SHUANGBAOTAI AWMS GHG MITIGATION PROJECT IN JIANGSU PROVNCE

Document Prepared by Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.

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CONTENTS

1 PROJECT DETAILS

1.1 Summary Description of the Implementation Status of the Project

Shuangbaotai AWMS GHG Mitigation Project in Jiangsu Province (hereafter referred to as the project) installs new animal waste management systems (AWMSs) to treat the manure from 4 existing swine farms in Jiangsu Province, China, which are owned by Shuangbaotai Animal Husbandry Group Co., Ltd. (hereinafter called "Shuangbaotai") Each subsidiary swine farm installs one AWMS, and the manure is treated on site. The purpose of the project activity is to treat the manure and wastewater to avoid methane emissions generated in the baseline uncovered anaerobic lagoons.

The project activity uses flushing system to collect the manure automatically. All the manure and wastewater are collected and then be separated first. The separated solid are treated in aerobic composting system and the organic fertilizers are produced. The separated liquid is treated through anaerobic digestion process and the biogas generated during the treatment process is captured for electricity generation and surplus biogas is destroyed through the flaring system (if any). After anaerobic digestion, the sludge produced from anaerobic digestion are treated through aerobic composting together with the separated solid, the effluent is supplied to the farmers living around free for agriculture irrigation.

Prior to the implementation of the project, the animal manure waste was left to decay in uncovered open lagoon at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility.

It is estimated that approximately 685 tons of animal manure can be handled daily by the AWMSs. The biogas generated during the anaerobic process is collected for electricity production and 1,481.072472*10^4 m^3 of biogas are expected to produce annually. The total installed capacity of the project is 2.78 MW, and the annual electricity production is estimated to be 19,254 MWh. Also, the generated electricity is only used for daily operation of AWMSs and the 4 swine farms and cannot be connected to the region grid net or other users. For conservativeness, baseline emissions from power generation are neglected.

The project activity reduces of GHG in the atmosphere through avoiding methane emissions from anaerobic treatment of swine manure and wastewater. It is estimated that 150,212 tCO_2e emission reductions will be produced annually and total emission reductions are 1,502,120 tCO_2e in the 10-year fixed crediting period covering from 10-June-2020 to 09-June-2030.

Project timeline for the implementation date of the project is shown in Table 1-1:

Table 1-1 Milestone in the project's implementation

Date	Milestone(s) in the Project's Implementation

25-February-2020	The start date of Siyang Aiyuan swine farm and Siyang Nanliuji swine farm to construct the AWMS
27- February-2020	The Start date of the Sheyang Linhai Farm to construct the AWMS
01-March-2020	The Start date of the Dongtai Jianggang Farm to construct the AWMS
28-May-2020	The Start Commissioning date of the AWMS for the Siyang Nanliuji Farm
29-May-2020	The Start Commissioning date of the AWMS for the Siyang Aiyuan Farm
30-May-2020	The Start Commissioning date of the AWMS for the Sheyang Linhai Farm
01-June-2020	The Start Commissioning date of the AWMS for the Dongtai Jianggang Farm
10-June-2020	Formally put into operation of all the 4 sets of AWMSs
10-June-2020 to 09-June-2030	The 10-year fixed crediting period
10-June-2020 to 31-December-2021	The 1st monitoring period
01-January-2022 to 31-December-2022	The 2nd monitoring period (this monitoring period)

This monitoring period is the second monitoring period and covering from 01-January-2022 to 31-December-2022. During this monitoring period, the project is in good operation condition, the operation environment and status in this monitoring period hasn't been changed from the last monitoring periods, which is also consistent with the description of the registered JPM. The emission reduction achieved by the project in this monitoring period is 118,757 tCO_2e.

Table 1-2 The audit history of the project

Audit Type	Period	Program	VVB Name	Number of years
Validation (Joint with the 1st verification)	20-October-2022[1]	VCS	Shenzhen CTI International Certification Co., Ltd	NA
1st verification	10-June-2020 to 31-December-2021)	VCS	Shenzhen CTI International Certification Co., Ltd	1.56 years
2nd Verification	01-January-2022 to 31-December-2022	VCS	China Certification Center Inc.	1 year
Total	10-June-2020 to 31-December-2022	VCS	/	2.56 years

[1] This project was being developed in conjunction with the validation and 1st periodic of verification, and the onsite interviews were conducted from 22-March-2022 to 24-March-2022, the Joint Validation and Verification Report (version 1.0) was completed on 13 May 2022, and the completion date of the final version of Joint Validation and Verification Report (version 3.0) at the project registration was 20-October-2022.

1.2 Sectoral Scope and Project Type

The project falls into sectoral scope 01: Energy industries (renewable -/ non-renewable sources), sectoral scope 13: Waste handling and disposal and Sectoral Scope 15: Livestock and manure management. The project is not a grouped project.

The project type of this project belongs to Type III "Other project activities not included in Type I or Type II".

The applied methodology for this project is ACM0010"GHG emission reductions from manure management systems[2]"(Version 08.0).

1.3 Project Proponent

Organization name	Shuangbaotai Animal Husbandry Group Co., Ltd.
Contact person	Yuan Xue
Title	Deputy General Manager
Address	201, 2nd Floor, Office Building, No. 799, Torch Street, Nanchang High-paying Technology Industrial Development Zone, Nanchang City, Jiangxi Province
Telephone	/
Email	snowgirl1984@hotmail.com

1.4 Other Entities Involved in the Project

Organization name	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
Role in the Project	VCS Consultant
Contact person	Joanna Zhu
Title	Project Director
Address	No.2815 Longteng Avenue, Baihui Park full river view office building, Shanghai, China
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[2] https://cdm.unfccc.int/methodologies/DB/99QRTE6N5QJEBOV2XP374B25SSIXBB

1.5 Project Start Date

As per section 1.8 of the registered JPM, the project start date is 10-June-2020.

1.6 Project Crediting Period

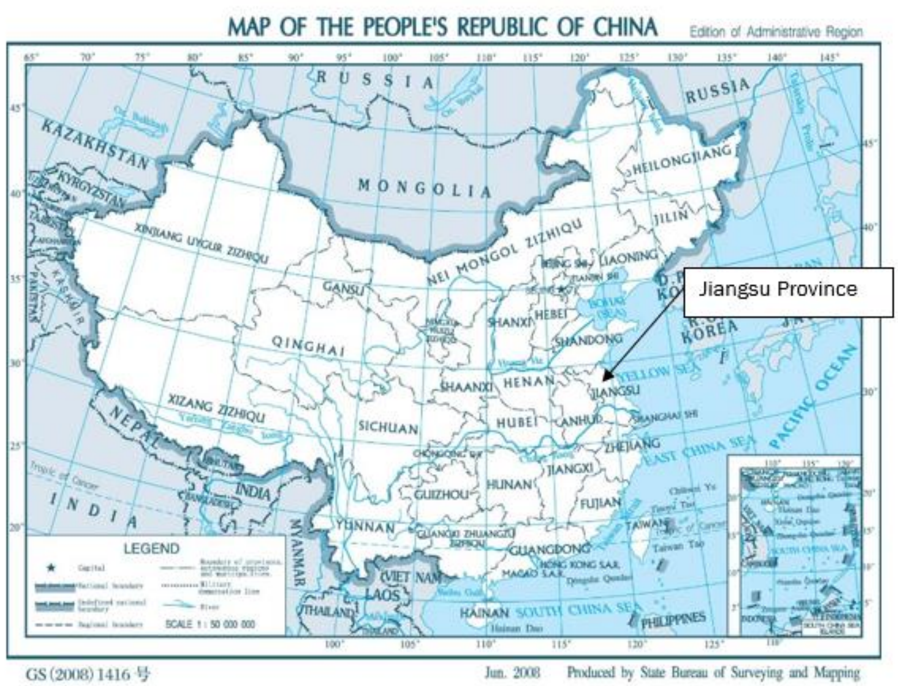
As per section 1.9 of the registered JPM, this project adopts fixed crediting periods of 10 years. The crediting period is 10 years 0 month from 10-June-2020 to 09-June-2030 (both days included).

1.7 Project Location

The project is located in Jiangsu Province, China. The location of the four subsidiary farms is shown in Table 1-3 and Figure 1-1:

Table 1-3 The location of the four subsidiary farms in this project

Swine farm	Location	North latitude	East longitude
Siyang Aiyuan Farm	Aiyuan village, Siyang county, Suqian City	33.954582091°	118.655479148°
Dongtai Jianggang Farm	Jianggang Town, Dongtai City	32.713709053°	120.891217509°
Sheyang Linhai Farm	Linhai Town, Sheyang County, Yancheng City	34.061443924°	120.264208749°
Siyang Nanliuji Farm	Nanliuji Village, Siyang county, Suqian City	33.800379189°	118.677887823°



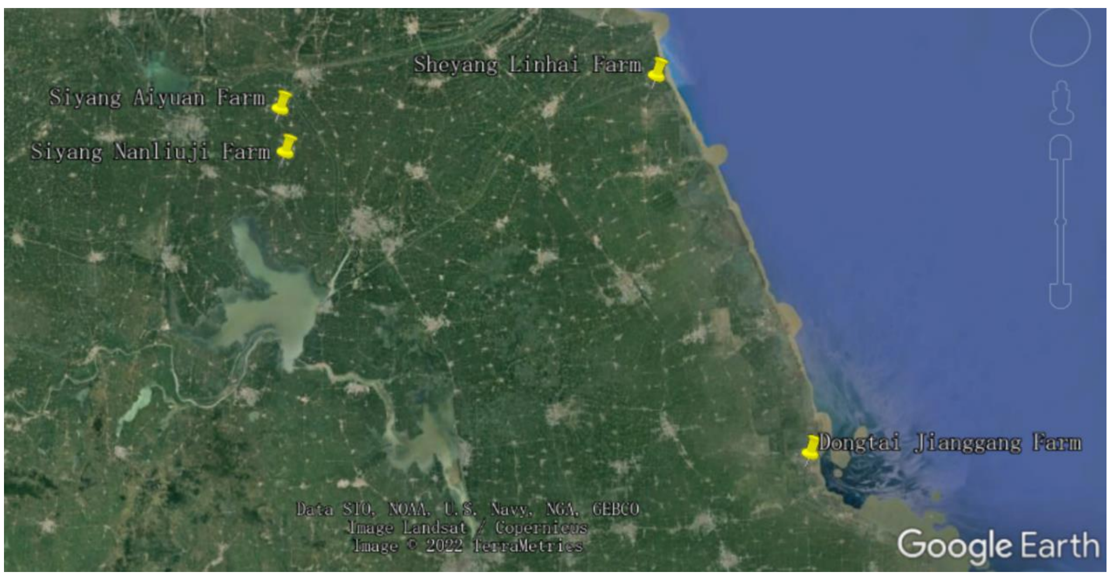


Figure1-1. The Geographic location of the four subsidiary farms in this project

1.8 Title and Reference of Methodology

The following methodologies are applicable to the project activity.

ACM0010" GHG emission reductions from manure management systems (Version 08.0)[3]".

The latest version of the following tools will also be used in this Project activity:

Tool 02: "Combined tool to identify the baseline scenario and demonstrate additionality (version 07.0)[4]"

[3] https://cdm.unfccc.int/methodologies/DB/99QRTE6N5QJEBOV2XP374B25SSIXBB

[4] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-7.0.pdf/history_view

Tool 05:" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 3.0)[5]"

Tool 06:" Project emissions from flaring (Version 4.0)[6]"

Tool 08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version03.0)[7]"

Tool 14: "Project and leakage emissions from anaerobic digesters (Version 02.0)[8]"

Tool 24:" Common practice (Version 03.1)[9]"

1.9 Participation under other GHG Programs

The project has neither been registered nor seeking registration under any other GHG programs. The project is participating only in VCS program.

