	No	Excluded for simplification. This emission source is assumed to be very small.
		CH_4	Yes	Emissions during waste composting are included to account for methane emissions occurring during the composting process.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions from runoff water	CO_2	No	Excluded for simplification. This emission source is assumed to be very small.
		CH_4	No	Emissions caused by runoff water are not applied to the project activity. The mechanized composting units are designed so as to not apply excessive wastes on the substrate and to recirculate it into the composting mass. Besides that, the sheds are covered, avoiding rainwater percolation onto the substrate.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.
	Emissions due to compost storage	CO_2	No	Excluded for simplification. This emission source is assumed to be very small.
		CH_4	No	Emissions caused by storage and final disposal of the compost applied to the project activity are not considered. The compost will not be stored in anaerobic conditions, nor will it be sent to a landfill. Besides, produced compost is completely stabilized, and its application to the soil as fertilizer does not generate methane emissions into the atmosphere.
		N_2O	No	Excluded for simplification. This emission source is assumed to be very small.

2.4 Baseline Scenario

The baseline scenario is identified according to general guidance to the small-scale CDM methodologies[14], especially procedures described on paragraph 21. The baseline scenario is identified by assessing possible alternatives to the project that could provide similar levels of activity.

The baseline assessment is made once for all the swine farms included in the project. Since they all operate in similar conditions (in terms of technology availability, market conditions, legal framework, amongst others) this approach is considered appropriate.

Furthermore, the scenario existing prior to the project initiation was similar for 8 swine farms included in the project, namely the use of anaerobic lagoons as waste management system. The remaining 5 farms, which are Greenfield projects, can reasonably be considered to have a similar baseline to the Brownfield project sites. The process follows the steps below:

Step 1: identification of alternatives

The possible alternatives to the project are based on Animal Waste Treatment Systems that allow sufficient storage of wastes for later soil application. The alternatives below are considered relevant baseline candidates:

1. Continuation *of the historical practice, which involves the use of anaerobic lagoons to store and stabilize the wastes for later soil application*: this alternative is the common practice in Brazil swine farms[15] and also the scenario existing prior to the project initiation for majority of the swine farms.
2. *Installation of an anaerobic digester as a waste management system*: This alternative would provide the same level of activity of the project and would result in GHG emission reductions due to the biogas capture and destruction. However, the swine farmers still lack the knowledge and the assistance to successfully install and operate anaerobic digesters for the treatment of animal manure. Besides that, this alternative has high implementation and maintenance costs.
3. *Installation of a mechanized composting unit not undertaken as a GHG emission reduction project*: It is an innovative manure treatment system that would result in GHG emission reductions due to the aerobic decaying of the organic matter. However, the carbon credits income is still necessary to implement this process of treatment due to the high costs of implementation and operation.

Step 2: List the alternatives identified per Step 1 in compliance with the local regulations

All the alternatives identified in Step 1 are in accordance with local regulations. Therefore, 3 baseline alternatives remain.

Step 3: Eliminate and rank the alternatives identified in Step 2 taking into account barrier tests

The barrier test is applied as part of the Section 2.5. Please refer to this Section to obtain more information on the criteria for the elimination and ranking of the identified alternatives.

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[14] Available at: <http://cdm.unfccc.int/Reference/Guidclarif/ssc/methSSC_guid25.pdf >. Last visit on: 26/03/2012.
[15] Article Technologies for the management of Swine Manure researched in Brazil. Available at: <seer.sct.embrapa.br/index.php/cct/article/download/8663/4852 >. Last visit on: 26/03/2012

As a result of the barriers test, only one alternative remains: the use of anaerobic lagoons to store and treat animal manure for later soil application. This is considered the historical (business as usual) practice for swine confinement farms in the Southern region of Brazil.

This situation was also the scenario existing prior to the initiation of the project for all Brownfield farms. Anaerobic lagoons have been used as waste management system with methane being emitted to the atmosphere. Please refer to Section 3.1 to obtain additional information on the calculation of baseline emissions. Given the historical practices and the barriers faced by alternatives, anaerobic lagoons are considered the baseline scenario for all Greenfield farms as well;

Step 4: As described above, the remaining alternative is not the proposed project alternative not undertaken as a GHG emission reduction project and corresponds to one of the baseline scenarios provided by the applied methodology. Hence, the proposed project is eligible under the methodology.

2.5 Additionality

The methodology applied is *AMS-III.F. - "Avoidance of methane emissions through composting",* version 10, which is applicable to the composting of the organic fraction of municipal solid waste and biomass waste from agricultural or agro-industrial activities, including manure, that would have otherwise been left to decay anaerobically in a solid waste disposal site (SWDS), or in an animal waste management system (AWMS), or in a wastewater treatment system (WWTS). In the project activity, controlled aerobic treatment by composting of biomass is introduced avoiding methane emissions.

The project involves the replacement of the baseline system by an automated composting unit which will treat the swine manure in a controlled and economically sustainable manner. Furthermore, the project will result in emission reductions lower than 60,000 tCO_2e per year.

The baseline scenario is the installation of anaerobic lagoons to store and stabilize the wastes for later soil application. This is a common practice in swine farms in Brazil[16]. Project additionality is explained according to the *guidelines on the demonstration of additionality of small-scale project activities*[18]. According to these guidelines, project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers: investment barriers, technological barriers, barriers due to prevailing practices Below, an analysis of barriers affecting the project activity is provided.

The identified alternatives to the project activity were identified in Section 2.4 and are described again below:

1. *Continuation of the historical practice, which involves the use of anaerobic lagoons to store and stabilize the wastes for later soil application:* this alternative is the common practice in Brazil swine farms[19] and also the scenario existing prior to the project initiation for majority of the swine farms.
2. *Installation of an anaerobic digester as a waste management system:* This alternative would provide the same level of activity of the project and would result in GHG emission reductions

[16] Second Brazilian Inventory of anthropogenic GHG emissions. Ministry of Science and Technology. Available at: <http://www.mct.gov.br/upd_blob/0214/214061.pdf>. Last visit on: 08/02/2012
[18] Clean Development Mechanism Executive Board, Meeting Report 68,Annex 27. Document available at: < http://cdm.unfccc.int/Reference/Guidclarif/meth/methSSC_guid05.pdf >. Last visit on 02/01/2014.
[19] Second Brazilian Inventory of anthropogenic GHG emissions. Ministry of Science and Technology. Available at: <http://www.mct.gov.br/upd_blob/0214/214061.pdf>. Last visit on: 08/02/2012

due to the biogas capture and destruction. However, the swine farmers still lack the knowledge and the assistance to successfully install and operate anaerobic digesters for the treatment of animal manure. Besides that, it has high implementation and maintenance costs.

3. *Installation of a mechanized composting unit not undertaken as a GHG emission reduction project*: It is an innovative manure treatment system that would result in GHG emission reductions due to the aerobic decaying of the organic matter. However, the carbon credits income is still necessary to implement this process of treatment due to the high costs of implementation and operation.

All alternatives above are considered realistic and credible and could provide the same levels of activity than the project. As detailed in Step 1 of Section 2.4, the most probable baseline candidates (that are representative of common practice) is the use of anaerobic lagoons to store and stabilize the wastes for later soil application.

The project is not mandated by any enforced law, statute or other regulatory framework in Federal, State and Municipal levels in the survey performed. All participating farms are in accordance with the environmental authority. According to Normative Instruction nº 11 (IN 11) of FATMA, to obtain the environmental license it is necessary to present a technical project for an Animal Waste Management System with 120 days of storage capacity (open pit, biomanure pit, lagoons, etc.). Such project must be developed by a licensed technical professional, but it is not necessary to perform any environmental impact study. All the farms involved in the project activity have already obtained the licenses from FATMA.. Therefore, all alternatives identified in Sub-step 1a are consistent with current laws and regulations.

The additionality assessment will now perform barrier analysis. Barrier analysis is used to determine whether the proposed project activity faces barriers that:

(a) Prevent the implementation of this type of proposed project activity; and

(b) Do not prevent the implementation of at least one of the alternatives.

- **Technological Barrier**

As mentioned before, the composting system used to treat manure in Brazil is considered something innovative, utilized in a few farms in the country. As a result of the project, an important component was changed in the swine farms, the anaerobic lagoons were replaced by composting units.

The main technological barriers were the lack of experience with the new technology/measures proposed by the project, the internal logistic modification, higher maintenance necessity and related operational and maintenance costs. All the swine farms included in the project had no experience operating with composting units prior to the project initiation.

Before the project activity, the process was noticeably different: the swine manure was stored in anaerobic lagoons, emitting methane to the atmosphere. Manure was later used for soil applications. This was a well-known process that had occurred for long periods. It required little to no efforts from the farmers on the management of animal manure, since this treatment system was mostly passive.

The project, however, involves the introduction of mechanized composting units to treat the animal waste and obtain a final compost. The replacement of technology involves training the farmers to allow the proper and efficient use of equipments. This point is crucial in order to maintain the quality of the compost. It is important to clarify that alterations in the system of manure treatment were only needed because of the project. Otherwise, the swine farms would not replace their baseline AWMS. All these measures would not be implemented if the swine farms were still utilizing anaerobic lagoons.

- **Investment barrier**

With the project implementation, the swine farms had to withstand higher investment costs than if they had continued utilizing anaerobic lagoons. The most important additional costs are related to the installation of composting equipments and the construction of the composting sheds. Furthermore, the project involves increased operation and maintenance costs (such as electricity and man hour costs), as new equipments were introduced and the composting demands daily operation.

Besides, due to the implementation of the project activity, the farmers have to periodically purchase a substrate (e.g. sawdust) to allow the proper operation of the composting unit.

Due to all the above mentioned, the farmers had to deal with higher production costs. Those made the farmers think about stopping the composting project. The following tables summarize additional costs farms would have in the baseline alternatives.

Table 6. Main investment costs associated to each baseline alternative for Brownfield Projects.

Farmer	Unit [20]	Alternative 1	Alternative 2	Alternative 3[21]
Adelmo Pickler	$	0.00	20,966.40	84,485.00
Altenor José Basso	$	0.00	61,362.00	108,900.00
Diacir Coradi	$	0.00	44,730.00	240,600.00
Gilmar José Sinigaglia	$	0.00	38,404.80	98,560.00
Aírton Piovezan	$	0.00	21,369.60	68,550.00
Jair da Silva	$	0.00	28,980.00	86,560.00
Neimar Pissaia	$	0.00	40,320.00	118,300.00
Selvino Andretta	$	0.00	39,744.00	92,575.00

Table 7. Main investment costs associated to each baseline alternative for Brownfield Projects.

Farmer	Unit [22]	Alternative 1	Alternative 2	Alternative 3
Antônio Carlos Ramela	$	22,087.80	60,741.45	89,575.00
Belmiro Secco	$	21,268.80	58,489.20	106,600.00
Dario Marcos Zuffo	$	13,746.60	37,803.15	74,754.00
Nóbile Tomazi	$	50,135.40	137,872.35	152,560.00
Renato Baccin	$	50,400.00	138,600.00	149,340.00

As it is demonstrated above, the alternative that involves lower costs is Alternative 1, the continuation of the historical practices, which involves the use of anaerobic lagoons for later soil application.

[20] Monetary values in Brazilian Reais (BRL).
[21] These estimations are according to the LPC and include the costs with UMAC, purchase of substrate and construction of the composting sheds.
[22] Monetary values in Brazilian Reais (BRL).

In the Brownfield projects, the Alternative 1 does not involve additional costs, once the anaerobic lagoons were already present since the farm implementation. For Greenfields Projects, Alternative 1 involves costs regarding the construction of anaerobic lagoons. According to the Technological Inventory of EMBRAPA[23] the cost of an aerobic lagoon is around R$ 15.00/m³, which represents around R$ 12.60 per animal.

Alternatives 2 and 3, concerns to the costs regarding, respectively, the construction of the anaerobic digesters and composting units. As stated by the Technological Inventory of EMBRAPA, costs due to the construction of anaerobic digester, are around R$ 120.00/m³. In a brownfield project, average cost for the construction of anaerobic digesters is of R$ 30.06. For Greenfield projects, this costs would be of R$ 34.65 per animal. Costs for anaerobic digester were calculated considering a digester with 30 days storage time (to allow for biogas production[24])and complementing lagoons with 90 days storage time, in order to achieve the 120 days storage time required by normative Instruction 11 from FATMA. For brownfield farms, it is assumed the existing lagoons could be used for alternative two, and the only additional cost would be the anaerobic digester.

According to LPC, the average cost of installing a mechanized composting system is around R$ 91.28 per animal for Brownfield projects and R$ 45.79 per animal for Greenfield projects. These costs include the acquisition of the UMAC equipment, the purchase of the substrate and the construction of composting sheds. Higher costs for brownfield farms are attributed to filling of existing lagoons and adaptations to manure loading systems.

Besides the higher cost to install the composting system, Kunz et al. (2005)[25] states that the distribution cost of the composted material is also higher than the cost of the liquid waste removed from the lagoons, thus showing that the installation of the composting system presents a great barrier to investment.

The hypothesis of selling the organic compost resulting from the project activity as a way to amortize the investment is not valid at the time when the investment decision was taken. No farm involved in the project activity has frequent purchasers for this compost in the region. Therefore, the compost is not a regular source of income to the farmers, once there is no consolidated market to ensure the compost sale. Besides that, the farms are located in very rural areas and spread out over the region, this way making difficult the compost sale logistics.

Currently, the compost produced from manure competes with the compost from “bedding material of poultries”, a by-product of poultry farming used to fertilize soil in the region. The “bedding material of poultries” compost is offered in large quantities in the region where the project activity is developed. Besides, it has the preference among the compost purchasing companies, because of the greater nutrient concentration. This scenario may be evidenced in the study “Technologies for the management and treatment of manure studied in Brazil” (*Tecnologias de manejo e tratamento de dejetos suínos estudadas no Brasil*[26]) by Kunz et al. (2005b) and the statements by companies in the region, all of them located in the western part of the state of Santa Catarina.

As demonstrated above, it can be concluded that the project faces investment and technology barriers, and that without the incentive of the carbon credits, would have led the owners of the farms involved in the project to install anaerobic lagoons, instead of the mechanized composting system. The main

[23] Technological Inventory of EMBRAPA. *Sistemas de tratamento de dejetos suínos - Inventário tecnológico*. Available at: <http://www.cnpsa.embrapa.br/invtec>. Last visit on: 04/01/ 2012.

[24] 30 days is the recommended storage capacity of anaerobic digesters to allow for biogas production. Information was taken from: http://www.cnpsa.embrapa.br/invtec/10.html. Last visit on 26/03/2012.

[25] Comparison of costs to implement different storage/treatment and pig waste distribution technologies - <http://www.cnpsa.embrapa.br/sgc/sgc_publicacoes/publicacao_c6f75b0x.pdf>. Last visit on: 04/01/ 2012.

[26] Swine waste management and treatment Technologies studied in Brazil. Available at: <http://webnotes.sct.embrapa.br/pdf/cct/v22/v22n3p651.pdf>. Last visit on: 04/01/ 2012.

contribution of the carbon credits to overcome the project barriers is the financial contribution which for the farmer is a sufficient resource to compensate for the difference in investment between the mechanized composting system and the anaerobic lagoons. The financial return with the carbon credits was also the main incentive to overcome the technological barrier, ie., to encourage installing a technically more complex system, uncommon in Brazil and in the project region, which will require new procedures to manage swine waste.

- **Barriers due to prevailing practices**

Activities that are similar to the project are not common in Brazil. As detailed in Section 2.4, the prevailing practice in swine farms is the use of anaerobic lagoons for later soil application[29].

Similar activities found in the country do exist, but represent a small fraction of manure management systems available in animal confinements. The 2006 Agricultural Census from IBGE (Brazilian Institute of Geography and Statistics) indicates composting is used in only 11.74% of agricultural properties for which the main activity is animal farming[30]. This figure includes all classes of farm animals and all types of composting. Also, the Second Brazilian Inventory of Anthropogenic Emissions and Removals of Greenhouse Gases provides data on manure management systems on a State level. This information demonstrates anaerobic lagoons and open tanks (referred to in Portuguese as *esterqueiras*[31]) represent nearly 88% of all AWMS. There are no specific values for composting units, given their low relevance. Composting units are classified under the "others" category that represent around 12% of AWMS in Santa Catarina[32].

Therefore, the use of automated composting in swine farms is expected to be even lower than that, given the barriers preventing a wider use of composting for swine manure treatment, as described on the previous steps of the barrier analysis.

Also, similar activities to the Project (meaning automated composting for swine manure treatment) are being developed within the carbon market[33] (as voluntary or CDM project activities) and hence cannot be included in this analysis.

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29 Article Technologies for the management of Swine Manure researched in Brazil. Available at: <seer.sct.embrapa.br/index.php/cct/article/download/8663/4852>. Last visit on: 26/03/2012

30 Information available at: <http://www.sidra.ibge.gov.br/bda/tabela/protabl.asp?c=1010&i=P&orc218=4&opc12552=1&poc12552=1&orc12548=6&nome=on&qtu8=137&tab=1010&opc12628=1&poc12628=2&opc218=1&opc12517=1&poc12517=1&orc220=8&opn8=0&unit=0&pov=1&sec12548=0&sec220=0&OpcTipoNivt=1&opn1=2&nivt=0&orc12628=3&orc12517=7&opc220=1&orp=9&qtu3=27&opv=1&orc12552=5&opc12548=1&poc12548=1&pop=1&opn2=0&orv=2&poc220=1&qtu2=5&sev=1000057&opp=1&opn3=0&qtu6=5548&sec12628=118154&sec12628=114174&sec12628=114175&sec12628=114176&sec12628=114177&sec12628=114178&poc218=1&sec12517=111523&decm=99&sec218=0&qtu1=1&opn9=0&cabec=on&sec12552=0&pon=1&qtu9=558&opn6=0&digt6=&OpcCara=44&proc=1&sep=43445&orn=1>. Last visit on 07/11/2013.

31 A sort of simplified anaerobic lagoon without technical design features such as geomembranes and pumping systems.

32 Information available at: <http://www.alice.cnptia.embrapa.br/bitstream/doc/921485/1/2011MZ02.pdf>. Data is displayed on page 119. Last visit on 07/11/2013.

33 Such as the CDM Projects "Organoeste Dourados & Andradina Composting Project", validated in 2010 and the "Greenhouse emission reductions on swine production by means the installation of composting systems" under validation. Information on these Projects are, respectively, available at: <http://cdm.unfccc.int/Projects/DB/RWTUV1269261429.29/view> and <http://cdm.unfccc.int/Projects/Validation/DB/8RLU92CP0VC06Q13N7ETEEZNDA3AP0/view.html>. Last visit on: 08/02/2011..

Conclusions on the barrier analysis:

The identified barriers have higher impacts on alternatives 2 and 3 than they do on alternative 1 (continuation of historical practices). The continued use of anaerobic lagoons at the baseline does not involve technological barriers, since the swine farms have operated in such conditions for long periods. This is a common practice in Brazil. Also, for the Brownfield projects the alternative 1 does not have investment costs, since no modifications to the AWMS would be needed. In case of Greenfield Projects, the construction of anaerobic lagoons is significantly less expensive than the remaining alternatives.

The impact of the identified technological and financial barriers is demonstrated by the technological level of anaerobic lagoons in swine farms in Brazil. Emissions from anaerobic lagoons represent 49.5% of the methane emissions in the livestock sector[34].

Therefore, alternatives 2 and 3 are prevented by barriers that have little to no impact on the alternative 1 (continuation of historical practices). Hence, the carbon credits income is necessary to cover the expenses and risks related to changes in animal waste management and make the project an attractive alternative.

The project approval will alleviate the barriers associated to the project measures, by providing financial benefits to the swine farms.

2.6 Methodology Deviations

Project Proponents have applied a minor deviation to the equation used for determining the annual average number of animals of type *LT* in year *y* (parameter $N_{LT,y}$)[35]. This adaptation increases the accuracy of emission reduction quantification, since it allows PPs to use reliable third party information to monitor key parameters related to animal production. Third party information shall be sourced from entities that are the direct responsible for measuring monitored data, such as integrators (food companies that manage the complete meat production cycle) and State Agencies.

As farms operate in batches lasting from 3 to 4 months, all data on animal production is documented by integrators after each batch is delivered. Batches and related documents do not follow a yearly calendar.

This deviation will not negatively impact the conservativeness of the quantification of GHG emission reductions or removals, rather increase the accuracy of monitoring and emission reduction calculations, as described above. This deviation also relates only to the criteria and procedures for monitoring or measurement, and does not relate to any other part of the methodology.

Project Proponents have also used a deviation in the monitoring of the quantity of electricity consumed by the project, which is related to emissions from electricity consumption. AMS-III.F version 10 determines it shall be assumed that all relevant electrical equipment operate at full rated capacity, plus 10% to account for distribution losses, for 8,760 hours per annum in case electricity consumption is not directly monitored.

However, given the farms management processes and their low energy consumption, a conservative value was applied. Such value is based on LPC judgment on the expected time of operation of the manure pump and the UMAC equipment[36], which are the only two equipments demanding electricity consumption in the AWMS. Estimates applied on the emission reduction calculation are corrected with

[34] Second Brazilian Inventory of anthropogenic GHG emissions. Ministry of Science and Technology. Available at: <http://www.mct.gov.br/upd_blob/0214/214061.pdf>. Last visit on: 08/02/2012

[35] Please check equation 4 on Section 3.1 of the VCS PD.

[36] Estimates from LPC took into consideration the design of each individual farm. Estimates were based on the size of each composting site and the typical operating conditions of the UMAC system.

the use of a conservative factor of 125%, meaning an operation time 25% higher than expected by LPC was considered. This estimate is also considered conservative given that electricity is an significant cost for the operation of the composting unit and farmers would have no interest in using the equipments longer than necessary.

This deviation will not negatively impact the conservativeness of the quantification of GHG emission reductions or removals, since conservative estimated values will be applied in case monitoring data is incomplete [37]. This deviation also relates only to the criteria and procedures for monitoring or measurement, and does not relate to any other part of the methodology.

Project Proponents have also used a deviation regarding the monitoring of the quantity of manure treated in the year *y* (parameter Q_y) and the monitoring of the quantity of compost produced in year *y* (parameter $Q_{y,treatment}$). The applied version of the methodology establishes these parameters should be monitored by on-site data measurement using weigh bridges. However, the project does not involve the transportation of waste by vehicles[38] and compost is mostly used as fertilizer within the farm or on nearby farms, where weigh bridges are not available.

Project Proponents have proposed to determine the amount of waste composted by monitoring the number of operating hours of the pump that sends manure to the composting unit and/or applying default values.

Since this parameter is only used to calculate **project emissions**, using default values is conservative as long as values are higher than monitored data. Also, the CDM Methodological Tool "Project and leakage emissions from composting" (EB 65 Annex 09) allows for a different procedure in case there are no weighing device. The tool recommends estimating the amount of waste based on the number of trucks and their capacity. Under this option, no direct measurement or calibrated equipments are used for the monitoring of the amount waste composted.