1.10 Other Forms of Credit and Supply Chain (Scope 3) Emissions

Emission Trading Programs and Other Binding Limits

The project proponent is not part of any emission trading program. The project does not reduce GHG emissions from activities that are included in an emissions trading program or any other mechanism that includes GHG allowance trading. There is a cap & trade scheme in China. However, China's national emissions trading scheme (ETS), which is at its very early stage, only includes 2,225 fossil fuel-fired power plants in the power sector[10], and the project proponent is not included in the list. China's ETS is expected to include all companies with annual GHG emissions greater than 26,000 tCO_2e in eight emission-intensive industries including power generation, petrochemicals, chemicals, building materials, non-ferrous metals, papermaking, steel and aviation[11]. The industry of the project participant is agriculture, not the industry mentioned above according to the business license. There are no mandatory regulations on GHG emission cap for the industry of agriculture as per the "Interim Measures for Carbon Emissions Trading Management" issued by NDRC December of 2014[12] and the "Management Measures for Carbon Emissions Trading (Trial)" issued by the Ministry of Ecology and Environment in December of 2020[13]. Therefore, it will not be included in the national ETS. No emission cap will be enforced on the project proponent, nor can it participate in carbon transactions in the national ETS.

[5] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-3.0.pdf/history_view
[6] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-v4.0.pdf
[7] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-3.0.pdf/history_view
[8] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-14-v2.pdf/history_view
[9] https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf
[10] http://mee.gov.cn/xxgk2018/xxgk/xxgk03/202012/W020201230736907682380.pdf
[11] http://www.mee.gov.cn/xxgk2018/xxgk/xxgk05/202103/t20210330_826728.html
[12] http://www.gov.cn/gongbao/content/2015/content_2818456.htm
[13] https://www.mee.gov.cn/gzk/gz/202112/t20211213_963865.shtml

Therefore, the net GHG emission reductions from the Project will not be used for compliance with emission trading programs or to meet binding limits on GHG emissions.

In addition, the project owner had signed the Declaration of No Double Counting Statement and Declaration of not involved in other GHG scheme to ensure that the project will not apply for emission reduction credits or labels under any other schemes other than VCS.

Other Forms of Environmental Credit

The project hasn't sought or received another form of environmental credits other than VCUs.

Supply Chain (Scope 3) Emissions

NA. The project does not affects associated with a good or services in a supply chain.

1.11 Sustainable Development Contributions

The project activity implemented by the project owner can contribute to sustainable development as defined by and tracked against the United Nations Sustainable Development Goals (SDGs). The specific analysis is as follows:

SDG 13: Climate Action

Prior to the implementation of the project, the animal manure waste was left to decay in uncovered open lagoon at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from anaerobic treatment of swine manure. So, the impact parameter of the proposed project on SDG13 is the amount of GHGs emission reductions. It is estimated that 150,212 tCO_2e emission reductions can be produced annually.

SDG 7: Affordable and Clean Energy

The biogas generated during the treatment process are captured for power generation, the electricity generated are all used by the AWMSs and the 4 swine farms, which is supplied by the grid company in baseline scenario. The grid company is dominated by thermal power generation. Therefore, the project activity can provide clean energy and the impact parameter of the proposed project on SDG7 is the amount of electricity generated. It is estimated that 19,254 MWh of electricity generated annually by the project.

SDG 8: Decent Work and Economic Growth

Temporary and permanent job opportunities are created for locals during the construction and operation period of the project. So, the impact parameter of the proposed project on SDG8 is the number of full-time jobs created. 18 local residents (9 females and 9 males) are employed permanently during the operation period of the project during project implementation and monitoring activities.

For this monitoring period covering 365 days (01-January-2022 to 31-December-2022), the actual emission reduction is 118,757 tCO_2e and 17,086.59 MWh of electricity (please refer to monitored parameter "$EG_{d,y}$" in Section 4.2 of Monitoring Report for detail) is generated by the project. Total18 jobs for local people were created (including 9 females and 9 males). Please see below Table 1-4 for details.

Table 1-4: Sustainable Development Contributions

Row number	SDG Target	SDG Indicator	Net Impact on SDG Indicator	Current Project Contributions	Contributions Over Project Lifetime
1)	7.2	7.2.1 renewable energy share in the total final energy consumption	Implemented activities to increase	During this monitoring period, 17,086.59 MWh of electricity through capturing biogas is generated by the project.	This is the 2nd monitoring period, therefore, from the operation start date of the project activity to the end of this monitoring period, 43,976.03[14] MWh of electricity through capturing biogas is generated by the project.
2)	8.3	8.3.1 Proportion of informal employment in non-agriculture employment, by sex	Implemented activities to increase	During this monitoring period, total 18 jobs for local people were created (including 9 females and 9 males) by the project.	The project activity generates permanent job opportunities for 18 persons including 9 females and 9 males during the operation period. From the operation start date of the project activity to the end of this monitoring period, 18 jobs for local people were created (including 9 females and 9 males) by the project.
3)	13.0	Tonnes of greenhouse gas emissions avoided or removed	Implemented activities to increase	During this monitoring period, the project has achieved GHG emission reductions of 118,757 tCO_2e.	This is the 2nd monitoring period, therefore, from the operation start date of the project activity to the end of this monitoring period, the project has achieved GHG emission reductions of 304,998[15] tCO_2e.

[14] The electricity generation in the 1st monitoring period is 26,889.44MWh, the electricity generated in the 2nd monitoring period is 17,086.59 MWh, so from the operation start date of the project activity to the end of this monitoring period, total 43,976.03 MWh (26,889.44MWh + 17,086.59) electricity generated.

[15] The project achieved 186,241 tCO_2e GHG emission reductions in the 1st monitoring period and the project achieved 118,757 tCO2e GHG emission reductions in the 2nd monitoring period, so from the operation start date of the project activity to the end of this monitoring period, the project achieved total 304,998 tCO2e (186,241 tCO_2e + 118,757 tCO2e) GHG emission reductions.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) Report for the Project has been approved by Jiangsu Provincial Department of Environmental Protection. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project operation, the details as follows:

Wastewater in operation period

Strengthen the prevention and control of wastewater pollution. The project shall implement the separation of sewage and rainwater. The waste liquid generated from gas-water separation and gas purification and plant domestic sewage will be remitted to the biogas facility for treatment. digested effluent will be used to irrigate the surrounding crops after treatment and is not allowed to be discharged to the surrounding water bodies.

Gas pollution in operation period

Strengthen the prevention and control of waste gas pollution. The collection pond and anaerobic digestion should seal well in order to reduce emission of malodorous gases. In the process of organic fertilizer production, waste gas collection and treatment measure shall be implemented as design plan. Strengthen solid waste pollution prevention. All biogas residues are used for organic fertilizer production.

Solid waste in operation period

Strengthen solid waste management. All digestate is used for organic fertilizer production. Waste desulfurizers should be collected centrally and disposed of properly in accordance with the relevant regulations on solid waste management. The company's solid waste temporary storage site should be impermeable, rainwater scouring and have sewage collection measures to avoid secondary pollution.

Pollutant disposal methods are fully implemented in accordance with the measures specified in the EIA, so the project operation during this monitoring period has not caused any negative impact on the environment. Meanwhile, the implementation of the project improved local socio-economic development through creating career opportunities.

2.2 Local Stakeholder Consultation

Local stakeholder consultation was conducted by project owner during the monitoring period through the survey questionnaire.

During this monitoring period, a questionnaire survey was adopted for stakeholder consultation by PP. The questionnaire survey was conducted by project proponent from 24-May-2022 to 27-May-2022. The employees hired by the project owner manually distributed 15 questionnaires near each swine farm, and the project distributed a total of 60 questionnaires, and all questionnaires have been recollected. The basic information about the survey respondents is listed in Table 2-1. Responses and comments from these questionnaires are summarized in Table 2-2.

Table 2-1 Structure of stakeholder survey

Items		Amount
Gender	Male	32
	female	28
Age	<25	4
	25-55	50
	>55	6
Education	Junior high school or below	7
	Senior high school	45
	College or above	8
Occupation	Worker	10
	Farmer	37
	Management personnel	8
	Civil servant	5

Table 2-2 Summary of the survey results in monitoring period

No	Question	Response	Amount	Percentage
1	Do you know the purpose of this project?	Very much	57	95%
		A little	3	5%
		Not at all	0	0%
2	What do you think is the impact of the implementation of this project on the local environment?	Reduce odor	41	68%
		Improve water quality	12	20%
		Reduce waste pollution	7	12%
		none	0	0%
3	What impact do you think the implementation of this project will have on your life?	Improve the quality of surrounding environment	39	65%
		providing employment opportunities	14	23%
		Free use of fertilizer	7	12%
4	Are you satisfied with the environmental protection measures that the project has made?	Satisfied	60	100%
		Dissatisfied	0	0%
		Indifferent	0	0%
5	What do you think is the impact of the project on local employment?	Positive	58	97%
		Negative	0	0%
		None	2	3%
6	What do you think is the impact of the project on local economy?	Positive	57	95%
		Negative	0	0%
		None	3	5%

7	In general, what is your attitude towards the Project construction?	Supportive	60	100%
		Against	0	0%
		Indifferent	0	0%
8	Do you think other regions should also vigorously promote this type of technology?	Yes	53	88%
		No	0	0%
		No idea	7	12%

The stakeholder survey results are as follows: 95% of the surveyed stakeholders are aware of the purpose of the project; All respondents believe that the project has a positive impact on the environment (68% believe that the project can improve odor, 20% believe that the project can improve water quality, and 12% of respondents believe that the implementation of the project can reduce waste pollution); Regarding the impact of the project implementation on the lives of the respondents, 65% of the respondents believe that the project can improve the living environment, 23% of the respondents believe that the project can improve employment opportunities, and the remaining 12% of the respondents believe that the project can Provide free organic fertilizers to nearby farmers; All respondents agree with the measures taken by the project for environmental protection; Regarding the impact of the project on local employment, 97% of the respondents believed that the project had a positive impact on employment, and 3% believed that it had no impact; 95% of the respondents believed that the project had a positive impact on the local economy, and 5% believed that it had no impact on the economy; 100% of the respondents support the project construction; 88% of the respondents think that such projects can be promoted and implemented in other regions, and 12% have no opinion on whether such projects can be implemented.

In order to set up the mechanism for on-going communication with local stakeholders, a grievance book was put in Front Desk Administration of the PP. All stakeholders are allowed to record their grievances or comments in the book at any time.

In all, all the villagers and local government that filling out questionnaires are all supportive of the project and to date there has been no need to modify the due to the comments received.

2.3 AFOLU-Specific Safeguards

The project is a non-AFOLU project, this section is not required.

3 IMPLEMENTATION STATUS

3.1 Implementation Status of the Project Activity

The project activity is to install 4 sets of new AWMSs to replace the traditional uncovered anaerobic lagoons to treat the swine manure in the swine farms owned by Shuangbaotai.

The project activity implemented 4 sets of AWMSs in 4 existing swine farms involving 99,450 heads of commercia swine, 54,252 heads of breeding swine. Total 246,740 tons of manure and 1,481.072472*10^4m^3 of biogas are estimated to produce annually. All of these 4 existing swine farms were put into operation before the implementation of this project. Prior to the implementation of the project, all manure waste produced from the existing 4 swine farms was left to decay in 4 uncovered anaerobic lagoons at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility.

There are 4 existing swine farms for this project, and the technology implemented at each swine farm was same. while the treatment capacities of each AWMS and the size of each swine farm and corresponding design of the AWMS was different. The processing capacity and equipment of the system are designed according to the size of the farm. The equipment parameters used of each swine farm are shown in below Table 3-1. The specific process is as follows:

All the manure and wastewater are collected into waste collecting tanks and then be separated first by Solid-liquid separators. The separated solid is treated in aerobic composting system, which are used as fertilizer. The separated liquid is treated through anaerobic digestion and the biogas generated during the treatment process is captured for electricity generation. If there is surplus biogas, then the biogas is flared through the flaring system. The sludge produced from anaerobic digestion are treated through aerobic composting together with the separated solid, the effluent is used for agriculture irrigation. The process flow diagram of this project activity is shown in Figure 3-1.