Also, since no project emissions from the produced compost are expected (as explained on Section 3.2), this deviation will not negatively impact the conservativeness of the quantification of GHG emission reductions or removals, as a conservative approach was chosen to monitor Q_y and $Q_{y,treatment}$. The approach is considered conservative since it is based either on on-site data or reliable EMBRAPA default values that are applicable to local conditions. This deviation also relates only to the criteria and procedures for monitoring or measurement, and does not relate to any other part of the methodology.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

The baseline emissions refer to the amount of GHG that would be emitted into the atmosphere after anaerobic lagoons are installed for the treatment of manure at the farms involved in the project.

The baseline emissions are calculated using the most recent IPCC publication, Tier 2 (2006 IPCC - Guidelines for National Greenhouse Gas Inventories) and, as recommended on version 10 of the methodology of AMS-III.F., paragraph 14. According to such paragraph of the methodology, baseline emissions are calculated as:

[37] Evidence on the expected time of operation of electric equipments of each farm was provided to the Validation and Verification Body responsible for project validation.
[38] Waste is carried to the composting units by gravity and electrical pumps. Compost is usually removed with wheelbarrow or small vehicles (tractors). This is applicable to all farms included in the project.

$$BE_y = BE_{CH4,SWDS,y} + BE_{ww,y} + BE_{CH4,manure,y} - MD_{y,reg} * GWP\_CH_4$$

Equation 1

Where,

$BE_{CH4,SWDS,y}$	Yearly methane generation potential of the solid waste composted by the project activity during the years x from the beginning of the project activity (x=1) up to the year y estimated as per the latest version of the “Tool to determine methane emissions avoided from disposal of waste at a solid waste disposal site” (tCO_2e). The tool may be used with the factor “f=0.0” assuming that no biogas is captured and flared. With the definition of year x as ‘the year since the project activity started diverting wastes from landfill disposal’, x runs from the first year of crediting period (x=1) to the year for which emissions are calculated (x=y).
MDy,reg	Amount of methane that would have to be captured and combusted in the year y to comply with the prevailing regulations (tonne)
$BE_{CH4,manure,y}$	Baseline emissions from manure composted by the project activities, as per the procedures of AMS-III.D
$BE_{ww,y}$	Where applicable, baseline emissions from the wastewater co-composted, calculated as per the procedures in AMS-III.H

Only baseline emissions from animal manure composted by the project activities are considered. Hence, baseline emissions are calculated in accordance to procedures from approved methodology AMS-III.D, version 18. Procedures from paragraph 9(a) are used, since data needed to apply option 9(b) is not available.

The baseline emissions are calculated by Equation 2 below:

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

Equation 2

Where:

BE_y	Baseline emissions in year y (tCO_2e)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (21)
D_{CH4}	CH_4 density (0.00067 t/m3 at room temperature (20 ºC) and 1 atm pressure)
LT	Index for all types of livestock
j	Index for animal manure management system
MCF_j	Annual methane conversion factor (MCF) for the baseline animal manure management system *j*
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type LT (m^3 CH4 / kg dm)
$N_{LT,y}$	Annual average number of animals of type *LT* in year *y* (numbers)

$VS_{LT,y}$ 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 (0.94)

The value of $VS_{LT,y}$ is adjusted according to the average animal weight of project activity, by means of Equation 3, considering the default value of IPCC ($VS_{default}$):

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

Equation 3

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, this data is sourced from 2006 IPCC (kg).

$VS_{default}$ 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 animal manure management system is operational.

The average number of animals ($N_{LT,y}$) is calculated by Equation 4:

$$N_{LT,y} = N_{da,y} * \left(\frac{N_{p,y}}{365}\right)$$

Equation 4

N_{day} - Number of days animal is alive in the farm in the year *y* (numbers).

$N_{p,y}$ - Number of animals produced annually of type *LT* for the year *y* (numbers).

A minor adaptation to equation 4 is used in this project. Since documents regarding the production of animals is not generated monthly, but based on batches, a period of time different than 365 is usually considered. Hence, $N_{LT,y}$ is obtained by dividing the number of animals produced by the number of days in the period of time considered.

This causes no significant alteration to $N_{LT,y}$, but allows for a correct calculation given the type of documentation available on animal production. Farmers are granted documents and financial compensation from integrators for each batch. Thus, animal production controls do not follow an annual schedule; instead it is based on each batch period. Project Proponents consider documents provided by integrators to be the most reliable and conservative source of monitoring data. Hence, monitoring will be done based on documents for each batch.

The values of parameters GWP_{CH4}, D_{CH4}, UF_b, MCF_j, $B_{0,LT}$, $MS\%_{Bl,j}$, nd_y, $W_{default}$, and $VS_{default}$, used to calculate the baseline emissions are listed in section 4.1. The number of days animals is alive ($N_{da,y}$) , the number of animals produced in year y ($N_{p,y}$) and the annual average number of animals per type ($N_{LT,y}$), used to calculate ex-ante emission reductions are shown in the following table:

Table 8. Parameters used to calculate ex-ante baseline emissions.

Farmer	Category (*LT*)	$N_{da,y}$	$N_{p,y}$	$N_{LT,y}$
Adelmo Pickler	Market swine - finisher	120.88	5,910.00	832.00
Airton Piovezan	Market swine - finisher	115.00	1,807.85	848.00
Altenor José Basso	Market swine - finisher	115.00	11,180.00	2,435.00
Antônio Carlos Ramela	Market swine - finisher	180.00	4,677.00	1,753.00
Belmiro Secco	Market swine - finisher	135.67	5,674.00	1,688.00
Dario Marcos Zuffo	Market swine - finisher	117.33	3,471.00	1,091.00
Diacir Coradi	Market swine - finisher	128.00	6,272.00	1,775.00
Selvino Andreta	Breeding swine[39] – sows	274	477	477
	Breeding swine – boars	274	3	3
	Market swine – piglets	25.98	6,297	597
	Market swine - nursery	49	4,551	813
Gilmar José Sinigaglia	Market swine - finisher	125.57	12,225.00	1,524.00
Jair da Silva	Breeding swine[40] – gilts	210	45	45
	Breeding swine – sows in gestation	210	250	250
	Breeding swine – sows	210	50	50
	Breeding swine – boars	210	5	5

[39] Livestock was calculated with data from 274 days (from 31/12/2010 to 01/10/2011). Breeding animals remain constantly in the farm, for 365 days per year. $N_{da,y}$ was considered as 274 in the equation to account for this shorter period of time considered.

[40] Livestock was calculated with data from 210 days (from 01/12/2010 to 29/06/2011). Breeding animals remain constantly in the farm, for 365 days per year. $N_{da,y}$ was considered as 210 in the equation to account for this shorter period of time considered.

Farmer	Category (*LT*)	$N_{da,y}$	$N_{p,y}$	$N_{LT,y}$
	Market swine – piglets	25.98	4,865	601
	Market swine - nursery	49	1,216	283
Nóbile Tomazi	Market swine - finisher	115.00	4,118.00	3,979.00
Neimar Pissaia	Market swine - finisher	115.00	7,543.00	1,600.00
Renato Baccin	Market swine - finisher	115.00	12,696.00	4,000.00

For the ex-ante emission reductions calculation, the average animal weight used at the project site (W_{site}) was obtained preferably from third party information (such as documents from integrators or State Agricultural agencies) or from on site measurements. The sources of data will used during the project crediting period to monitor this parameter are described on Section 4.2.

3.2 Project Emissions

According to the methodology AMS-III.F., version 10, the project activity emissions consist of:

(i). CO_2 emissions due to the incremental transportation distances;

(ii). CO_2 emissions from electricity and/or fossil fuel consumption by the project activity facilities;

(iii). methane emissions during composting process;

(iv). methane emissions from runoff water; and

(v). methane emissions due to compost storage.

The equation for project emission calculation is:

$$PE_y = PE_{y,transp} + PE_{y,power} + PE_{y,comp} + PE_{y,runoff} + PE_{y,res\ waste}$$

Equation 5

Where:

PE_y	- Project activity emissions in the year *y* (tCO_2e)
$PE_{y,\ transp}$	- Emissions from incremental transportation in the year *y* (tCO_2e)
$PE_{y,power}$	- Emissions from electricity or fossil fuel consumption in the year y (tCO_2e)
$PE_{y,comp}$	- Methane emissions during composting process in the year y (tCO_2e)
$PE_{y,runoff}$	- Methane emissions from runoff water in the year y (tCO2e)
$PE_{y,res\ waste}$	- In case produced compost is subjected to anaerobic storage or disposed in a landfill: methane emissions from the anaerobic decay of the residual organic content (tCO_2e)

Among the project emissions listed by the methodology AMS-III.F., version 10, the proposed project activity will not produce emissions referring to the consumption of fossil fuels, emissions due to the incremental transportation distances, emissions due to the runoff water and emissions related to compost storage. This is justified by the following:

- ✓ There will be no fossil fuel consumption by the equipments installed as part of the project; the project will not result in additional transportation of waste or compost.
- ✓ The project results in a significant reduction in the volume of treated manure, since the composting process evaporates most of the water content on the treated manure. This reduction in volume also reduces associated consumption of fossil fuels for its transportation until final destination;
- ✓ The mechanized composting units are automated and designed not apply excessive wastes on the substrate. Also, the sheds are covered, avoiding rainwater percolation onto the substrate. Any runoff water is recirculated into the composting mass;
- ✓ Finally, the compost will not be stored in anaerobic conditions nor sent to landfills. Thus, the equation to be applied to determine the project activity emissions takes the following structure:

$$PE_y = PE_{y,power} + PE_{y,comp}$$

Equation 6

Emissions from grid electricity consumed by the project are determined according to the Tool to calculate baseline, project and/or leakage emissions from electricity consumption, version 01[41]. Emissions from electricity are hence the product of energy consumed and the CO_2 emission factor of the grid.

$$PE_{y,power} = \sum_j \mathrm{EC}_{\mathrm{PJ,j,y}} \times \mathrm{EF}_{\mathrm{EL,j,y}} \times (1 + \mathrm{TDL}_{\mathrm{j,y}})$$

Equation 7

Where:

$EC_{PJ,j,y,}$ - Quantity of electricity consumed by the project electricity consumption source j in year y (MWh/yr)

$EF_{EL,j,y}$ - Emission factor for electricity generation for source j in year y (tCO_2/MWh)

$TDL_{j,y}$ - Average technical transmission and distribution losses for providing electricity to source j in year y

Therefore, $PE_{y,power}$ (as defined on Equation 6, above) is equal to $PE_{EC,y}$ as provided by the referred tool. Please note that in Equation 7 the term $PE_{EC,y}$ was replaced by $PE_{y,power}$ to ensure consistency with the applied methodology. The quantity of electricity consumed by the project activity on each farm ($EC_{PJ,j,y}$) is determined considering the combined power capacity of the all equipments in the mechanized composting unit and a conservative estimate on the time of operation of each equipment, as explained on Section 2.6.

[41] Tool available at: <http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-v1.pdf>. Last visited on 25/01/2012.

All farms included in the project consume electricity exclusively from the grid. Grid emission factors shall be determined with Tool to calculate baseline, project and/or leakage emissions from electricity consumption, version 01. According to Table III.F.1, paragraph 27 of methodology AMS-III.F., version 10, $TDL_{j,y}$ is defined as 10%.

Emission factor for electricity generation is determined using Option A1 of the referred tool. The emission factor of the grid was calculated by the Brazilian Designated National Authority (Interministerial Commission on Global Climate Change - *Comissão Interministerial de Mudança Global do Clima* - CIMGC), as the Combined Margin (CM) which consists of combining the Operating Margin (OM) and the Build Margin (BM), which is in accordance with procedures described in version 17 of AMS-III.D, paragraph 12 (a). The calculated emission factors are available at:

<http://www.mct.gov.br/index.php/content/view/307492.html>

The most recent emission factor available at the beginning of validation was for year 2011,equal to 0.1988 tCO_2/MWh. This value was adopted for the ex-ante calculations of $PE_{y,power}$ expected for the project activity during the credits period. However, this value will be monitored and updated yearly during the crediting period according to the most recent data available at the time of the verification process.