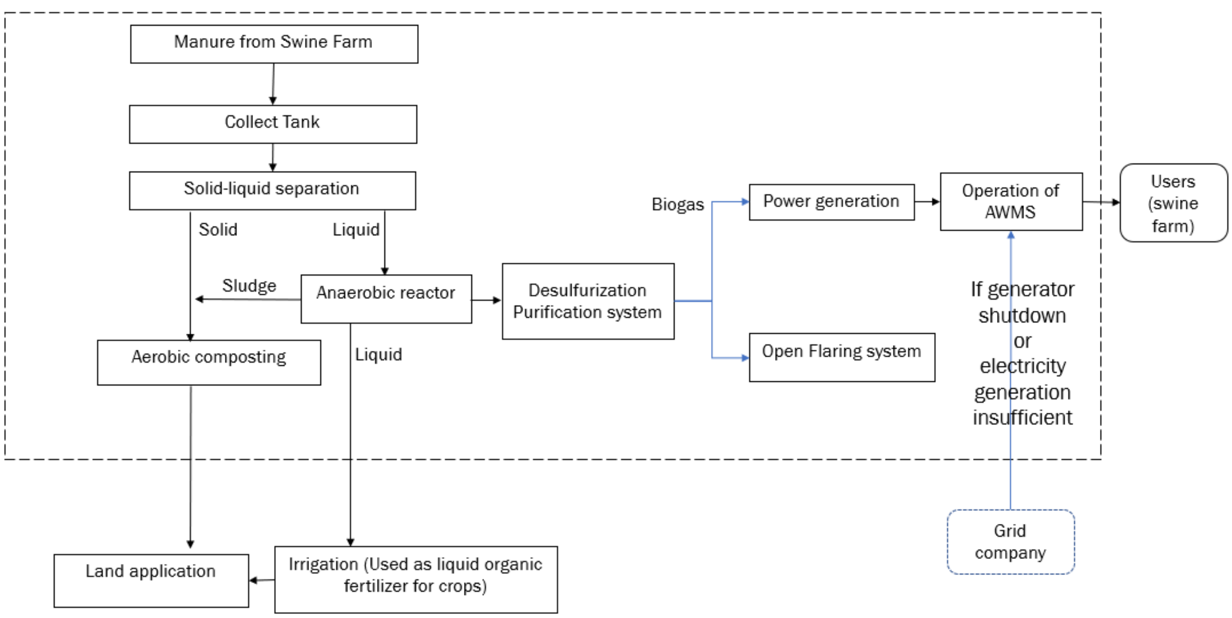


Figure 3-1 Process flow diagram of the project activity

Table 3-1 The main technical parameters of equipment involved in this project.

Farm name	Siyang Aiyuan farm	Dongtai Jianggang Farm	Sheyang Linhai farm	Siyang Nanliuji farm

Treatment capacities of AMMS(t/d)	120	180	85	300
Baseline anaerobic lagoon				
Size of baseline anaerobic lagoon (m^3)	50*80*3	80*70*3	50*80*3	80*90*3
technical life	No Less than 15 years			
Biogas Generator				
Type	C480D5E	C750D5E	C350D5E	C1200D5E
Electricity power(kw)	480	750	350	1200
Rated Current (A)	450	450	450	450
Rated speed (rpm)	1500	1500	1500	1500
Equipment Quantity	1	1	1	1
Equipment technical life	No Less than 30 years			
Anaerobic tank				
Design capacity (m^3)	2000	3000	1500	5000
Anaerobic technology	UASB	UASB	UASB	UASB
Stay time(day)	15.5-16	15.5-16	15.5-16	15.5-16
Fermentation temperature(℃)	35-38	35-38	35-38	35-38
Equipment Quantity	1	1	1	2
Equipment technical life	No Less than 15 years			
Turnover machine				
Type	FP-2800	FP-2800	FP-2800	FP-3800
Speed of work(m/h)	6.85	6.85	6.85	6.85
walking width (mm)	2800	2800	2800	3800
flip speed (rpm/min)	50	50	50	50
Equipment Quantity	1	1	1	1
Equipment technical life	No Less than 15 years			
Flared system				
Open flare	Open flare	Open flare	Open flare	Open flare
Material	304 stainless steels	304 stainless steels	304 stainless steels	304 stainless steels
Height (m)	3.5	3.5	3.5	3.5
Main wall thickness (mm)	3	3	3	3
Equipment technical life	No Less than 15 years			

During this monitoring period, the project was implemented in accordance with the registered JPM. The project has operated without any accidental or emergency events that might impact the GHG emission reductions or removals and monitoring.

3.2 Deviations

3.2.1 Methodology Deviations

There is no methodology deviation in this monitoring period.

3.2.2 Project Description Deviations

Not applicable.

3.3 Grouped Projects

Not applicable.

4 DATA AND PARAMETERS

4.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	tCO_2/tCH_4
Description	Global Warming Potential of CH_4
Source of data	IPCC Fifth Assessment Report
Value applied	28
Justification of choice of data or description of measurement methods and procedures applied	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014[16], which complies with the requirement described in Section 3.15.4 of VCS Standard (V4.4).
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	N/A

Data / Parameter	GWP_{N2O}
Data unit	tCO_2e/tN_2O
Description	Global Warming Potential of N_2O
Source of data	IPCC Fifth Assessment Report
Value applied	265
Justification of choice of data or description of measurement methods and procedures applied	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014, which complies with the requirement described in Section 3.15.4 of VCS Standard (V4.4).
Purpose of Data	Used in project emission/baseline calculations
Comments	N/A

[16] https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

Data / Parameter	D_{CH4}
Data unit	t/m³
Description	Density of CH_4
Source of data	ACM0010 Version 08.0
Value applied	0.00067
Justification of choice of data or description of measurement methods and procedures applied	0.00067 t/m³ at room temperature 20℃ and 1 atm pressure.
Purpose of Data	Used in project emission/baseline calculations
Comments	N/A

Data / Parameter	MCF_j
Data unit	-
Description	Methane conversion factor for the baseline AWMSj
Source of data	IPCC 2006 table 10.17, chapter 10, volume 4
Value applied	69.56%
Justification of choice of data or description of measurement methods and procedures applied	MCFj value for uncovered anaerobic lagoon (baseline AWMS) is chosen. A conservativeness factor has been applied by multiplying MCFj value (i.e., 74%) with a value of 0.94, to account for the 20 per cent uncertainty in the MCFj values as reported by IPCC 2006. For this project, the annual average temperature is 15.3[17]℃ and the conservative value of 74% is applied. Therefore, MCFj value of 69.56% will be applied.
Purpose of Data	project/baseline emission calculations
Comments	N/A

Data / Parameter	$MS\%_{Bl,j}$

[17] http://jiangsu.china.com.cn/html/jsnews/around/4842719_1.html

Data unit	Fraction
Description	Fraction of manure handled in system j in the baseline.
Source of data	Project proponents
Value applied	100%
Justification of choice of data or description of measurement methods and procedures applied	In this project, the baseline manure management system is uncovered anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon is 100%.
Purpose of Data	Calculation of baseline emissions
Comments	N/A

Data / Parameter	$W_{default}$
Data unit	kg
Description	Default average animal weight of a defined population
Source of data	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Value applied	$W_{default}$(Market swine)=28 kg $W_{default}$(Breeding swine)=28 kg
Justification of choice of data or description of measurement methods and procedures applied	The values in IPCC 2006 and US-EPA are compared and the lower value from IPCC 2006 is applied.
Purpose of Data	Calculation of Baseline emissions
Comments	N/A

Data / Parameter	$VS_{default}$
Data unit	kg-dm/animal/day
Description	Default value for the volatile solid excretion per day on a dry-matter basis for a defined livestock population
Source of data	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Value applied	$VS_{default}$(Market swine)=0.3 $VS_{default}$(Breeding swine)=0.3

Justification of choice of data or description of measurement methods and procedures applied	The values in IPCC 2006 and US-EPA are compared and the lower value from IPCC 2006 is applied.
Purpose of Data	Used in project emission/baseline calculations
Comments	N/A

Data / Parameter	$NEX_{IPCC\ default}$
Data unit	kg N/ animal/year
Description	Default value for the nitrogen excretion per head of a defined livestock population
Source of data	Calculated by the equation: $NEX_{IPCC\ default} = N_{rate(T)} * TAM/1000*365$
Value applied	$NEX_{IPCC\ default}$ (Market swine) =4.29 $NEX_{IPCC\ default}$ (Breeding swine) =2.45
Justification of choice of data or description of measurement methods and procedures applied	$NEX_{IPCC\ default}$ is calculated as equation 10.30 in IPCC 2006, $N_{rate(T)}$) and TAM are default value from IPCC 2006.
Purpose of Data	Baseline, Project and leakage emissions calculations
Comments	N/A

Data / Parameter	$N_{rate,(T)}$
Data unit	kg N (1000 kg animal mass)$^{-1}$ day^{-1}
Description	default N excretion rate
Source of data	IPCC 2006 table 10.19, chapter 10, volume 4
Value applied	$N_{rate,(T)}$ (Market swine) =0.42 $N_{rate,(T)}$(Breeding swine) =0.24
Justification of choice of data or description of measurement methods and procedures applied	Default value from IPCC 2006 is applied
Purpose of Data	$NEX_{IPCC\ default}$ calculations
Comments	N/A

Data / Parameter	TAM
Data unit	kg animal^{-1}
Description	typical animal mass for livestock category
Source of data	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Value applied	TAM (Market swine) =28 TAM (Breeding swine) =28
Justification of choice of data or description of measurement methods and procedures applied	Default value from IPCC 2006 is applied
Purpose of Data	$NEX_{IPCC\ default}$ calculations
Comments	N/A

Data / Parameter	$F_{gas\ MS,j,LT}$
Data unit	Fraction
Description	Default values for nitrogen loss due to volatilization of NH_3 and NO_X from manure management
Source of data	IPCC 2006 table 10.22, chapter 10, volume 4
Value applied	$F_{gasMS,j,LT}$, (anaerobic lagoon) : 40% $F_{gasMS,j,LT}$, (solid storage) : 45%
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	$EF_{N2O,D,j}$
Data unit	Kg N_2O-N/kg N

Description	Direct N_2O emission factor for the treatment system j of the manure management system
Source of data	IPCC 2006 table 10.21, chapter 10, volume 4
Value applied	$EF_{N2O,D,j}$ =0 for anaerobic lagoon and digester, $EF_{N2O,D,j}$ =0.01 for aerobic lagoon
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	$EF_{N2O,ID,j}$
Data unit	kgN_2O-N/kg NH_3-N and NO_X-N
Description	Indirect N_2O emission factor for the treatment system j of the manure management system
Source of data	IPCC 2006 table 11.3, chapter 11, volume 4
Value applied	0.01
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	$EF_{CH4,default}$
Data unit	t CH_4 leaked / t CH_4 produced
Description	Default emission factor for the fraction of CH_4 produced that leak from the anaerobic digester (fraction)
Source of data	Tool 14:” Project and leakage emissions from anaerobic digesters (version 02.0)”
Value applied	0.05

Justification of choice of data or description of measurement methods and procedures applied	UASB type digesters[18], floating gas holders with no external water seal
Purpose of Data	Calculation of project emissions
Comments	$PE_{CH4,y}$ for ex ante estimation adopted equation(4) of Methodological tool " Project and leakage emissions from anaerobic digesters", the amount of biogas collected at the digester will be monitored in Section 4.2 of Monitoring Report.

Data / Parameter	$R_{VS,n}$
Data unit	Fraction
Description	Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to waste being treated
Source of data	Refer to Annex 1 of methodology ACM0010 (version 08.0)
Value applied	$R_{VS,n}$, aerobic treatment and anaerobic digester[19]: 20%, 80% for leakage N_2O emission released during project activity $R_{VS,n}$, one cell lagoon[20]: 85% for leakage N_2O emission released during baseline scenario
Justification of choice of data or description of measurement methods and procedures applied	Estimated from Table provided in Appendix 1 of ACM0010. The most conservative value for the given technology must be used.
Purpose of Data	project emission/ leakage calculation
Comments	The most conservative value for the given technology must be used

Data / Parameter	$R_{N,n}$

[18] As per tool 14:" project and leakage emission from anaerobic digesters (version 02.0)", the value this parameter should be determined according to the type of digester used in the project activity and the digester type shall be identified by manufacturer information. For this project, as per the purchasing contract of Anaerobic digester, the type of digester used in the project activity belongs to UASB type digester, so the Default emission factor for the fraction of CH_4 produced that leak from the anaerobic digester (fraction) is 0.05 t CH_4 leaked / t CH_4 produced.

[19] For project, Before the treated manure is applied to the land, it undergoes two stages of pre-treatment and an anaerobic-aerobic combined treatment technology, the pre-treatment belong to underfloor pit storage in the Appendix 1 of applied methodology ACM0010 (version 08.0), so, the $R_{VS,n}$ is 20% which is the most conservative value. The anaerobic-aerobic combined treatment technology belongs to covered first cell of two cell lagoon in the Appendix 1 of applied methodology ACM0010 (version 08.0), so the R_{VS} 80% which is the most conservative value.

[20] For project, the baseline is uncovered anaerobic lagoon which belongs to the anaerobic treatment of One-cell lagoon in the Appendix 1 of applied methodology ACM0010 (version 08.0), so, the $R_{VS,n}$ is 85% which is the most conservative value.

Data unit	Fraction
Description	Nitrogen reduction factor
Source of data	Refer to Appendix 1 of methodology ACM0010 (version 08.0)
Value applied	$R_{N,n}$, aerobic treatment and anaerobic digester:5%, 25%[21] $R_{N,n}$, uncovered anaerobic lagoon : 80%[22]
Justification of choice of data or description of measurement methods and procedures applied	Estimated from Table provided in Appendix 1 of ACM0010. The most conservative value for the given technology must be used.
Purpose of Data	Calculation of leakage emission
Comments	The most conservative value for the given technology must be used

Data / Parameter	EF_1, EF_4, EF_5
Data unit	kg N_2O-N/kg N for EF_1, EF_5 and [kg N_2O-N/ (kg NH_3-N and NO_X-N) for EF_4
Description	Emission factor for N_2O emissions from N inputs; from N leaching and runoff; from atmospheric deposition of N on soils and water surfaces
Source of data	IPCC 2006 Guidelines default values are be used, since country specific or region-specific data are not available. EF_1 from table 11.1, chapter 11, volume 4. EF_4 and EF_5 from table 11.3, chapter 11, volume 4
Value applied	EF_1 = 0.010 EF_4 =0.010 EF_5 = 0.0075
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Calculation of leakage emission

[21] For project, before the treated manure is applied to the land, it undergoes two stages of pre-treatment and the an anaerobic-aerobic combined treatment technology, the pre-treatment belong to underfloor pit storage in the Appendix 1 of applied methodology ACM0010 (version 08.0), so, the $R_{N,n}$ is 5% which is the most conservative value. The anaerobic-aerobic combined treatment technology belongs to covered first cell of two cell lagoon in the Appendix 1 of applied methodology ACM0010 (version 08.0), so the $R_{N,n}$ is 25% which is the most conservative value.

[22] For project, the baseline is uncovered anaerobic lagoon which similar to the anaerobic treatment of One-cell lagoon in the Appendix 1 of applied methodology ACM0010 (version 08.0), so, the $R_{N,n}$ is 80% which is the most conservative value.

Comments	N/A

Data / Parameter	F_{gasm}
Data unit	Fraction
Description	Fraction of N lost due to volatilization
Source of data	Default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines
Value applied	0.2
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Used in project/baseline emission calculations
Comments	N/A

Data / Parameter	F_{leach}
Data unit	Fraction
Description	Fraction of all N added to/mineralized in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff
Source of data	Default values from table 11.3, chapter 11, volume 4 of IPCC 2006 guidelines
Value applied	0.3
Justification of choice of data or description of measurement methods and procedures applied	Site specific data is unavailable therefore default values are opted for.
Purpose of Data	Calculation of leakage emission
Comments	N/A

Data / Parameter	MCF_d

Data unit	-
Description	Methane conversion factor for leakage calculation
Source of data	Methodology ACM0010(version 08.0)
Value applied	1
Justification of choice of data or description of measurement methods and procedures applied	According to paragraph 51 of the methodology ACM0010" GHG emission reductions from manure management systems (version08.0)", Methane conversion factor for leakage calculation assumed to be equal 1
Purpose of Data	Calculation of leakage emission
Comments	N/A

Data / Parameter	$EF_{EF,j,y}$
Data unit	tCO_2/MWh
Description	Emission factor for electricity generation
Source of data	Published by Ministry of Ecology and Environment of China, which is the DNA of China[23], the project location is Jiangsu province, belongs to the East China Power Grid (ECPG), so the Emission factor of ECPG is applied.
Value applied	0.58955[24]
Justification of choice of data or description of measurement methods and procedures applied	According to tool" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Purpose of Data	Calculation of project emission
Comments	N/A

Data / Parameter	R_u
Data unit	$Pa.m^3/kmol.K$
Description	Universal ideal gases constant

[23] https://cdm.unfccc.int/DNA/bak/index.html
[24] https://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/t20201229_815386.shtml

Source of data	Tool 08:" Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)"
Value applied	8,314
Justification of choice of data or description of measurement methods and procedures applied	Value is fixed as Tool 08/
Purpose of Data	Calculation of project emission
Comments	/

Data / Parameter	MM_i
Data unit	kg/kmol
Description	Molecular mass of greenhouse gas i
Source of data	Tool 08:" Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)"
Value applied	16.04 kg/mol for methane
Justification of choice of data or description of measurement methods and procedures applied	Value is fixed as Tool 08
Purpose of Data	Calculation of project emission
Comments	/

Data / Parameter	$\eta_{flare,m}$
Data unit	%
Description	Flare efficiency in minute m
Source of data	Tool 06" Project emissions from flaring (Version 04.0)"
Value applied	0%
Justification of choice of data or description of	0% is the conservative value.

measurement methods and procedures applied	
Purpose of Data	Calculation of project emission
Comments	/

4.2 Data and Parameters Monitored

Data / Parameter	$N_{p,LT}$
Data unit	Number
Description	Number of animals of type LT produced annually for the year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals, can track automatically. This electronic ear tag will be connected to the Data Collection System (DCS), which can store and read information. Therefore, the number of swine produced in the farm can be monitored through the auto tracking devices of electronic ear tag once pig slaughter monthly and obtained by the DCS. At the same time, the technicians in farms will record manually the number of swine produced in the farms monthly. Also, the number of monthly exported from the stock will also be recorded.
Frequency of monitoring/recording	Monthly
Value monitored	(see table below)

Time	$N_{p,LT}$ (heads of market swine)
01-January-2022 to 31-January-2022	15,921
01-February-2022 to 28-February-2022	15,835
01-March-2022 to 31-March-2022	15,897
01-April-2022 to 30-April-2022	15,956
01-May-2022 to 31-May-2022	15,943
01-June-2022 to 30-June-2022	15,911
01-July-2022 to 31-July-2022	15,927
01-August-2022 to 31-August-2022	15,887
01-September-2022 to 30-September-2022	15,948
01-October-2022 to 31-October-2022	15,937
01-November-2022 to 30-November-2022	15,997
01-December-2022 to 31-December-2022	15,915
01-January-2022 to 31-December-2022	**191,074**

Monitoring equipment	N/A
QA/QC procedures to be applied	The sale records can be crosschecked during the monitoring period and archive electronically during project plus 5 years.
Purpose of the data	Used for the calculation of N_{LT}, which used in the calculation of the baseline emission, Project emission and leakages emission.
Calculation method	N/A
Comments	Based on the Equation 5, the calculated N_{LT} is 94,228 heads (191,074 heads*180days/365days). However, according to the number of market pigs produced annually of each farm, the N_{LT} calculated by Equation 5 is rounded to an integer as 94,226 heads. According to the conservative principle, the 94,226 heads was applied in the calculations of emission reductions in MR. $N_{p,LT}$ sourced from the monthly exported record and has been crosschecked with the monthly sale records during this monitoring period and it can be concluded that the data is consistent. Therefore, $N_{p,LT}$ is reasonable and credible.

Data / Parameter	$N_{da,LT}$
Data unit	Number
Description	Number of days animal of type LT is alive in the farm in the year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals. This electronic ear tag will be connected to the Data Collection System (DCS), which can store and read information. Therefore, the days of swine alive in the farm can be traced through the electronic ear tag by the technical staff in each farm and obtained by the DCS.
Frequency of monitoring/recording	Monthly
Value monitored	(see table below)

Time	$N_{da,LT}$ (number of days)
01-January-2022 to 31-January-2022	180[25]
01-February-2022 to 28-February-2022	180
01-March-2022 to 31-March-2022	180
01-April-2022 to 30-April-2022	180
01-May-2022 to 31-May-2022	180
01-June-2022 to 30-June-2022	180

[25] During this monitoring period, a certain number of market swine are exported from the stock every month, as per monthly export record of Market swine, the number of days Market swine alive in the farm is 180 days, also this parameter needs to be monitored every month, therefore, the number of days of the market swine which exported from the stockin every month is 180 day.

	<table><tr><td>01-July-2022 to 31-July-2022</td><td>180</td></tr><tr><td>01-August-2022 to 31-August-2022</td><td>180</td></tr><tr><td>01-September-2022 to 30-September-2022</td><td>180</td></tr><tr><td>01-October-2022 to 31-October-2022</td><td>180</td></tr><tr><td>01-November-2022 to 30-November-2022</td><td>180</td></tr><tr><td>01-December-2022 to 31-December-2022</td><td>180</td></tr><tr><td>**01-January-2022 to 31-December-2022**</td><td>180</td></tr></table>
Monitoring equipment	N/A
QA/QC procedures to be applied	The sale records can be crosschecked during the monitoring period and archive electronically during project plus 5 years.
Purpose of the data	Used for the calculation of N_{LT}, which used in the calculation of the baseline emission, Project emission and leakages emission.
Calculation method	N/A
Comments	During this monitoring period, a certain number of market swine are slaughtered in each farm every month and the number of days market swine alive in the farm is 180 days as per monthly export record of marketing swine. Also this parameter needs to be monitored every month, therefore, the number of days of the market swine alive in the farm is 180 day. The number of days the animal alive in the farm is crosschecked through the monthly sale records of 4 swine farms during this monitoring period, and it can be concluded that the data is consistent.

Data / Parameter	$N_{AA,LT}$
Data unit	Number
Description	Daily stock of animals in the farm, discounting dead and discarded animals
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification and electronic management of animals. This electronic ear tag will be connected to the Data Collection System (DCS), which can store and read information. The technicians in farms monitor and record the number of breeding swine through the auto tracking devices of electronic ear tag daily, of which new imported animals are included and dead and discharge animals are excluded. The annual average number of animals ($N_{AA,LT}$) is calculated as an average of the daily stock of breeding swine in the farms without considering dead animals and discarded animals.
Frequency of monitoring/recording	Daily
Value monitored	<table><tr><td>Time</td><td>$N_{AA,LT}$ (heads of breeding swine)</td></tr></table>

	<table><tr><td>01-January-2022 to 31-January-2022</td><td>51,851</td></tr><tr><td>01-February-2022 to 28-February-2022</td><td>51,422</td></tr><tr><td>01-March-2022 to 31-March-2022</td><td>51,878</td></tr><tr><td>01-April-2022 to 30-April-2022</td><td>51,867</td></tr><tr><td>01-May-2022 to 31-May-2022</td><td>51,807</td></tr><tr><td>01-June-2022 to 30-June-2022</td><td>51,827</td></tr><tr><td>01-July-2022 to 31-July-2022</td><td>51,818</td></tr><tr><td>01-August-2022 to 31-August-2022</td><td>51,830</td></tr><tr><td>01-September-2022 to 30-September-2022</td><td>51,018</td></tr><tr><td>01-October-2022 to 31-October-2022</td><td>51,826</td></tr><tr><td>01-November-2022 to 30-November-2022</td><td>51,806</td></tr><tr><td>01-December-2022 to 31-December-2022</td><td>51,828</td></tr><tr><td>01-January-2022 to 31-December-2022</td><td>51,731</td></tr></table>
Monitoring equipment	N/A
QA/QC procedures to be applied	Archive electronically during project plus 5 years.
Purpose of the data	Used for the calculation of N_{LT}, which used in the calculation of the baseline emission, Project emission and leakages emission.
Calculation method	N/A
Comments	Monitored daily through the auto tracking devices of electronic ear tag and the data can be obtained from DCS. The technicians in farms record the daily stock number of animals, and this record data including the new imported animal and discounting dead and discharge animals.