(i) Methane emissions during composting process in the year *y* (tCO_2e)

The methane emissions during composting process ($PE_{y,comp}$) are determined according with Equation 8 below:

$$PE_{y,comp} = Q_y * EF_{composting} * GWP\_CH_4$$

Equation 8

Where:

Q_y - Quantity of raw waste/manure treated in the year y (tonnes).

$EF_{composting}$ - Emission factor for composting of manure (t CH_4/ton waste treated). Emission factors can be based on site measurements, country specific values or IPCC default values (table 4.1, chapter 4, Volume 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories). IPCC default values are 10 g CH_4/kg waste treated on a dry basis and 4g CH_4/kg waste treated on a wet basis. $EF_{composting}$ can be set zero in case the monitored oxygen content during of the composting process within the windrow is above 8%.

For the ex-ante calculation of emission reductions, $EF_{composting}$ is considered as 4g CH_4/Kg of waste treated on a wet basis, sourced from 2006 IPCC as referred in the methodology. This approach is taken since the level of oxygen in the composting windrows will not be monitored. For the ex-ante calculation of emission reductions, the quantity of raw manure treated per year (Q_y) was estimated with default values taken from literature on swine manure management[42]. During the project operation the amount of raw waste treated (Q_y), will be monitored as described in Section 4 and the same emission factor ($EF_{composting}$) will be adopted.

[42] OLIVEIRA, P.A.V. *Produção e Manejo de Dejetos de Suínos*, available at: <http://www.cnpsa.embrapa.br/pnma/pdf_doc/8-PauloArmando_Producao.pdf>. Last visit on 22/03/2012. Values described on the third column of Table 1.

Table 9. Parameters used to calculate ex-ante project emissions.

Farm owner	Quantity of raw manure treated in the year y (tonnes)	Emission factor for composting manure (g CH_4/Kg waste composted)	Electricity consumption for the operation of the project AWMS (MWh)	Grid emission factor (tCO_2/MWh)
Adelmo Pickler	1,488.03	4	11.11	0.1988
Airton Piovezan	1,516.65	4	10.89	0.1988
Altenor José Basso	4,355.00	4	17.35	0.1988
Antônio Carlos Ramela	3,135.24	4	14.49	0.1988
Belmiro Secco	3,018.99	4	16.18	0.1988
Dario Marcos Zuffo	1,951.25	4	10.60	0.1988
Diacir Coradi	3,174.59	4	22.40	0.1988
Selvino Andreta	3,425.65	4	16.54	0.1988
Gilmar José Sinigaglia	1,488.03	4	11.11	0.1988
Jair da Silva	1,627.48	4	13.36	0.1988
Nóbile Tomazi	7,116.44	4	29.70	0.1988
Neimar Pissaia	2,861.60	4	20.05	0.1988
Renato Baccin	7,154.00	4	26.45	0.1988

3.3 Leakage

Since the project does not involve equipment transference from another activity, there is no leakage to be considered, according to methodology AMS-III.F., version 10.

3.4 Net GHG Emission Reductions and Removals

According methodology AMS-III.F., version 10, the emission reductions achieved by the project activities are calculated as the difference between the baseline emissions and the project emissions.

$$ER_y = BE_y - PE_y$$

Equation 9

ER_y - Emission reduction in year y (tCO_2e)

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals[43] (tCO_2e)
2011	9,147	1,905	0	7,241
2012	15,022	3,263	0	11,758
2013	17,112	3,707	0	13,405
2014	17,112	3,707	0	13,405
2015	17,112	3,707	0	13,405
2016	17,112	3,707	0	13,405
2017	17,112	3,707	0	13,405
2018	17,112	3,707	0	13,405
2019	17,112	3,707	0	13,405
2020	17,112	3,707	0	13,405
Total	**161,065**	**34,824**	**0**	**126,239**

The major uncertainties regarding the estimation of emission reductions are related to the quantification of project emissions, since farmers did not monitor some of parameters involved, such as the quantity of electricity consumed by the project (parameter $EC_{PJ,j,y}$) and the quantity of raw manure treated (Q_y). To deal with these uncertainties, Project Proponents have chosen conservative approaches in order to avoid overestimating emission reductions.

The calculation of baseline emissions is based on site specific parameters and on default values. To minimize uncertainties, Project Proponents have based site specific parameters on third party information to the extent possible. The use of third party information minimizes the risks that farmers or Project Proponents manipulate data on animal production to account for higher baseline emissions. Default values have been chosen from recognized sources, such as the IPCC and Embrapa (Brazilian Agricultural Research Corporation), thus minimizing the risk of using inconsistent values.

4 MONITORING

4.1 Data and Parameters Available at Validation

Data Unit / Parameter:	**Annual average temperature**
Data unit:	ºC
Description:	Annual average temperature at project site
Source of data:	National Institute of Meteorology (Instituto Nacional de

[43] Emission reductions have been rounded down as calculated on each farm. A summary of emission reductions on each farm ins available in Annex 1 of this VCS PD, Table 1B.

	Meteorologia – INMET).
Value applied:	18ºC
Justification of choice of data or description of measurement methods and procedures applied:	The annual average temperature at western region of Santa Catarina State was determined according the data available by INMET as shown respectively in FIGURE 2.
Purpose of data	This parameter is used to determine the appropriate value of MCF_j for the project sites.
Any comment:	

Data Unit / Parameter:	GWP_{CH4}
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential of CH_4
Source of data:	Methodology AMS-III.D., version 18
Value applied:	21
Justification of choice of data or description of measurement methods and procedures applied:	This value is indicated in version 18 of AMS-III.D. It should be updated according to the future decisions of COP/MOP.
Purpose of data	This parameter is used to convert methane emissions to tCO_2e.
Comments:	

Data Unit / Parameter:	DCH_4
Data unit:	t/m^3
Description:	Density of CH_4
Source of data:	Methodology AMS-III.D., version 18
Value applied:	0.00067 at room temperature (20ºC) and 1 atm pressure
Justification of choice of data or description of measurement methods and procedures applied:	Value proposed by the methodology.
Purpose of data	This parameter is used to convert estimated methane emissions from cubic meters to tonnes
Comments:	

Data Unit / Parameter:	***UF_b***
Data unit:	Fraction
Description:	Correction factor to account for model uncertainties.
Source of data:	Methodology AMS-III.D., version 18
Value applied:	0.94
Justification of choice of data or description of measurement methods and procedures applied:	Value proposed by the methodology.
Purpose of data	Correction factor to account for model uncertainties on the calculation of emission reductions.
Comments:	

Data Unit / Parameter:	***MCF_j***
Data unit:	Fraction
Description:	Annual methane conversion factor for the baseline animal manure management system *j*.
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 4, chapter 10, table 10.17.
Value applied:	Uncovered anaerobic lagoons:77%
Justification of choice of data or description of measurement methods and procedures applied:	The value of methane conversion factor of 77% for anaerobic lagoons was determined according to the Table 10.17 considering the annual average temperature at the region where project is being developed of 18ºC (Figure 2).
Purpose of data	This parameter is used to calculate baseline methane emissions from the treatment of animal manure in anaerobic treatment systems
Comments:	

Data Unit / Parameter:	***$B_{0,LT}$***
Data unit:	m³ CH_4/kg dm
Description:	Maximum methane producing potential of the volatile solid generated for animal type *LT.*
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 4, chapter 10, table 10.A-7 and 10A-8.
Value applied:	0.29 for market swine and 0.45 for breeding swine. Values for Latin America are used for market swine and for Western Europe are used for breeding swine, since farrowing farms

	comply with all conditions of paragraph 10 (d) of AMS-III.D, version 18.
Justification of choice of data or description of measurement methods and procedures applied:	Brazil does not have published data of the maximum methane producing potential from manure. Hence, default values sourced from 2006 IPCC were applied.
Purpose of data	This parameter is used calculate baseline emissions by determining potential methane emissions from the amount of volatile solids generated for each animal type
Comments:	Compliance with all conditions described in paragraph 10 (d) of AMS-III.D version 18 is found in both Farrowing farms included in the project. Hence, the use of default values from developed countries is allowed.

Data Unit / Parameter:	$MS\%_{0BL,j}$
Data unit:	%
Description:	Fraction of manure handled in baseline animal manure management system *j*
Source of data:	Project proponent.
Value applied:	100%
Justification of choice of data or description of measurement methods and procedures applied:	All waste was sent to the baseline treatment system (anaerobic lagoons) prior to the project initiation in the Brownfield farms. This is considered the baseline scenario for Greenfield farms, since it is the common practice in the region.
Purpose of data	This parameter is used calculate baseline emissions by determining the fraction of manure that is handled on each treatment system considered
Comments:	

Data Unit / Parameter:	$W_{default}$
Data unit:	kg
Description:	Default average animal weight of a defined population
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 4, chapter 10, tables 10A-7 and 10A-8.
Value applied:	28 for market swine and 198 for breeding swine. Values for Latin America are used for market swine and for Western Europe are used for breeding swine, since farrowing farms comply with all conditions of paragraph 10 (d) of AMS-III.D,

	version 18.
Justification of choice of data or description of measurement methods and procedures applied:	Default average animal weight sourced from 2006 IPCC were used.
Purpose of data	This parameter is used calculate baseline emissions by providing parameters to estimate the amount of volatile solid excretion rate for each animal type according to average animal weight.
Comments:	Compliance with all conditions described in paragraph 10 (d) of AMS-III.D version 18 is found in both Farrowing farms included in the project. Hence, the use of default values from developed countries is allowed.

Data Unit / Parameter:	$VS_{default}$
Data unit:	Kg dm/animal/day
Description:	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories, volume 4, chapter 10, tables 10A-7 and 10A-8.
Value applied:	The following values are applied: 0.46 for breeding swine (Western Europe default value) 0.3 for market swine (Latin America default value) The exact value used for each farm is available on the individual emission reduction estimation spreadsheets of each farm.
Justification of choice of data or description of measurement methods and procedures applied:	Brazil does not have published data of the volatile solid excretion rate by animal type. Hence, default values sourced from 2006 IPCC were applied. Values for Latin America are used for market swine and for Western Europe are used for breeding swine, since farrowing farms comply with all conditions of paragraph 10 (d) of AMS-III.D, version 18. Hence, the use of default values from developed countries is allowed.
Purpose of data	This parameter is used calculate baseline emissions by providing parameters to estimate the amount of volatile solid excretion rate for each animal type according to average animal weight.
Comments:	Compliance with all conditions described in paragraph 10 (d) of AMS-III.D version 18 is found in both Farrowing farms included in the project. Hence, the use of default values from developed countries is allowed.

Data Unit / Parameter:	***$EF_{composting}$***
Data unit:	g CH_4/kg ton waste treated on a wet basis.
Description:	Emission factor for composting of manure
Source of data:	IPCC (table 4.1, chapter 4, Volume 5, 2006 IPCC Guidelines for National Greenhouse Gas Inventories)
Value applied:	4
Justification of choice of data or description of measurement methods and procedures applied:	This emission factor is described in the applied methodology to calculate methane emissions from composting
Purpose of data	This parameter is used calculate project emissions from composting. It is a default value that provides composting emissions from the amount of waste composted per year
Comments:	

Data Unit / Parameter:	$TDL_{j,y}$
Data unit:	Percentage
Description:	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data:	Approved methodogy AMS-III.F, version 10.
Value applied:	10%
Justification of choice of data or description of measurement methods and procedures applied:	This value is recommended by the applied methodology, as described on Table III.F.1.
Purpose of data	This parameter is used calculate project emissions from electricity consumption taking in consideration expected transmission and distribution losses.
Comments:	

Data Unit / Parameter:	MD
Data unit:	Kg/m³
Description:	Manure density
Source of data:	OLIVEIRA, P.A.V. *Produção e Manejo de Dejetos de Suínos*. Available at: <http://www.cnpsa.embrapa.br/pnma/pdf_doc/8-PauloArmando_Producao.pdf>. Last visit on 28/11/2013.