Data / Parameter	W_{site}
Data unit	kg
Description	Average animal weight of a defined livestock population at the project site
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Measured by the weight measurer
Frequency of monitoring/recording	Monthly
Value monitored	<table><tr><th>Time</th><th>W_{site} for Market swine(kg)</th><th>W_{site} for Breeding swine(kg)</th></tr><tr><td>01-January-2022 to 31-January-2022</td><td>57.6</td><td>72.0</td></tr><tr><td>01-February-2022 to 28-February-2022</td><td>57.8</td><td>74.3</td></tr></table>

01-March-2022 to 31-March-2022	58.6	72.4
01-April-2022 to 30-April-2022	58.0	71.8
01-May-2022 to 31-May-2022	57.9	73.4
01-June-2022 to 30-June-2022	58.9	72.1
01-July-2022 to 31-July-2022	59.1	72.2
01-August-2022 to 31-August-2022	58.2	72.4
01-September-2022 to 30-September-2022	57.4	71.4
01-October-2022 to 31-October-2022	57.6	73.1
01-November-2022 to 30-November-2022	58.1	73.8
01-December-2022 to 31-December-2022	58.7	73.0
01-January-2022 to 31-December-2022	**58.1**	**72.6**

Monitoring equipment	Weight measurers
QA/QC procedures to be applied	Measured by the weight measurers and recorded by the technical staff in each farm monthly. Weight measurers were calibrated on 13-May-2021 and 10-May-2022 by Jiangsu Institute of Metrology in compliance with JJG539-2016 "Verification Regulation of Digital Indicating Weighting Instruments" in China.

Swine farm	Type/Accuracy	Series number	Calibration date	Validity
Siyang Aiyuan	XK3190-A12+(E)/3 level	2020010125	13-May-2021 and 10-May-2022	1 year
Dongtai Jianggang		2020020114		
Sheyang Linhai		2020030108		
Siyang Nanliuji		2020040095		

Purpose of the data	Used for estimating $VS_{LT,y}$
Calculation method	N/A
Comments	Sampling procedures and method is described in Section 4.3 of Monitoring Report.

Data / Parameter	F_{Aer}
Data unit	Fraction
Description	Fraction of volatile solids directed to aerobic treatment
Source of data	Project evaluation report
Description of measurement methods and procedures to be applied	The maximum value of 100% will be applied during the monitoring period due to not monitored in operation period.
Frequency of monitoring/recording	Annually

Value monitored	100%
Monitoring equipment	N/A
QA/QC procedures to be applied	The value of this parameter in the emission reduction calculation is 100%, which is conservative.
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	During this monitoring period, there is no equip install in the project activity to monitor the influent into anaerobic digestion and aerobic system, therefore the value of F_{Aer} is applied as 100%, which is conservative.

Data / Parameter	n_{dy}
Data unit	number
Description	Number of days treatment plant was operational in year y
Source of data	Project proponent
Description of measurement methods and procedures to be applied	The number of of days treatment plant was operational will be recorded manually by the responsible staff.
Frequency of monitoring/recording	Daily
Value monitored	The actual number of days 4 treatment plants that was operational are 365 days during this monitoring period.
Monitoring equipment	N/A

Time	n_{dy} (number of days)
01-January-2022 to 31-January-2022	31
01-February-2022 to 28-February-2022	28
01-March-2022 to 31-March-2022	31
01-April-2022 to 30-April-2022	30
01-May-2022 to 31-May-2022	31
01-June-2022 to 30-June-2022	30
01-July-2022 to 31-July-2022	31
01-August-2022 to 31-August-2022	31
01-September-2022 to 30-September-2022	30
01-October-2022 to 31-October-2022	31
01-November-2022 to 30-November-2022	30
01-December-2022 to 31-December-2022	31
01-January-2022 to 31-December-2022	365

QA/QC procedures to be applied	Production record from the DCS system can be crosscheck that the treatment plant is operational.
Purpose of the data	Calculation of Baseline emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	v_f
Data unit	m^3
Description	Biogas flow
Source of data	Project proponent
Description of measurement methods and procedures to be applied	Measured by the flow meters.
Frequency of monitoring/recording	Continuously by flow meters and reported cumulatively on weekly basis
Value monitored	

Time	Vf1- at outlet of the anaerobic digestion (m3)	Vf2- at the inlet of generator (m3)	Vf3- in inlet of flare system (m3)
01-January-2022 to 31-January-2022	1,097,442.30	1,075,493.79	0.00
01-February-2022 to 28-February-2022	990,015.84	970,213.32	0.00
01-March-2022 to 31-March-2022	1,098,526.26	1,076,557.46	0.00
01-April-2022 to 30-April-2022	1,065,508.56	1,044,198.83	0.00
01-May-2022 to 31-May-2022	1,100,102.88	1,078,093.43	0.00
01-June-2022 to 30-June-2022	1,062,268.50	1,041,013.78	0.00
01-July-2022 to 31-July-2022	1,098,466.74	1,076,494.58	0.00
01-August-2022 to 31-August-2022	1,096,407.36	1,074,476.40	0.00
01-September-2022 to 30-September-2022	1,059,202.08	1,038,018.18	0.00
01-October-2022 to 31-October-2022	1,100,689.92	1,078,674.12	0.00
01-November-2022 to 30-November-2022	1,063,772.64	1,042,489.62	0.00
01-December-2022 to 31-December-2022	1,099,411.68	1,077,423.66	0.00

	01-January-2022 to 31-December-2022 | 12,931,814.76 | 12,673,147.17 | 0
Monitoring equipment	Flow meters
QA/QC procedures to be applied	Monitored continuously by flow meter 1, flowmeter 2 and flowmeter 3. Flow meter 1 was installed at the outlet of the anaerobic tank to monitor the volumetric flow of biogas produced. Flow meter 2 was installed at the inlet of the biogas generator set to monitor the volumetric flow of biogas entering the biogas generator. Flow meter 3 was installed at the inlet of the flare system to monitor the volumetric flow of biogas destroyed by the flare. The monitored data can be recorded hourly and saved automatically in the Data Collection System (DCS). The data can be obtained from this system. Flowmeters were calibrated on 13-May-2020 and 10-May-2022 by JIANGSU INSTITUTE OF METROLOGY in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China. For this monitoring period, all the biogas produced is used for power generation, no surplus biogas for the flaring system. The calibration information for flow meter 1 is as follows:

Swine farm	Type/Accuracy	Series number	Calibration date	Validity
Siyang Aiyuan	HD-LU/1.5 Level	202001003478	13-May-2020 and 10-May-2022	2 years
Dongtai Jianggang		202002005859		
Dongtai Linhai		202003003867		
Siyang Nanliuji		202004004231		

The calibration information for flow meter 2 is as follows:

Swine farm	Type/Accuracy	Series number	Calibration date	Validity
Siyang Aiyuan	HD-LU/1.5 Level	202001003479	13-May-2020 and 10-May-2022	2 years
Dongtai Jianggang		202002005860		
Dongtai Linhai		202003003868		
Siyang Nanliuji		202004004232		

The calibration information for flow meter 3 is as follows:

Swine farm	Type/Accuracy	Series number	Calibration date	Validity
Siyang Aiyuan	HD-LU/1.5 Level	202001003480	13-May-2020 and 10-May-2022	2 years
Dongtai Jianggang		202002005861		
Dongtai Linhai		202003003869		
Siyang Nanliuji		202004004233		

Purpose of the data	To calculated CH_4 generated in the anaerobic digester in the project situation $Q_{CH4,y}$
Calculation method	N/A
Comments	The biogas flow will be measured at four points, as shown in the figure. But if the project participants can demonstrate that leakage in distribution pipeline is zero, it need be measured at any three points. The biogas flow to electricity or heat equipment in a moment can be considered destroyed, by monitoring that the equipment was working at this time. For the proposed project, the biogas generated during the

	treatment process will be captured for power generation, so the biogas produced from the anaerobic digestion, the amount of biogas used for electricity generation and the amount of biogas flared (if any) will be monitored through the flow meter.

Data / Parameter	$EC_{PJ,j,y}$[26]
Data unit	MWh
Description	Quantity of electricity consumed by the project in year y
Source of data	Direct measurement or calculated based on measurements from more than one electricity meters
Description of measurement methods and procedures to be applied	Measured by electricity meter installed at the electricity consumption sources.
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value monitored	(see table below)
Monitoring equipment	Electricity meters

Time	$EC_{PJ,j,y}$ (MWh)
01-January-2022 to 31-January-2022	35.42451
01-February-2022 to 28-February-2022	37.98294
01-March-2022 to 31-March-2022	36.82105
01-April-2022 to 30-April-2022	37.09454
01-May-2022 to 31-May-2022	35.60149
01-June-2022 to 30-June-2022	30.87975
01-July-2022 to 31-July-2022	37.54392
01-August-2022 to 31-August-2022	33.85002
01-September-2022 to 30-September-2022	34.94843
01-October-2022 to 31-October-2022	31.64299
01-November-2022 to 30-November-2022	36.86195
01-December-2022 to 31-December-2022	35.99579
01-January-2022 to 31-December-2022	**424.64738**

[26] In this monitoring period, all the biogas generated by the anaerobic fermentation process is used for power generation. While the amount of biogas generated in Siyang Nanliuji farm cannot reach the biogas required for the full-load operation of the generator set. When the generator does not generate electricity, the system runs electricity must be purchased from the grid. In other three farm, the amount of biogas produced can meet the full load operation of the generators, so there is no need to purchase electricity from power grid. So, in this monitoring period, the electricity consumed from power grid company only happened in Siyang Naliuji swine farm.

QA/QC procedures to be applied	Monitored continuously by electricity meter 1 installed in the 4 manure treatment plants. Power consumption data is recorded daily and summarized monthly and cross-checked with Grid Company Electricity Statement. Electricity meters were calibrated on 18-May-2020 by JIANGSU INSTITUTE OF METROLOGY in compliance with JJG596-2012" Verification Regulation of electrical meters" in China. And during this monitoring period, most of the electricity consumed by the project came from the electricity generated by the biogas generated from the anaerobic fermentation process of the project, which is belongs to self-generated and self-consumed. Only a small amount of the electricity consumption of AWMSs were sourced from the grid company when the biogas generators were not operation.
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Swine farm	Type/Accuracy	Series number	Calibration date	Validity
Siyang Aiyuan	DTSD341/0.2S	01000009330210	18-May-2020	5 years
Dongtai Jianggang		1311198937000001		
Dongtai Linhai		010000085605372		
Siyang Nanliuji		010000078304212		

Data / Parameter	$EG_{d,y}$
Data unit	MWh
Description	Electricity generated using biogas in year y
Source of data	Project proponents
Description of measurement methods and procedures to be applied	Measured by electricity meters installed at the generator outlet.
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value monitored	

Time	$EG_{d,y}$ (MWh)
01-January-2022 to 31-January-2022	1,449.93
01-February-2022 to 28-February-2022	1,308.09
01-March-2022 to 31-March-2022	1,451.40
01-April-2022 to 30-April-2022	1,407.91
01-May-2022 to 31-May-2022	1,453.61

<table>
<tr><td></td><td>
<table>
<tr><td>01-June-2022 to 30-June-2022</td><td>1,403.48</td></tr>
<tr><td>01-July-2022 to 31-July-2022</td><td>1,451.36</td></tr>
<tr><td>01-August-2022 to 31-August-2022</td><td>1,448.52</td></tr>
<tr><td>01-September-2022 to 30-September-2022</td><td>1,399.70</td></tr>
<tr><td>01-October-2022 to 31-October-2022</td><td>1,454.40</td></tr>
<tr><td>01-November-2022 to 30-November-2022</td><td>1,405.56</td></tr>
<tr><td>01-December-2022 to 31-December-2022</td><td>1,452.64</td></tr>
<tr><td>01-January-2022 to 31-December-2022</td><td>17,086.59</td></tr>
</table>
</td></tr>
<tr><td>Monitoring equipment</td><td>Electricity meters</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Monitored continuously by electricity meter 2 installed in the outlet of biogas generators. The quantity of electricity generation can be obtained from the monthly summary table of electricity generated.
Electricity meters were calibrated on 18-March-2020 by JIANGSU INSTITUTE OF METROLOGY in compliance with JJG596-2012" Verification Regulation of electrical meters" in China.
<table>
<tr><th>Swine farm</th><th>Type/Accuracy</th><th>Series number</th><th>Calibration date</th><th>Validity</th></tr>
<tr><td>Siyang Aiyuan</td><td rowspan="4">DTSD341/0.2S</td><td>01000009330211</td><td rowspan="4">18-March-2020</td><td rowspan="4">5 years</td></tr>
<tr><td>Dongtai Jianggang</td><td>1311198937000002</td></tr>
<tr><td>Dongtai Linhai</td><td>010000085605373</td></tr>
<tr><td>Siyang Nanliuji</td><td>010000078304213</td></tr>
</table>
</td></tr>
<tr><td>Purpose of the data</td><td>The electricity generated using biogas does not involve the calculation of emission reduction since baseline emissions due to electricity generation is not taken into account. However, according to applied methodology ACM0010 (version08.0), this parameter needs to be monitored.</td></tr>
<tr><td>Calculation method</td><td>N/A</td></tr>
<tr><td>Comments</td><td>N/A</td></tr>
</table>

Data / Parameter	$TDL_{j,y}$
Data unit	%
Description	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*
Source of data	Tool 05" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)
Description of measurement methods and procedures to be applied	Default value of 20% will be applied, which is conservative. According to tool 05" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0)
Frequency of monitoring/recording	Value will change once the tool is updated

Value monitored	20%
Monitoring equipment	N/A
QA/QC procedures to be applied	N/A
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$V_{t,db}$
Data unit	m³ dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Measured by flowmeters from project proponents
Description of measurement methods and procedures to be applied	Monitored by flowmeters and Volumetric flow measurement should always refer to the actual pressure and temperature.
Frequency of monitoring/recording	Continuous measurement
Value monitored	(see table below)

Time	$V_{t,db}$ (m³ dry gas/h) monitored by flow meter 1	$V_{t,db}$ (m³ dry gas/h) monitored by flow meter 3
01-January-2022 to 31-January-2022	1,475.057	0.00
01-February-2022 to 28-February-2022	1,473.238	0.00
01-March-2022 to 31-March-2022	1,476.514	0.00
01-April-2022 to 30-April-2022	1,479.873	0.00
01-May-2022 to 31-May-2022	1,478.633	0.00
01-June-2022 to 30-June-2022	1,475.373	0.00
01-July-2022 to 31-July-2022	1,476.434	0.00
01-August-2022 to 31-August-2022	1,473.666	0.00
01-September-2022 to 30-September-2022	1,471.114	0.00
01-October-2022 to 31-October-2022	1,479.422	0.00
01-November-2022 to 30-November-2022	1,477.462	0.00
01-December-2022 to 31-December-2022	1,477.704	0.00
01-January-2022 to 31-December-2022	1,476.207	0.00

Monitoring equipment	flow meters
QA/QC procedures to be applied	Monitored continuously by flow meter 1 and 3. The flow meters 1 was installed at the outlet of the anaerobic tank to monitor the volumetric flow

	of biogas produced. Flow meter 3 was installed at the entrance of the flare system to monitor the volumetric flow of biogas destroyed by the flare. The monitored data can be recorded hourly and saved automatically in the Data Collection System (DCS). The data can be obtained from this system. Flow meters were calibrated on 13-May-2020 and 10-May-2022 by JIANGSU INSTITUTE OF METROLOGY in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China. The calibration specifics information is listed in above table of monitored parameter "v_f".
Purpose of the data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$V_{i,t,db}$
Data unit	m^3 gas i/m^3 dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Source of data	Measured by gas analyzers from project proponents
Description of measurement methods and procedures to be applied	Continuous gas analyser operating in dry-basis. Volumetric flow measurement should always refer to the actual pressure and temperature
Frequency of monitoring/recording	Continuous measurement
Value monitored	(see table below)

Time	$V_{i,t,db}$ (m^3 gas i/m^3 dry gas)
01-January-2022 to 31-January-2022	59.84
01-February-2022 to 28-February-2022	60.37
01-March-2022 to 31-March-2022	61.12
01-April-2022 to 30-April-2022	59.99
01-May-2022 to 31-May-2022	60.32
01-June-2022 to 30-June-2022	60.38
01-July-2022 to 31-July-2022	61.08
01-August-2022 to 31-August-2022	59.31
01-September-2022 to 30-September-2022	61.29
01-October-2022 to 31-October-2022	60.48
01-November-2022 to 30-November-2022	60.28
01-December-2022 to 31-December-2022	61.09
01-January-2022 to 31-December-2022	60.46

<table>
<tr><td>Monitoring equipment</td><td>Gas analyzers</td></tr>
<tr><td>QA/QC procedures to be applied</td><td>Measured continuously and recorded hourly by online gas analysers installed at the outlet of the anaerobic digesters and saved automatically in the DCS (Data Collection System). The data can be obtained from this system. Daily and Monthly CH_4 concentration was calculated based on the 24-hour average and daily average CH_4 concentration.
All the gas analysers were calibrated on 10-May-2021 and 07-May-2022 by JIANGSU INSTITUTE OF METROLOGY in compliance with JJG693-2011” Verification Regulation of Alarmer Detectors of Combustible Gas” in China. And the zero verification with an inert gas (N_2) and one reading verification with a standard gas (single calibration gas) are implemented in the process of calibration, which is in accordance with JJG693-2011. All calibration gases are from Nanjing Changyuan Industrial Gas Co. Ltd, which is a qualified reference materials manufacturer issued by the General Administration of Quality Supervision, Inspection and Quarantine of the People's Republic of China on 06-September-2017.
<table>
<tr><th>Swine farm</th><th>Type/Accuracy</th><th>Series number</th><th>Calibration date</th><th>Validity</th></tr>
<tr><td>Siyang Aiyuan</td><td rowspan="4">Gasboard-9060/±1%</td><td>2020010034781</td><td rowspan="4">10-May-2021 and 07-May-2022</td><td rowspan="4">1 years</td></tr>
<tr><td>Dongtai Jianggang</td><td>2020020058591</td></tr>
<tr><td>Dongtai Linhai</td><td>2020030038671</td></tr>
<tr><td>Siyang Nanliuji</td><td>2020040042311</td></tr>
</table></td></tr>
<tr><td>Purpose of data</td><td>Calculation of project emissions</td></tr>
<tr><td>Calculation method</td><td>N/A</td></tr>
<tr><td>Comments</td><td>N/A</td></tr>
</table>

<table>
<tr><td>Data / Parameter</td><td>T_t</td></tr>
<tr><td>Data unit</td><td>K</td></tr>
<tr><td>Description</td><td>Temperature of the gaseous stream in time interval t</td></tr>
<tr><td>Source of data</td><td>Measured by instrument</td></tr>
<tr><td>Description of measurement methods and procedures to be applied</td><td>Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermos resistance, etc</td></tr>
<tr><td>Frequency of monitoring/recording</td><td>Continuous unless differently specified in the underlying methodology</td></tr>
<tr><td>Value monitored</td><td>
<table>
<tr><th>Time</th><th>Average T_t (K)</th></tr>
<tr><td>01-January-2022 - 31-January-2022</td><td>308.58</td></tr>
<tr><td>01-February-2022- 28-February-2022</td><td>309.27</td></tr>
<tr><td>01-March-2022 - 31-March-2022</td><td>308.95</td></tr>
</table></td></tr>
</table>

	01-April-2022 - 30-April-2022 | 308.54 01-May-2022 - 31-May-2022 | 308.58 01-June-2022 - 30-June-2022 | 308.29 01-July-2022 - 31-July-2022 | 309.96 01-August-2022-31-August-2022 | 309.53 01-September-2022-30-September-2022 | 308.47 01-October-2022 - 31-October-2022 | 308.91 01-November-2022 - 30-November-2022 | 307.11 01-December-2022 - 31-December-2022 | 308.55 **01-January-2022-31-December-2022 | 308.73**
Monitoring equipment	Instruments with recordable electronic signal (analogical or digital)
QA/QC procedures to be applied	Measured continuously by the biogas flow meters, since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously. And record hourly and saved automatically in the DCS system. The readout of flowmeter was indicated degrees Celsius (°C). Therefore, the temperature Tt(K) is calculated as the equation T(K)=t(°C) +273.15. The data can be obtained from DCS system. Daily and Monthly temperature was calculated based on the 24-hour average and daily average temperature. Flow meters were calibrated on 13-May-2020 and 10-May-2022 by JIANGSU INSTITUTE OF METROLOGY in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China. The calibration specifics information is listed in above table of monitored parameter "v_f".
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	P_t
Data unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	Measured by instrument
Description of measurement methods and procedures to be applied	Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc

Frequency of monitoring/recording	Continuous unless differently specified in the underlying methodology
Value monitored	<table><tr><th>Time</th><th>Pt (pa)</th></tr><tr><td>01-January-2022 - 31-January-2022</td><td>101325</td></tr><tr><td>01-February-2022- 28-February-2022</td><td>101325</td></tr><tr><td>01-March-2022 - 31-March-2022</td><td>101325</td></tr><tr><td>01-April-2022 - 30-April-2022</td><td>101325</td></tr><tr><td>01-May-2022 - 31-May-2022</td><td>101325</td></tr><tr><td>01-June-2022 - 30-June-2022</td><td>101325</td></tr><tr><td>01-July-2022 - 31-July-2022</td><td>101325</td></tr><tr><td>01-August-2022-31-August-2022</td><td>101325</td></tr><tr><td>01-September-2022-30-September-2022</td><td>101325</td></tr><tr><td>01-October-2022 - 31-October-2022</td><td>101325</td></tr><tr><td>01-November-2022 - 30-November-2022</td><td>101325</td></tr><tr><td>01-December-2022 - 31-December-2022</td><td>101325</td></tr><tr><td>**01-January-2022-31-December-2022**</td><td>**101325**</td></tr></table>
Monitoring equipment	Instruments with recordable electronic signal (analogical or digital)
QA/QC procedures to be applied	Measured continuously by the biogas flow meters, since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously. And recorded hourly and saved automatically in the DCS system. The data can be obtained from DCS system. Daily and Monthly temperature was calculated based on the 24-hour average and daily average temperature. Flowmeters were calibrated on 13-May-2020 and 10-May-2022 by JIANGSU INSTITUTE OF METROLOGY in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China. The information about flowmeter, please refer to monitored parameter "v_f" for details.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	$\rho_{i,t}$
Data unit	kg gas i/m³ gas i
Description	Density of greenhouse gas i in the gaseous stream in time interval t
Source of data	Calculated

Description of measurement methods and procedures to be applied	Calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t.
Frequency of monitoring/recording	Pressure and temperature are measured continuously by the biogas flow meters
Value monitored	<table><tr><th>Time</th><th>$\rho_{i,t}$ (kg /m³)</th></tr><tr><td>01-January-2022 - 31-January-2022</td><td>0.63</td></tr><tr><td>01-February-2022- 28-February-2022</td><td>0.63</td></tr><tr><td>01-March-2022 - 31-March-2022</td><td>0.63</td></tr><tr><td>01-April-2022 - 30-April-2022</td><td>0.63</td></tr><tr><td>01-May-2022 - 31-May-2022</td><td>0.63</td></tr><tr><td>01-June-2022 - 30-June-2022</td><td>0.63</td></tr><tr><td>01-July-2022 - 31-July-2022</td><td>0.63</td></tr><tr><td>01-August-2022-31-August-2022</td><td>0.63</td></tr><tr><td>01-September-2022-30-September-2022</td><td>0.63</td></tr><tr><td>01-October-2022 - 31-October-2022</td><td>0.63</td></tr><tr><td>01-November-2022 - 30-November-2022</td><td>0.63</td></tr><tr><td>01-December-2022 - 31-December-2022</td><td>0.63</td></tr><tr><td>**01-January-2022-31-December-2022**</td><td>0.63</td></tr></table>
Monitoring equipment	N/A
QA/QC procedures to be applied	Calculated value according to the pressure and temperature
Purpose of Data	Calculation of project emissions
Calculation method	Calculation as Equation 19 and Equation 24 in registered JPM
Comments	Calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t using Equations (19) and (24) in JPM. The monitoring result of Pressure and temperature are listed in the above two tables.