	Value described on Table 15.
Value applied:	1,016
Justification of choice of data or description of measurement methods and procedures applied:	A density of 1,016 kg per m³ was chosen from a publication of an EMBRAPA researcher (Mr. Paulo Armando V. de Oliveira). Such density is expected for swine manure with 3% of solid matter, which is the expected value for the farms included in the project[44].
Purpose of data	This value is used to convert monitored values of Qy (Quantity of manure treated in the year *y*) from volume to weight.
Comments:	More information on the calculation of QY is available on Section 4.2.

4.2 Data and Parameters Monitored

Data Unit / Parameter:	$VS_{LT,y}$
Data unit:	kg dm/animal/year
Description:	Volatile solids for livestock *LT* entering the animal manure management system in year *y.*
Source of data:	- IPCC default value from: 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9; - W_{site}: Farmers, based on documents provides by the integrators, State Agencies or internal documents.
Description of measurement methods and procedures to be applied:	The value of 2006 IPCC will be applied ($W_{default}$ and *VS*); however they will be adjusted considering the weight of animals in the project sites (W_{site}). The Parameter W_{site} will be monitored as described in this Section 4.2.
Frequency of monitoring/recording:	Annually
Value applied:	Values applied are available in Annex 1 - Table 1A.
Monitoring equipment:	No monitoring equipment is used. Since this is a default value from IPCC, it is not possible to quantify the accuracy. However, the correction of this parameter with W_{site} will ensure values are consistent to the project situation.
QA/QC procedures to be applied:	This parameter shall be calculated with monitored data on ndy and Wsite. QA/QC procedures for these parameters are described on Pages 49 and 50.
Purpose of data	This parameter is used to calculate baseline methane emissions from animal manure treatment
Calculation method:	Calculated through Equation 3 of the VCS PD, considering the average animal weight at the project site (W_{site}), the

[44] This value is used by LPC Tecnologia Ambiental on the Technical Project of the composting unit. Hence, it is considered applicable to the farms conditions.

	default average animal weight ($W_{default}$) according to 2006 IPCC, the default value of volatile solid excretion rate ($VS_{default}$) also according to 2006 IPCC and the number of days the system is operational during year *y* (nd_y).
Comments:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	nd_y
Data unit:	Days
Description:	Number of days in year *y* where the animal manure management system is operational.
Source of data:	Project proponent
Description of measurement methods and procedures to be applied:	The number of days the manure management system is operational is obtained either from monitoring spreadsheets where farmers record operating time of the composting unit or from third party information (such as documents from integrators or State Agricultural agencies). The treatment plan is considered to be operational whenever manure is applied and/or the composting windrows are mixed with substrate to produce compost. In case third party information is used, nd_y will be considered as the number of days where animals are alive in the farm (parameter $N_{da,y}$), since farmers need to operate the composting unit on a daily basis when animals confined in the farms
Frequency of monitoring/recording:	Annually based on daily records (monitoring spreadsheets) or monthly records (third party information regarding $N_{da,y}$)
Value applied:	365
Monitoring equipment:	No equipment is used to monitor this parameter. Farmer shall fill in paper spreadsheets or store third party information regarding animal confinement to monitor this parameter
QA/QC procedures to be applied:	Farmers were trained for the monitoring of this parameter. Monitoring spreadsheets shall be cross checked with third party information to assess possible errors.
Purpose of data	This parameter is used to calculate baseline methane emissions from animal manure treatment. It is also used to determine the quantity of manure treated in the year *y*
Calculation method:	Counting days in the years where monitoring data indicates the manure management system was operational on each farm.
Comments:	The considered baseline system is anaerobic lagoons. This system operates during 365 days/year. Hence, nd_y for the baseline is considered as 365. Both the baseline and the project treatment systems are operational for 365 days, as manure is stored and treated by bacterial activity during 365 days of the year. These systems are never subject to maintenance or emptied for other

	reasons. Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	W_{site}
Data unit:	kg
Description:	Average animal weight of a defined livestock population at the project site (kg)
Source of data:	Project proponent
Description of measurement methods and procedures to be applied:	The average animal weight by type applied for project activity will be obtained from the following sources (in a order of preference): 1. Third party information (such as documents from integrators or State Agricultural agencies) 2. Onsite measurements 3. Other farms included in the Project that have similar production conditions 4. Conservative default values given the project conditions.
Frequency of monitoring/recording:	Periodic records provided by integrators for each batch. Integrators provide documents for each batch, as described above in section 3.1. Thus, animal weight controls do not follow an annual schedule; instead they are based on each batch period.
Value applied:	Values applied are available in Annex 1.- Table 1A.
Monitoring equipment:	No monitoring equipment is used. Animal weight is usually measured by integrators for commercial purposes (to determine due financial compensations for farmers). Therefore, although it is not feasible to quantify accuracy, a high level of accuracy is expected.
QA/QC procedures to be applied:	Control forms and registration documents provided by the third parties (integrators, State Agencies, etc) are considered reliable sources, once data are used for financial purposes. Sustainable Carbon - Projetos Ambientais Ltda will keep a database with the information provided for each farm.
Purpose of data	This parameter is used to calculate baseline methane emissions from animal manure treatment
Calculation method:	Calculated based in the difference of the date of input and output of the animals in each farm.
Comments:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project

	activity, whichever occurs later.

Data Unit / Parameter:	$N_{da,y}$
Data unit:	Days
Description:	Number of days animal is alive in the farm in the year *y*
Source of data:	Project proponent
Description of measurement methods and procedures to be applied:	Market swine: this parameter will be monitored using internal registries from farmers or third parties (integrators, State Agencies, etc) regarding input and output data of the animals in each farm. Breeding swine: the value considered to this parameter will be 365 days per year, once the animals stay in the farm during the whole year.
Frequency of monitoring/recording:	Periodic records provided by integrators for each batch.
Value applied:	Values applied for the calculation of ex-ante emission reductions are available on Table 8.
Monitoring equipment:	No monitoring equipment is used. This parameter is usually based on third party information, such as documents from integrators and State Agencies. Therefore, although it is not feasible to quantify accuracy, a high level of accuracy is expected.
QA/QC procedures to be applied:	Control forms and registration documents provided by the third parties (integrators, State Agencies, etc) are considered reliable sources, once data are used for financial purposes. Sustainable Carbon - Projetos Ambientais Ltda will keep a database with the information provided for each farm.
Purpose of data	This parameter is used to calculate baseline methane emissions from animal manure treatment
Calculation method:	Calculated based in the difference of the date of input and output of the animals in each farm.
Comments:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	$N_{p,y}$
Data unit:	Number

Description:	Number of animals produced annually of type *LT* for the year *y*
Source of data:	Project proponent
Description of measurement methods and procedures to be applied:	Market swine: this parameter will be monitored using internal registries from farmers or third parties (integrators, State Agencies, etc) regarding input and output data of the animals in each farm. Breeding swine: this parameter will be monitored using internal registries from farmers. The number of animals produced is considered the annual average.
Frequency of monitoring/recording:	Periodic records provided by integrators for each batch.
Value applied:	Values applied for the calculation of ex-ante emission reductions are available on Table 8.
Monitoring equipment:	No monitoring equipment is used. This parameter is usually based on third party information, such as documents from integrators and State Agencies. Therefore, although it is not feasible to quantify accuracy, a high level of accuracy is expected.
QA/QC procedures to be applied:	Control forms and registration documents provided by the third parties (integrators, STATE Agencies, etc) are considered reliable sources, once data are used to financial purposes. Sustainable Carbon - Projetos Ambientais Ltda will keep a database with the information provided for each farm.
Purpose of data	This parameter is used to calculate baseline methane emissions from animal manure treatment.
Calculation method:	Total of animals produced in a year or in a determined period of time is in the Section 3.1 of the VCS PD.
Comments:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	$N_{LT,y}$
Data unit:	Number
Description:	Annual average number of animals of type *LT* in year *y*
Source of data:	Project proponents
Description of measurement methods and procedures to be applied:	This parameter will be monitored based on the parameters $N_{da,y}$ and $N_{p,y}$ described above.

Frequency of monitoring/recording:	Annually, based on periodic records.
Value applied:	Values applied for the calculation of ex-ante emission reductions are available on Table 8.
Monitoring equipment:	No monitoring equipment is used. This parameter is calculated based on third party information, such as documents from integrators and State Agencies. Therefore, although it is not feasible to quantify accuracy, a high level of accuracy is expected.
QA/QC procedures to be applied:	The swine farmers will be responsible for storing data regarding animal production, such as control forms and registration documents provided by the integrators. Sustainable Carbon - Projetos Ambientais Ltda will keep a database with the information provided for each farm.
Purpose of data	This parameter is used to calculate baseline methane emissions from animal manure treatment. It is also used to determine the quantity of manure treated in the year *y*.
Calculation method:	The annual average number of animals of type *LT* will be calculated using Equation 4 of the VCS PD considering the number of days animals is alive in the farm ($N_{da,y}$) and the total number of animals produced ($N_{p,y}$) in year y. The annual average number of animals ($N_{LT,y}$) will be calculated by Sustainable Carbon technical team, who will manage the Project monitoring database.
Comments:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	$Q_{y,treatment}$
Data unit:	Tonnes
Description:	Quantity of compost produced in year *y*
Source of data:	Project proponents
Description of measurement methods and procedures to be applied:	Farmers shall monitor the amount of compost produced per year using spreadsheets. Compost will be measured using storage bags with predefined volume or weight. Farmer shall measure the amount of storage bags every time compost is used or sold and record the volume or weight capacity of each storage bag being used.
Frequency of monitoring/recording:	Annually, based on monthly records.
Value applied:	This parameter is not used in the ex-ante calculation of

	emission reductions
Monitoring equipment:	Storage bags with predefined weight or volume. The indirect measurement procedure chosen to monitor this parameter is expected to result in low levels of accuracy for the determination of this parameter. However, procedures with higher precision are not feasible to apply given the farmers reality. Also, no project emissions from the produced compost are expected. Hence, the low accuracy is not expected to affect the calculation of emission reductions during the crediting period.
QA/QC procedures to be applied:	Farmers were trained on the project monitoring to allow more precision in the determination of this parameter.
Purpose of the data	This parameter is monitored as requested by the applied methodology. However, since compost is not subject to anaerobic treatment or disposal, no emissions are associated to the amount of compost produced.
Calculation method:	Total of compost produced in a year will be the sum of all monitoring records regarding the final destination (usage, sale, etc.) of compost
Comments:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	$EC_{PJ,j,y}$
Data unit:	MWh
Description:	Quantity of electricity consumed by the project electricity consumption source j in year y
Source of data:	Project proponents
Description of measurement methods and procedures to be applied:	Farmers shall record the frequency of operation of the manure pumps and of the mixing equipment in spreadsheets on a daily basis. This shall be done to monitor the exact time when they turn these equipments on and off, thus allowing Sustainable Carbon to calculate the time of operation of each equipment. In case monitoring data is incomplete, a conservative estimate based on LPC judgment on the expected time of operation of the manure pump and the UMAC equipment corrected with the use of a conservative factor of 125% shall be used. This value will be used as long as it is considered conservative given the farms management processes and its energy consumption pattern.