Data / Parameter	$MS\%_j$
Data unit	Fraction
Description	Fraction of manure handled in system j in project activity
Source of data	Project proponents

Description of measurement methods and procedures to be applied	All the manure flew into AWMSs to be treated and no manure will be discharged outside. Therefore, the value of this parameter is 100%.
Frequency of monitoring/recording	Annually
Value monitored	100%
Monitoring equipment	N/A
QA/QC procedures to be applied	100% is the maximum value and conservative.
Purpose of Data	Calculation of project emissions
Calculation method	N/A
Comments	All the manure flew into AWMSs to be treated and no manure will be discharged outside. Therefore, the value of this parameter is 100%.

Data / Parameter	$B_{0,\ LT}$
Data unit	m^3CH_4/kg -dm
Description	Maximum methane producing potential of the volatile solid generated by animal type *LT*
Source of data	IPCC 2006 table 10A-7 and 10A-8, chapter 10, volume 4
Description of measurement methods and procedures to be applied	$B_{0,\ LT}$ can be measured as per ISO 11734:1995. As this parameter is not monitored in the actual operation. so, in the monitoring period 0.29 m^3CH_4/kg -dm is still applied. While the actual methane producing potential of the volatile solid generated by swine manure is 479.4ml/g VS according to the public literature[27],which is higher. Therefore 0.29 m^3CH_4/kg -dm applied in monitoring period is conservative.
Frequency of monitoring/recording	Annually
Value monitored	$B_{0,\ LT}$ (Market swine) =0.29 $B_{0,\ LT}$ (Breeding swine) =0.29
Monitoring equipment	N/A
QA/QC procedures to be applied	The value is taken from IPCC 2006. The parameter value should be updated on latest available IPCC.

[27] http://www.doc88.com/p-9902182440715.html

Purpose of Data	Used in project emission/baseline calculations
Calculation method	N/A
Comments	As per official website of IPCC[28], 2019 Refinement to the 2006 IPCC Guidelines is the latest version. 0.29 m^3CH_4/kg VS in Tables 10.16 chapter 10, volume 4 of is applied for the project, which is the same with the value in IPCC 2006.

Data / Parameter	Type
Data unit	/
Description	Type of barn and AWMS
Source of data	Project proponent
Description of measurement methods and procedures to be applied	The swine barn and AWMS layout and configuration are collected. Archive electronically during project plus 5 years.
Frequency of monitoring/recording	Once for each monitoring period
Value monitored	N/A
Monitoring equipment	N/A
QA/QC procedures to be applied	After the first verification, only changes in the type of barn and AWMS will be reported.
Purpose of Data	Confirm whether the implementation of project as design
Calculation method	N/A
Comments	N/A

Data / Parameter	T
Data unit	°C
Description	Annual average ambient temperature at project site

[28] https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

Source of data	Official publicly available information
Description of measurement methods and procedures to be applied	Data sourced from Official public information
Frequency of monitoring/recording	monthly
Value monitored	Time: 01-January-2022 to 31-December-2022; T (°C): 16.8[29]
Monitoring equipment	N/A
QA/QC procedures to be applied	Cross-Check with the value of ex-ante estimated, i.e., 15.3°C. In the monitoring period, to be conservative, corresponding MCFj with lower annual average ambient temperature as per Appendix 3 of ACM0010(Version08.0) will be used for calculation after comparing the actual value and the value of ex-ante estimated. The actual temperature in 2022 of the project sites is 16.8°C. After compared the actual temperature in 2022 and the temperature of ex-ante estimated, So, in this monitoring period, MCFj value is 74% with the lower temperature of 15.3°C as per Appendix 3 of ACM0010(Version 08.0). Then multiplying MCF values with a value of 0.94, so 69.56% of MCF_j (74%*0.94) is used for calculation during this monitoring period, which is consistent with the valued of ex-ante.
Purpose of Data	Used to select the annual MCFj from IPCC 2006 Guidelines
Calculation method	N/A
Comments	N/A

4.3 Monitoring Plan

As per registered JPM, the details of the monitoring plan are specified as follows:

1. Monitoring framework

The project owner will be responsible for the whole monitoring work. The VCS Monitoring Team will be established to collect and record monitoring data within the project boundary. The VCS monitoring team will be responsible for the normal operation of the manure treatment system and the collection and record of all the monitoring data. All the data will be reviewed by the project

[29] https://www.tianqi5.cn/jiangsu_suqian_lishitianqi/202201.html

developer and VVB. Each member of the VCS monitoring team will be trained by the project owner at least once a year. The overall monitoring system structure of the project shows as below:

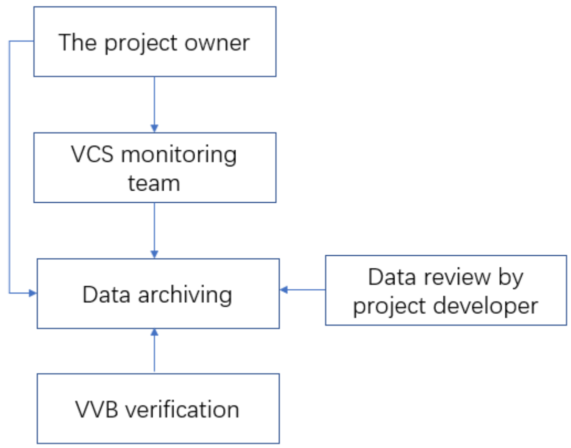


Figure 4-1 The Organization Structure of the Monitoring Team

2.Monitoring equipment and installation

Installation and configuration of meters are shown as Figure 4-2. In order to ensure measurements with a low degree of uncertainty, the data metering equipment will be calibrated and checked by an appropriately qualified third party according to an appropriate national standard. The calibration records will be appropriately maintained and made available for review by VVB.

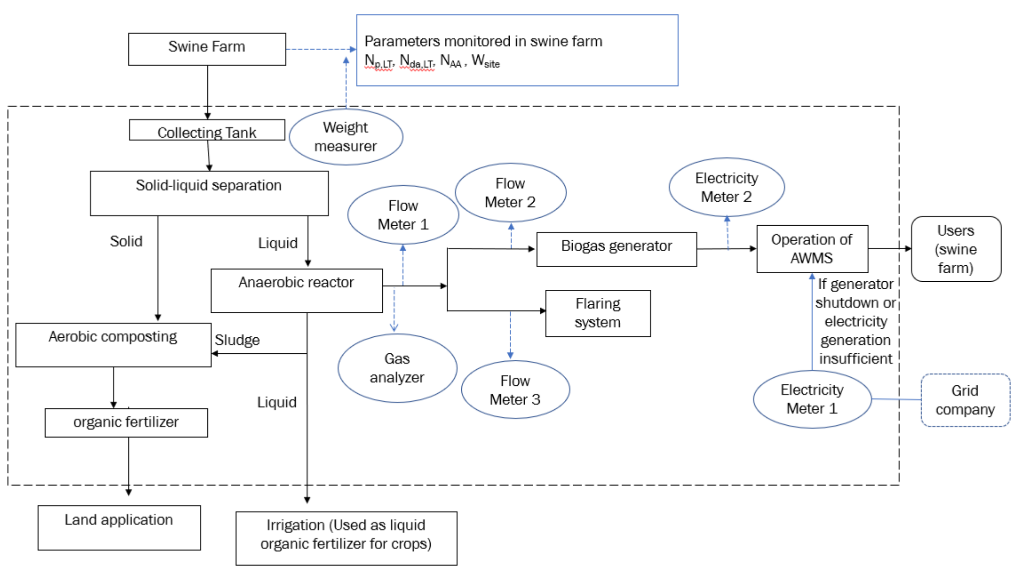


Figure 4-2 Installation and Configuration of Meters (Same monitoring system for each farm)

3. **Principle of Monitoring**

Every swine farm should monitor all the data mentioned description in Section 5.2 in the registered JPM.

The installation of relevant monitoring instruments shall be carried out in accordance with industry requirements and manufacturer specifications and shall be calibrated regularly as required.

If monitoring instruments is changed or added during the crediting period, this should be documented transparently in the monitoring reports, and the procedure for post registration changes shall be followed. For this project, during this monitoring period, the monitoring instruments have not changed or added.

4. Parameters to be monitored

The monitoring requirements for this methodology include the monitoring of parameters for both baseline emission, project emissions and leakage calculations. All provisions in the methodology and relevant tools shall apply, as described for each parameter in Section 5.2 of the registered JPM.

For this project, the parameters that need to be monitored as the description of section 5.2 of the registered JPM are as follows:

a) Number of animals of type LT produced annually for the year y, $N_{p,LT}$;

b) Number of days animal of type LT is alive in the farm in the year y, $N_{da,LT}$;

c) Daily stock of animals in the farm, discounting dead and discarded animals, $N_{AA,LT}$;

d) Average animal weight of a defined livestock population at the project site, W_{site};

e) Number of days treatment plant was operational in year y, n_{dy};

f) Quantity of electricity consumed by the project in year y, $EC_{PJ,j,y}$;

g) electricity generated using biogas in year y, $EG_{d,y}$

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

i) Biogas flow, V_f;

j) Volumetric flow of the gaseous stream in time interval t on a dry basis, $V_{t,db}$;

k) Volumetric fraction of greenhouse gas i in a time interval t on a dry basis, m^3 gas i/m^3 dry gas, $V_{i,t,db}$

l) Temperature of the gaseous stream in time interval t, T_t;

m) Pressure of the gaseous stream in time interval t, P_t.

n) Density of greenhouse gas i in the gaseous stream in time interval t, $\rho_{i,t}$

o) Fraction of volatile solids directed to aerobic treatment, F_{Aer} ;

p) Fraction of manure handled in system j in project activity, $MS\%_j$;

q) Maximum methane producing potential of the volatile solid generated by animal type *LT,* $B_{0, LT}$

r) Type of barn and AWMS, Type

s) Annual average ambient temperature at project site, T

For parameter $N_{p,LT}$ and $N_{AA,LT}$, i.e., the number of animals of type LT produced annually for the year y and the daily stock of animals in the farm, discounting dead and discarded animals, which are sourced from the monthly statistics of the number of exported from stock of market swine and the monthly number of the breeding in stock.

For parameter $N_{da,LT}$, number of days animal of type LT is alive in the farm in the year y is sourced from the data logged in the manure treatment plant, the data is usually 180 days.