Frequency of monitoring/recording:	Daily
Value applied:	Values applied for the calculation of ex-ante emission reductions are available on Table 9.
Monitoring equipment:	No equipment is used to monitor this parameter. Monitoring is based on spreadsheets which are manually filled by farmers. The indirect measurement procedure chosen to monitor this parameter is expected to result in low levels of accuracy for the determination of this parameter. However, procedures with higher precision are not feasible to apply given the farmers reality. Project emissions from electricity are expected to be quite low compared to emission reductions (around 1%). Hence, the low accuracy is not expected to significantly affect the calculation of emission reductions during the crediting period.
QA/QC procedures to be applied:	Farmers were trained to ensure this parameter is correctly monitored. Sustainable Carbon shall manage the project database and check possible errors. Estimated values shall only be applied if it is possible to determine that their use result in a conservative calculation of emission reduction. In case monitoring data for this parameter is incomplete, estimated values shall be compared either to existing data of the same farm (for different periods of time) or to data from other farms with similar operating conditions. Such comparison will be made to assess if the use of estimated values is conservative. Estimated values are presented in Annex 2 of this document.
Purpose of data	This parameter is used to calculate project emissions from electricity consumption.
Calculation method:	Farmers shall record the exact time they turn the mixing equipment and the manure pump on and off, to allow a calculation of the frequency of operation and total time of operation of these equipments. The total electricity consumption will be estimated as total time of operation multiplied by the nominal electricity consumption of each equipment. In case monitored data is incomplete, conservative estimated values will be applied. Values are described in Annex 2.
Comments:	Currently, electricity is measured for the whole farm, which includes several components that are not within the project boundary. This monitoring approach has been chosen since it is not feasible to measure the electricity consumption separately for the operation of the project AWMS. This would require installing equipments and making changes to

	electricity systems on the farm, which are costly. Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	$EF_{EL,j,y}$
Data unit:	tCO_2/MWh
Description:	Emission factor for electricity generation for source j in year y (tCO_2/MWh)
Source of data:	Brazilian DNA - CIMGC[45]
Description of measurement methods and procedures to be applied:	Sustainable Carbon – Projetos Ambientais Ltda will be responsible to archive data regarding the emission factor of the grid available in the CIMGC website.
Frequency of monitoring/recording:	Annually
Value applied:	0.1988
Monitoring equipment:	No monitoring equipment is used. As this parameter is calculated by the Brazilian Designated National Authority following CDM methodologies, it is expected to have a high level of accuracy.
QA/QC procedures to be applied:	The grid emission factor will be obtained directly from the CIMGC website. No QA/QC procedures are applied to this parameter.
Purpose of data	This parameter is used to calculate project emissions from electricity consumption.
Calculation method:	Emission factor is calculated by the Brazilian DNA according to current CDM tools and guidelines. More information on the calculation method of the grid emission factor is available at: <http://www.mct.gov.br/index.php/content/view/73318.html>
Comments:	All farms included in the project use exclusively electricity from the Brazilian Interconnected System. Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	Q_y
Data unit:	Tonnes (wet basis)

[45] Interministerial Committee of Global Climate Change (*Comissão Interministerial de Mudança Global do Clima – CIMGG*), Brazilian DNA.

Description:	Quantity of manure treated in the year *y*
Source of data:	Farmers
Description of measurement methods and procedures to be applied:	The amount of waste produced will be monitored by registering the operating hours of the pump which destine the manure from the storage tank to the composting unit. Spreadsheets will be used to record information on time of operation of manure pumps. Digital hour meters might be installed in specific farms during the project operation to automatically register this information. Defaults values of animal waste production shall be used to calculate quantity of manure treated (Q_y) in case monitoring data is incomplete. Default values used shall be consistent with the farms manure management techniques and shall only be applied if it is possible to determine that their use result in a conservative calculation of emission reduction. In case monitoring data for this parameter is incomplete, default values shall be compared either to existing data of the same farm (for different periods of time) or to data from other farms with similar operating conditions. Such comparison will be made to assess if the use of default values is conservative. In case monitoring data is incomplete and the use of default values cannot considered conservative, no emission reductions shall be claimed for the periods of time where monitoring data is incomplete.
Frequency of monitoring/recording:	Annually, based on monthly records
Value applied:	Values applied for the calculation of ex-ante emission reductions are available on Table 9.
Monitoring equipment:	Digital hour meter or data loggers might be installed. Initially, manual recording in spreadsheets will be used. . The indirect measurement procedure chosen to monitor this parameter is expected to result in low levels of accuracy for the determination of this parameter. However, procedures with higher precision are not feasible to apply given the farmers reality. The installation of hour meters or data loggers to record information automatically will increase accuracy, but this will only be possible in a near future. This parameter might also be calculated with default values of animal waste production that were considered by LPC in the design of the composting units. Hence, they are expected to be consistent with the farms manure management techniques. Please see calculation method below for more information.

QA/QC procedures to be applied:	Default values shall only be applied if it is possible to determine that their use result in a conservative calculation of emission reduction. In case monitoring data for this parameter is incomplete, default values shall be compared either to existing data of the same farm (for different periods of time) or to data from other farms with similar operating conditions. Such comparison will be made to assess if the use of default values is conservative. In case monitoring data is incomplete and the use of default values cannot considered conservative, no emission reductions shall be claimed for the periods of time where monitoring data is incomplete. Default values used are based in FATMA normative and specific literature and were also used by LPC in the design of the composting units. Values are described below, under "calculation method".
Purpose of data	This parameter is used to calculate project emissions from composting
Calculation method:	The amount of waste (in wet basis) is determined by the nominal flow rate of the pump multiplied by the time of operation, as monitored by the farmers with either manual spreadsheets, hour meters or data loggers. Thus, the value is estimated in liters and will be converted to weight, using a default value for the density of the waste. This parameter will also be corrected to discount water that is flushed to the composting site. Therefore, Q_y will be expressed by the following equation: $Qy = P_{NF} * P_{TO,y} * MD * 0.7$ Where: P_{NF} – Pump nominal flow (m³/hour) $P_{TO,y}$ – Pump time of operation in year y (hours) MD – Manure density (tonnes/m³) 0.7 – Fraction of waste from confinement that is manure In case monitored data is incomplete, the following EMBRAPA default values[46] shall be used: <table><tr><th>Animal</th><th>Average daily production of swine manure (manure and urine, in kg)</th></tr><tr><td>**Swine weight from 25 to 100**</td><td>4.90</td></tr></table>

[46] OLIVEIRA, P.A.V. *Produção e Manejo de Dejetos de Suínos*, available at: <http://www.cnpsa.embrapa.br/pnma/pdf_doc/8-PauloArmando_Producao.pdf>. Last visit on 28/11/2013. Values described on the third column of Table 1.

<table>
<tr><td></td><td>
<table>
<tr><td>kg</td><td></td></tr>
<tr><td>Sows in gestation</td><td>11.00</td></tr>
<tr><td>Sows</td><td>18.00</td></tr>
<tr><td>Boars</td><td>6.00</td></tr>
<tr><td>Nursery</td><td>0.95</td></tr>
<tr><td>Average</td><td>5.80</td></tr>
</table>
In case these values are used, they shall be multiplied by the annual average number of animals of each type and the number of days in year y where the animal manure management system was operational to obtain the quantity of manure treated in the year y .</td></tr>
<tr><td>Comments:</td><td>EMBRAPA publication indicates wastes from swine confinements are composed of dung, urine and flushed water. Swine manure (both dung and urine) consist of nearly 70% of total wastes (4.9kg out of 7 litters, or 7.112 kg considering a density of 1.016 kg per liter). Such density is expected for swine manure with 3% of solid matter, which is the expected value for the farms included in the project[47].

The predicted value of manure and urine to be processed by the LPC equipment is 7 litres of liquid waste, following Embrapa reference values..

The amount of wash water will not be considered as it does not present organic matter and does not result in methane emissions. This approach is considered appropriate, given that the UNFCCC Methodological Tool "Project and leakage emissions from composting” [48] provides the following information:

(i) Composting converts biodegradable organic carbon to mostly carbon dioxide (CO_2) and a residue (compost) that can be used as a fertilizer. Other outputs from composting can include, inter alia, methane (CH_4), nitrous oxide (N_2O), and run-off wastewater (in case of co-composting). Therefore, emissions from composting are only expected for the degradation of biodegradable organic carbon.

(ii) Even in cases of co-composting (a type of composting where solid wastes and wastewater are composted together), wastewater should not be accounted for the estimation of</td></tr>
</table>

[47] This value is used by LPC Tecnologia Ambiental on the Technical Project of the composting unit. Hence, it is considered applicable to the farms conditions.

[48] Available at: http://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-13-v1.pdf. Last visited on 08/08/2013

	Qy,. The current project does not involve co-composting. Instead, the project involves the composting of animal manure diluted with wash water from the barns. Such water does not contain organic carbon and, therefore, should not result in project emissions from composting. Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	**Conditions of the composting process**
Data unit:	ºC for temperature; moisture level (qualitative analysis), ranging from very humid to very dry; Frequency of time for operation of the mixing equipment.
Description:	Conditions of the composting process include monitoring the following parameters: temperature and moisture of the composting mass and frequency of operation of the mixing equipment
Source of data:	Project developers
Description of measurement methods and procedures to be applied:	Farmers shall follow technical recommendations from LPC to ensure composting is operated according to a quality control program. Farmers shall periodically monitor the temperature and moisture of the composting mass in the composting windrows, as well as record the frequency of operation of the UMAC equipment, which mixes the composting mass. Farmers shall take notes of the measurements on manual spreadsheets (paper copies).
Frequency of monitoring/recording:	Temperature and moisture shall be measured every 15 days. Frequency of operation of the composting equipment will be monitored on a daily basis.
Value applied:	Not applied for the calculations
Monitoring equipment:	Thermometers and moisture meters. Measurement accuracy is expected to be high (above 90%), given the technical specification of the equipments and the fact that farmers were trained for the measurement of these parameters.
QA/QC procedures to be applied:	Farmers will perform the measurement of the temperature and moisture of the composting mass using thermometers and moisture meters. Sustainable Carbon will control the database of the project (spreadsheet, measurements, etc.) LPC will give support on how control the moisture of the composting process. The moisture of the composting mass

	will be monitored by each farmer using visual inspections to check whether the composting mass is too dry (crumbling in the hand), or too wet (dripping liquid). In addition, a moisture meter will be used to indicate the level of moisture in the composting mass. Farmers were trained to ensure these parameters are correctly measured. Farmers shall be instructed to contact LPC for assistance in case the temperature or moisture of the composting mass is outside desired ranges.
Purpose of data	This parameter is monitored as requested by the applied methodology. However, it is not used for the calculation of emission reductions.
Calculation method:	Thermometers and moisture meters provide direct measurement of these parameters. Farmers shall record the exact time they turn the mixing equipment on and off to allow a calculation of the frequency of operation and total time of operation of this equipment.
Comments:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

Data Unit / Parameter:	**Soil application of the compost for agricultural purposes**
Data unit:	Numerical frequency
Description:	Count of compost removal from the treatment system and description of soil application.
Source of data:	Project proponents
Description of measurement methods and procedures to be applied:	The swine farmers will control the final destination of the compost (control of sales, consumer records, distance, etc) using a spreadsheet developed by Sustainable Carbon. Farmers will also provide to the buyers of the compost a guidance explaining how to properly apply the compost into the soil, to avoid methane emissions.
Frequency of monitoring/recording:	Annually, based on monthly records
Value applied:	Not applied for the calculation of emission reductions. It is assumed all compost is applied in a manner to avoid methane emissions.
Monitoring equipment:	No monitoring equipment is used. The indirect monitoring procedure chosen for this parameter is expected to result in medium to low levels of accuracy for the determination of this parameter. However, procedures with higher precision are not feasible to apply given the farmers reality. Also, no

	project emissions from the produced compost are expected. Hence, the low accuracy is not expected to affect the calculation of emission reductions during the crediting period.
QA/QC procedures to be applied:	An annual verification will be carried out by a technician on the compost application sites in a sample of users.
Purpose of the data	This parameter is monitored as requested by the applied methodology. It is used to confirm compost is not subject to anaerobic treatment or disposal and that, no emissions are expected from this source.
Calculation method:	The soil application of the compost will be monitored through a sheet that will be fed by the farmers, who are responsible for control the final destination of the compost in each farm.
Comments:	Data will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.

4.3 Monitoring Plan

Sustainable Carbon – Projetos Ambientais Ltda will be the party responsible for managing the monitoring plan during the crediting period and will also execute on site inspections on each individual farm for each verification period, to confirm that the monitoring plan is being executed properly.
Third parties mentioned on Section 4.2 (especially for parameters ndy, W_{site}, $N_{da,y}$ and $N_{p,y}$) such as integrators and State agencies are the direct responsible for measurement and recording of monitoring parameters. Such information is used to determine farms' productivity and to calculate financial compensations. For these reasons, third party information is considered the most reliable data source.
In general terms, farmers do not control animal production on a consistent and regular basis, as this is the responsibility of integrators as defined on predefined agreements and procedures. Integrators do use information from producers regarding many aspects on the farm management (including data on feed intake, mortality and disease control). However, integrators are responsible to measure and record monitoring data related to animal production.
Fazenda Andretta is an exception to this statement, as farmers use software to monitor animal production. Information from such software shall be preferred to third party information in such case.

Farmers received extensive training from LPC regarding the operation of the composting unit and from Sustainable Carbon regarding the emission reduction project and its monitoring. Trainings provided by LPC and Sustainable Carbon included information on how to manage, store and provide final destination to the compost. Sustainable Carbon has also provided training on data collection and storage, as well as emergency reporting procedures. Evidences of training were provided to the Validation and Verification Body responsible for project validation.
In case emergencies lead to unintended emissions, farmers shall contact LPC Tecnologia Ambiental immediately in case the emergency requires maintenance or repairs on the composting unit. Farmers shall also contact Sustainable Carbon to inform on the type of emergency, its cause, its consequences and any information needed to allow Sustainable Carbon to determine the impact of such emergency on the project emission reductions for the corresponding monitoring period. Sustainable Carbon shall provide a transparent approach on the emission reductions for that monitoring period, accounting for any

unintended emissions that might have occurred in a conservative manner. Sustainable Carbon shall store all communications from farmers during the crediting period.
Farmers will apply the monitoring plan on a regular basis and will be responsible to record and store data regarding animal production and the operation of the composting unit. This includes filling monitoring spreadsheets prepared by Sustainable Carbon, taking notes on animal production and storing documents provided by the integrators. Data monitored will be kept for two years after the end of the crediting period or the last issuance of carbon credits for this project activity, whichever occurs later.
The variables monitored are described in Section 4.2 above. For this purpose, there will be one authority for organizing the monitoring data in each farm, as described in the table below:

Table 10,. Monitoring authority on each farm.

Farm Name	Town	Monitoring authority
Fazenda Sitio Pickler	Arroio Trinta	Mr. Adelmo Pickler
Fazenda Altenor	Nova Erechim	Mr. Arlei Luiz Basso
Fazenda Ramela	Herval d'Oeste	Mr. Antônio Carlos Ramela
Sítio Santa Lucia	Jaborá	Mr. Clodoaldo Secco
Fazenda Helena	Vargeão	Mr. Leocimar Coradi
Fazenda Gilmar	Rio das Antas	Mr. Daltro Panegazi
Fazenda Suruvy	Concórdia	Mr. Airton Piovezan
Fazenda Granja Silva	Concórdia	Mr. Jair da Silva
Fazenda Colônia Suspiro	Nova Erechim	Ms. Lenize Tomazi
Fazenda Colônia Zuffo	Rio das Antas	Mr. Dario Marcos Zuffo
Fazenda Pissaia	Arvoredo	Mr. Neimar Pissaia
Fazenda Baccin	Concórdia	Mr. Renato Baccin
Fazenda Andretta	Nova Itaberaba	Ms. Fabiana Andretta

The organizational structure of the project regarding the monitoring plan is illustrated in figure below.

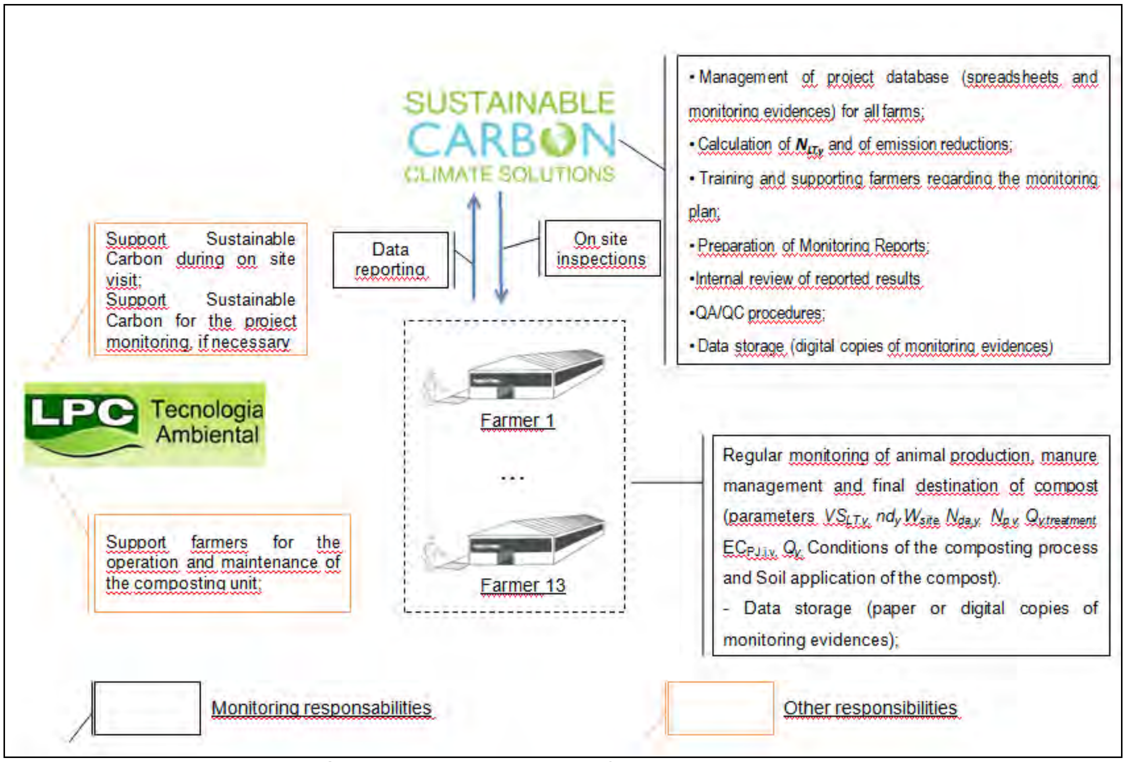

Figure 2. Organizational structure for the project monitoring.

Table below provides more information on how each parameter will be monitored during the crediting period.

Table 11. Further information on the monitored parameters

Parameter	Description	Unit	Origin	Responsibilities	Frequency
$VS_{LT,y}$	Volatile solids for livestock *LT* entering the animal manure management system in year *y*.	kg dm/animal/year	It will be monitored using the values of 2006 IPCC ($W_{default}$ and *VS*); however they will be adjusted considering the weight of animals on the project site (W_{site}). The Parameter W_{site} will be monitored by farmers based on third party documents or internal registries.	Sustainable Carbon shall calculate this parameter by applying default values from 2006 IPCC and data on W_{site}.	Annually
nd_y	Number of days in year *y* where the animal manure management system is operational.	Days	This parameter is obtained either from monitoring spreadsheets where farmers record operating time of the composting unit or from third party information (such as documents from integrators or State Agricultural agencies).	Farmers shall record the operating time of the composting unit on a daily basis and store information on the confinement of anils	Annually based on daily, monthly or periodic records
W_{site}	Average animal weight of a defined livestock population at the project site (kg)	kg	The average animal weight by type applied for project activity are obtained preferably from third party information (such as documents from integrators or State Agricultural agencies) or from on site measurements.	Farmers shall store copies of third party documents or perform on site measurements if these are not available. Sustainable Carbon shall store digital copies of monitoring evidences.	Annually, based on periodic records
$N_{da,y}$	Number of days animal is alive in the farm in the year *y*	Days	Market swine will be monitored using internal registries from farmers or third parties (integrators, State Agencies, etc) regarding input and output data of the animals in each farm. For breeding swine, the value considered will be 365 days per year, once the animals stay in the farm during the entire year.	Farmers shall store copies of third party documents or perform on site measurements if these are not available. Sustainable Carbon shall store digital copies of monitoring evidences.	Annually, based on periodic records
$N_{p,y}$	Number of animals produced annually of type *LT* for the year *y*	Number	Market swine will be monitored using internal registries from farmers or third parties (integrators, State Agencies, etc) regarding input and output data of the animals in each farm. Breeding	Farmers shall store copies of third party documents or perform on site measurements if these are not available. Sustainable Carbon shall	Annually, based on periodic records.

Parameter	Description	Unit	Origin	Responsibilities	Frequency
			swine will be monitored using internal registries from farmers.	store digital copies of monitoring evidences	
$N_{LT,y}$	Annual average number of animals of type *LT* in year *y*	Number	It will be monitored based on the parameters $N_{da,y}$ e $N_{p,y}$ described above.	Sustainable Carbon shall calculate this parameter based on the monitored data on animal production.	Annually, based on periodic records.
$Q_{y,treatment}$	Quantity of compost produced in year *y*	Tonnes	It will be monitored using on-site data sheets which will be recorded monthly by the farmers using a standard storage bags.	Farmers shall regularly monitor this parameter according to the monitoring plan. Sustainable Carbon shall store digital copies of monitoring evidences.	Annually, based on monthly records
$EC_{PJ,j,y}$	Quantity of electricity consumed by the project electricity consumption source j in year y	MWh	Farmers shall record the frequency of operation of the manure pumps and of the mixing equipment in spreadsheets on a daily basis. This shall be done to allow Sustainable Carbon to calculate the time of operation of each equipment.	Farmers shall regularly monitor this parameter according to the monitoring plan. Sustainable Carbon shall store digital copies of monitoring evidences. In case monitoring data is incomplete, conservative estimated values shall be applied.	Annually, based on daily records
$EF_{CO2,grid}$	CO_2 emission factor of the grid in year *y*	tCO_2/MWh	It will be monitored by Sustainable Carbon, archiving data regarding the emission factor of the grid available in the CIMGC website.	Sustainable Carbon shall apply and store the most recent values published by the Brazilian National Designated Authority.	Annually
Q_y	Quantity of manure treated in the year *y*	Tonnes	It will be controlled by the farmers by monitoring the time of operation of the pump, which destine the manure from the storage tank to the composting unit. Hour meters or data loggers might be installed during the crediting period to automatically record this information.	Farmers shall regularly monitor this parameter according to the monitoring plan. Sustainable Carbon shall store digital copies of monitoring evidences. Defaults values of animal	Annually, based on monthly records

Parameter	Description	Unit	Origin	Responsibilities	Frequency
				waste production shall be used to calculate quantity of manure treated (Q_y) in case monitoring data is incomplete.	
Conditions of the composting process	Conditions of the composting process	ºC for temperature; Moisture level (qualitative analysis); Frequency of time for operation of the mixing equipment.	Farmers shall periodically monitor the temperature and moisture of the composting mass in the composting windrows, as well as record the frequency of operation of the UMAC equipment, which mixes the composting mass.	Farmers shall regularly monitor this parameter according to the monitoring plan. Sustainable Carbon shall store digital copies of monitoring evidences.	Daily recording and mea-surements every 15 days
Soil application of the compost for agricultural purposes	Count of compost removal from the treatment system and description of soil application.	Numerical frequency	It will be monitored through a sheet that will be fed by the swine farmers responsible for control the final destination of the compost in each farm.	Farmers shall regularly monitor this parameter according to the monitoring plan. Sustainable Carbon shall store digital copies of monitoring evidences. LPC might assist in the monitoring of this parameter, if necessary.	Annually, based on monthly records

During the preparation of the monitoring reports, Sustainable Carbon shall perform internal reviews of reported data and clarify any pending issues with farmers. In case any erroneous measurements or incomplete data is found, Sustainable Carbon shall contact farmers to seek for clarification and design corrective actions to minimize data incompleteness. Corrective actions might include additional training, more frequent site visits or communications with farmers and other measures that are needed to ensure the monitoring plan is consistently applied over time.
Sustainable Carbon shall make conservative assumptions where data is missing or appears to be incorrect. This means calculation of emission reductions shall be claimed based on existing documentation and on the most conservative assumption in case of incompleteness of the monitoring data.

5 ENVIRONMENTAL IMPACT

Swine waste is considered a serious environmental concern in the project region. The environmental impacts of the project activity are considered positive, since they improve the treatment practices for wastes from agro industrial activity besides the requirements of environmental agencies.

The project proposes major improvements in swine waste handling. This will result not only in GHG emission reduction, but also in other environmental and social benefits, such as:

- **Contribution to local environmental sustainability:**

- Reduction in the risk of underground water contamination due to correct management of swine manure. The proposed AWMS is built in a manner to avoid manure leakages or uncontrolled disposal. All manure is managed in completely sealed pipeline. Guidance on compost disposal will be provided to avoid uncontrolled disposal of waste.

- Reduction in the odors arising from open anaerobic lagoons.

- Reduction in the pathogenic vectors associated to animal manure.

- Improvement of swine manure quality as fertilizer. The proposed AWMS results in a more efficient treatment in animal manure. The organic fraction and water content of manure will be significantly reduced due to improved aerobic digestion, when compared to baseline AWMS. The improvement in manure treatment reduces its pollutant potential and improves its quality as soil fertilizer.

- **Contribution to working conditions and employment creation**

- Increase of job opportunities during and post project activity due to the continuous need for equipment monitoring and workforce improvement. The proposed AWMS includes several equipments/technologies that do not exist in the baseline AWMS. These equipments demand regular monitoring, operation and maintenance, creating the potential for job opportunities.

- Improvement on working conditions to farms personnel, due to odor and pathogenic vectors reduction. The presence of odors and pathogenic vectors is unpleasant and might constitute health hazards to farms personnel and to the local community. The proposed AWMS will significantly reduced or eliminate these issues.

- Employees' professional skill development (training) to operate the installed AWMS; Training on farms personnel will be necessary to operate the proposed AWMS, since it is equipped with advanced technology that does not exist in baseline AWMS.

- **Contribution to income distribution**

- Improvement on the quality of manure to be used as fertilizer. Local farmers consider animal manure to be an important income. The use of animal manure as fertilizer reduces or eliminates the need to acquire industrial fertilizers for these farmers. With the proposed AWMS, the quality of such manure will be significantly improved. The amount of manure distributed to local farmers might also increase, due to better handling of animal waste.

- **Contribution to capacitating and technological development**

- Technological development of the region through the implementation of innovative equipment. The proposed AWMS is far more advanced than the baseline AWMS. The new AWMS is designed to allow for the aerobic degradation of swine manure, thus reducing local greenhouse gas emissions. Besides, the new AWMS reduces environmental hazards and pollutant potential due to improved manure handling. The new AWMS complies with local and national environmental law.

The proposed AWMS can also be applied to similar activities in the region, since it is produced or distributed by Brazilian companies. No international technical assistance is necessary for the operation and maintenance of the proposed AWMS.

All benefits above are in line with the farmer’s goals to improve the quality of the operation and to act in a positive manner in the community. According to the project participants, the project is an opportunity to adopt sustainable practices and provide guidelines for future swine confinement farms.

6 STAKEHOLDER COMMENTS

The main stakeholders considered in this project are the City Halls of the cities where the project takes place, the Foundation of the Environment (FATMA - Fundação do Meio Ambiente), the local swine farmers’ cooperatives, as CÓPERIO - *Cooperativa Rio do Peixe-Coperio* and COPÉRDIA - *Cooperativa de Produção e Consumo Concórdia*, the integrators of the Swine farms in the region and the employees. These letters were sent to the stakeholders informing about the project on 10/02/2012.

7 ANNEX 1 – DETAILED INFORMATION ON EX-ANTE CALCULATION OF EMISSION REDUCTIONS

Table 1A - Parameters used for the ex-ante calculation of baseline emissions

Data used to determine baseline emissions											
Farm owner	MCF_j	$B_{0,LT}$	$N_{da,y}$	$N_{p,y}$	$N_{LT,y}$*	$W_{default}$	W_{site}	$VS_{default}$	nd_y	$VS_{LT,y}$	MS%i,y
	(%)	(m^3 CH_4/Kg VS)	(numbers)	(numbers)	(numbers)	(Kg)	(Kg)	(Kg dm/animal/day)	(numbers)	(Kg dm/animal/year)	(%)
Adelmo Pickler	0.77	0.29	120.88	5,910.00	832.00	28.00	68.24	0.30	365.00	266.86	1.00
Airton Piovezan	0.77	0.29	115.00	1,807.85	848.00	28.00	61.73	0.30	365.00	241.39	1.00
Altenor José Basso	0.77	0.29	115.00	11,180.00	2,435.00	28.00	63.91	0.30	365.00	249.94	1.00
Antônio Carlos Ramela	0.77	0.29	180.00	4,677.00	1,753.00	28.00	61.73	0.30	365.00	241.39	1.00
Belmiro Secco	0.77	0.29	135.67	5,674.00	1,688.00	28.00	75.11	0.30	365.00	293.75	1.00
Dario Marcos Zuffo	0.77	0.29	117.33	3,471.00	1,091.00	28.00	68.72	0.30	365.00	268.75	1.00
Diacir Coradi	0.77	0.29	128.00	6,272.00	1,775.00	28.00	65.77	0.30	365.00	257.21	1.00
Selvino Andreta	0.77	0,45 for breeding and 0,29 for market swine	274 for breeding swine, 25.98 for piglets and 49 for nursery	Sows: 477.94; Boars: 3. Piglets: 6,297; Nursery: 4,551.	Sows: 477; Boars: 3; Piglets: 597; Nursery: 813	198 for Breeding swine and 28 for Market swine	198 for Breeding swine, 3.74 for Piglets and 17.505 for Nursery	0.46 for Breeding swine and 0.3 for Market swine	365.00	167.9 for Breeding swine. 14.626 for Piglets and 68.457 for Nursery.	1.00
Gilmar José Sinigaglia	0.77	0.29	125.57	12,225.00	1,524.00	28.00	72.84	0.30	365.00	284.86	1.00
Jair da Silva	0.77	0,45 for breeding and 0,29 for market swine	210 for breeding swine, 25.98 for piglets and 49 for nursery	gilts:45; sows in gestation: 250; Sows: 50; Boars: 5. Piglets: 4,865; Nursery: 1,216	gilts:45; sows in gestation: 250; Sows: 50; Boars: 5. Piglets: 601; Nursery: 283	198 for Breeding swine and 28 for Market swine	198 for Breeding swine, 3.74 for Piglets and 17.505 for Nursery	0.46 for Breeding swine and 0.3 for Market swine	365.00	167.9 for Breeding swine. 14.626 for Piglets and 68.457 for Nursery.	1.00
Nóbile Tomazi	0.77	0.29	115.00	4,118.00	3,979.00	28.00	61.73	0.30	365.00	241.39	1.00
Neimar Pissaia	0.77	0.29	115.00	7,543.00	1,600.00	28.00	67.33	0.30	365.00	263.29	1.00
Renato Baccin	0.77	0.29	115.00	12,696.00	4,000.00	28.00	61.73	0.30	365.00	241.39	1.00

Table 1B – Calculation of ex-ante emission reductions on each farm[49]

Emission reductions				
Farm owner	**BEy** (tCO₂e)	**PEy** (tCO₂e)	**Leakage** (tCO₂e)	**ERy** (tCO₂e)
Adelmo Pickler	655.72	127.43	0.00	528.29
Airton Piovezan	604.55	129.78	0.00	474.77
Altenor José Basso	1,797.41	369.61	0.00	1,427.80
Antônio Carlos Ramela	1,249.73	266.53	0.00	983.20
Belmiro Secco	1,464.39	257.13	0.00	1,207.25
Dario Marcos Zuffo	865.92	166.22	0.00	699.70
Diacir Coradi	1,348.32	271.56	0.00	1,076.76
Selvino Andreta	559.49	291.37	0.00	268.12
Gilmar José Sinigaglia	1,282.14	232.50	0.00	1,049.64
Jair da Silva	352.48	139.63	0.00	212.85
Nóbile Tomazi	2,836.66	604.28	0.00	2,232.38
Neimar Pissaia	1,244.13	244.76	0.00	999.37
Renato Baccin	2,851.63	606.72	0.00	2,244.91
TOTAL	**17,112.00**	**3,707.00**	**0.00**	**13,405.00**

[49] Total emissions on this table were rounded down.

8 ANNEX 2 – CONSERVATIVE ESTIMATED VALUES OF TIME OF OPERATION OF ELECTRIC EQUIPMENTS

Farm Owner	Farm	LPC JUDGEMENT		CONSERVATIVE ESTIMATE	
		UMAC equipment daily operating time (hours)	Manure pump daily operating time (hours)	UMAC equipment daily operating time (decimal hours)	Manure pump daily operating time (decimal hours)
Airton Piovesan	Fazenda Suruvy	2:10	0:25	**2,71**	**0,52**
Jair da silva	Fazenda Granja Silva	2:38	0:35	**3,29**	**0,73**
Altenor José Basso	Fazenda Altenor	3:30	0:32	**4,38**	**0,67**
Diacir Coradi	Helena	4:20	1:00	**5,42**	**1,25**
Neimar Pissaia	Fazenda Pissaia	3:57	0:35	**4,94**	**0,73**
Adelmo Pickler	Sítio Pickler	2:15	0:32	**2,81**	**0,67**
Selvino Andretta	Fazenda Andretta	3:15	0:45	**4,06**	**0,94**
Gilmar José Sinigaglia	Fazenda Gilmar	3:10	0:46	**3,96**	**0,96**
Dário Marcos Zuffo	Fazenda Colônia Zuffo	2:10	0:25	**2,71**	**0,52**
Belmiro Secco	Sitio Santa Lúcia	3:10	0:46	**3,96**	**0,96**
Renato Baccin	Fazenda Baccin	5:05	0:46	**6,35**	**0,96**
Antonio Carlos Ramella	Fazenda Ramella	2:40	0:35	**3,33**	**0,73**
Lenize Tomazi	Fazenda colônia Suspiro	5:16	1:10	**6,58**	**1,46**

Conservative factor:	125%