For parameter W_{site}, the monitoring activities of the average animal weight of a defined livestock population at the project site will be conducted by sampling in the three age groups of Nursery phase, Growing phase and Mature phase in each swine farm at least one monthly. The monthly data is recorded by the PP and then average animal weight of a defined livestock population at the project site was calculated based on these data.

For parameter n_{dy}, i.e., the number of days treatment plant was operational can be determined according to the actual operating days of the manure treatment system during the monitoring period. The data can be obtained from the production record from the DCS system.

For electricity generated using biogas in year y can be obtained from the monthly summary table of electricity generated, i.e., $EC_{PJ,j,y}$. The quantity of electricity consumed from the grid company by the proposed project is sourced from the summary table of monthly power consumption and cross-checked by the grid statement issued by the power company.

For $TDL_{j,y}$, the average technical transmission and distribution losses for providing electricity to source j is sourced from the tool" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" and will be renewed once the tool is updated.

Biogas flow (V_f), Volumetric flow of the gaseous stream in time interval t on a dry basis ($V_{t,db}$) and the volumetric fraction of greenhouse gas i in a time interval t on a dry basis ($V_{i,t,db}$) can be monitored by the flowmeters and gas analysers, the data are sourced from the production record from the DCS system.

The temperature (T_t) and pressure (P_t) of the gaseous stream in time interval t is measured by the instruments with recordable electronic signal, the monitoring is continuous, and the change is very small. so, the data can be obtained from the production record from the DCS system. And the Density ($\rho_{i,t}$) of greenhouse gas i in the gaseous stream in time interval t should be calculated based on the temperature and pressure of the gaseous stream in time interval t.

For Fraction of volatile solids directed to aerobic treatment (F_{Aer}) and Fraction of manure handled in system j in project activity (MS%j), since there is no monitoring equipment to monitor in the actual operation. So, in the monitoring period, to be conservative, the value of the two parameters in the emission reduction calculation is 100%.

For $B_{0,LT}$, a default value from IPCC 2006 is applied, therefore it is not monitored during the operation period.

For Type of barn and AWMS (Type), the swine barn and AWMS layout and configuration are collected, which can be prove the Type of barn and AWMS, and only changes in the type of barn and AWMS will be reported after the first verification.

For annual average ambient temperature at project site (T), the monthly data can be sourced from publicly available information and can be cross-checked with the value of ex-ante estimated, i.e., 15.3℃.

5. Quality control and quality assurance procedures

A quality management system will be established, which ensures the quality and accuracy of the measured data.

Training

For all members involved in the project, necessary trainings will be provided by the project owner. Besides, the project owner should ensure that only skilled employees are allowed to undertake the monitoring work. The training contents should be regard to the general and technical aspects of the project to the extent appropriate, as well as basic understandings of VCS Standard and climate change. During this monitoring period, the training was conducted on 18-May-2022.

Data management

All data collected as part of monitoring plan should be saved with at least 1 backup copy until the end of the crediting period. After the crediting period ends, the data should be archived electronically on hard disks and be kept at least 2 years after the end of the last crediting period.

Corrective actions

The project will sign an agreement that it will not participate in other environment credits, other GHG programs and has not been rejected by any other GHG Programs. The whole VCS monitoring team will follow recognized standard data evaluation methods to guarantee that the data is reliable and accurate. The quality control and quality assurance procedures include the handling and correction of nonconformities in the implementation of the project or the monitoring plan. In case such nonconformities are observed:

- An analysis of the nonconformity and its causes will be carried out immediately by the project owner, with the help of external experts if necessary.

- A corrective action plan should then be developed to eliminate the non-conformity and its causes to prevent its recurrence.

- Corrective actions are implemented and reported back to the VCS monitoring team.

- Relative information will be included in the monitoring report and reported to VVB during the verification.

If the data record is missing or damaged during the monitoring periods, the following makeup process will be conducted:

-The general principle is that Conservative value will be used for the missing or damaged data. This is most conservative approach. The monitoring personnel will be trained before the starting of the project operation to ensure that each team member is fully aware of and able to strictly follow this conservative principle. During the monitoring process, the monitoring personnel will be required to strictly abide by the above conservative principle in data recording, i.e., use Conservative value for all the missing or damaged data.

-If this is due to the working error of the monitoring personnel, further train the person until he or she can perform the job properly. And in the meantime, use Conservative value for the missing or damaged data;

-If this is due to the inability or attitude of a particular worker in monitoring team, dismiss such worker and re-hire those with proper ability and attitude. And in the meantime, use Conservative value for the missing or damaged data;

-If some data recorded are significantly higher than the normal range, the monitoring personnel should ask for the reason. If the measurement is high due to the damage of measurement equipment, Conservative value will be used for that day's data. And need to calibrate and maintain the measuring equipment immediately and avoid this situation in the future.

If the monitoring results are satisfactory in terms of correct reporting, data completeness and correct analysis, the data will be accepted for the monitoring report.

Emergency procedure

Employees need to be familiar with the process flow and emergency situations that may occur during project operation and operate in strict accordance with the technical specifications of each process treatment equipment and monitoring equipment. During the operation of the project, all equipment and related instruments shall be checked regularly according to the manufacturer's recommendations. If necessary, calibration and/or proper repair have to be carried out immediately.

In case of malfunction and/or damage of any system or piece of the process, it may cause damage to the operation of the system, especially serious damage to the biogas generation and combustion system it must be dealt with as soon as possible and reported to the responsible technician immediately.

During this monitoring period, there was no emergency event occurred, such as overhaul and downtimes of anaerobic digesters. All the equipment operated well, and no equipment was under overhauled during this monitoring period and There was no emergency happened during this monitoring period.

6. Sample plan

The sampling objective

To determining the average animal weight of a defined livestock population (W_{site}) at the project site during the crediting period with a 95/10 confidence/precision.

According to “Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)”, the sampling plan is as follows:

Parameter	W_{site}
Objectives and reliability requirements	Determining the Average animal weight of a defined livestock population at the project site during the crediting period. According to the “Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)”, PP shall use 95/10 confidence/precision as the criteria for the reliability of sampling efforts for large-scale project. According to the methodology” ACM0010” GHG emission reductions from manure management systems (Version 08.0)”, each defined livestock population should be classified into a minimum of three age categories; The three age categories of marketing swine are classified according to the age in days, i.e. Nursery phase with 30-60days, Growing phase with 60-130days and Mature phase with 130-180days. The three age categories of breeding swine are classified according to the age in days, i.e. Nursery phase with 30-70days, Growing phase with 70-220days and Mature phase with 220-310days. For each defined livestock population, a minimum of one monthly sample per age category should be taken. In this project, the monitoring activities of the Average animal weight of a defined livestock population at the project site will be conducted in the three age groups of Nursery phase, Growing phase and Mature phase in each swine farm at least one monthly.
Target population and sampling frame	For the ex-calculation, A total of 99,450 Market swine and 54,252 breeding swine included in this project and the data of the average animal weight of a defined livestock population at the project site is from the Project evaluation report. As the applied value of 99,450 Market swine and 54,252 Breeding swine is the design scale, during the monitoring periods, the actual breeding scale of the farm will not exceed the design value, so the sample size calculated from the design values for monitoring period is conservative.
Sampling method	For this project, Siyang Aiyuan farm, Dongtai Jianggang Farm and Sheyang Linhai farm has breeding swine and market swine in stock, Siyang Nanliuji farm belongs to fatting farm which only have market swine. As this project involved 4 swine farms and two types of swine i.e., Market swine and Breeding swine, and as per applied methodology, each defined livestock population should be classified into a minimum of three age categories, so the sampling method is Stratified random sampling. The specific sampling methods are as follows:

	For the sampling, PP should calculate the overall sample size based on the population of pigs in stock firstly. As the project involved 4 swine farms, so the sample size in each swine farm should be determined based on the proportion of the number of each farm in the total number of 4 farms. Similarly, the sample size of each age group of Market swine and Breeding swine in a farm were also calculated based on the proportion of the number of each age group of Market swine and Breeding swine to the total number of swine in the farm. After the sample size in each age group of Market swine and Breeding swine of each swine farm determined, the sample can be conducted in every swine farm. Since swine in different age are kept in the different pig houses, samples can be randomly selected from pig houses of this age group. After the samples are selected, the weight is measured by weight measurers and recorded in the weight record table.

The sampling sizes.

According to the standard of the "Sampling and surveys for CDM project activities and programmes of activities (Version 09.0)", PP shall use 95/10 confidence/precision as the criteria for the reliability of sampling efforts for large-scale project.

According to statistical principles and sampling survey method, the sample size should be determined as follows[30]:

$$n_1 = \frac{Z^2\sigma^2}{d^2} = \frac{Z^2(\sigma^2/X^2)}{d^2/X^2} = Z^2V^2/e^2$$

$n_2 = n_1N/(N+n_1)$

$n_3 = Bn_2$

$n_4 = n_3/r$

$n = n_4\ (110\%)$

Where:

Z *the Z-statistic and the value taken is 1.96 (corresponding to 95% confidence level);*

σ *the standard deviation;*

d *the maximum error of estimate;*

X *the mean value of samples;*

V *the coefficient of variation, V= σ/X≤1 and its maximum value 1 is taken;*

e *the allowed relative sampling error ("precision") and the value taken is 10%;*

N the total number of involved swine 153,702;

B the survey design effect and the value taken is 1 because for stratification sampling the *B* value is less than or equal to 1;

[30] https://www.doc88.com/p-73947158230.html

r the survey reply rate and the value taken is 100%;

110% 10% contingency was added to produce the final sample size;

n_1, n_2, n_3, n_4, n the adjusted values after each step with n being the final number of samples to be taken. Actually, n4 is the required number of samples based on calculation, 10% contingency was added to n_4 to produce n in this sampling.

For pre-calculation, since the total number of involved swine is 153,702, N in the calculation of sample size is 153,702, and the calculation result is as follows:

Z	*V*	*e*	*N*	*B*	*r*
1.96	1	10%	153,702	1	100%
n_1	Z^2V^2/e^2	384			
n_2	$n_1N/(N+n_1)$	383			
n_3	Bn_2	383			
n_4	n_3/r	383			
n	n_4 (110%)	422			

The calculation result of n is 422. Therefore, 422 samples should be sufficient to satisfy the desired confidence and precision. 422 samples will be selected from the sampling frame according to the stratified sampling method every month.

As the applied value of 99,450 Market swine and 54,252 Breeding swine is the design scale, during the monitoring periods, the actual breeding scale of the farm will not exceed the design value, so the sample size calculated from the design values for monitoring period is conservative.

Stratified sampling (with samples of 422) was used for the monitoring of the W_{site}. The specific sampling methods are as follows: For the sampling, PP should calculate the overall sample size based on the population of pigs in stock firstly. As the project involved 4 swine farms, so the sample size in each swine farm should be determined based on the proportion of the number of each farm in the total number of 4 swine farms. Similarly, the sample size of each age group of Market swine and Breeding swine in a farm were also calculated based on the proportion of the number of each age group of Market swine and Breeding swine to the total number of swine in the farm. To be conservative, both the samples number of the four subsidiary farms is adjusted to be integer value. As a result, 436 samples of swine population were selected for the monitoring of the W_{site}.

The distribution of the samples in each age category in each farm shows as follow:

NO.	Swine farm	Swine type	Age catagory	Sample size
1	Siyang Aiyuan Farm	Market	Nursery phase with 30-60days	9
			Growing phase with 60-130days	9
			Mature phase with 130-180days	9
		Breeding	Nursery phase with 30-70days	16
			Growing phase with 70-220days	16
			Mature phase with 220-310days	16
2		Market	Nursery phase with 30-60days	10

	Dongtai Jianggang Farm		Growing phase with 60-130days	10
			Mature phase with 130-180days	10
		Breeding	Nursery phase with 30-70days	29
			Growing phase with 70-220days	29
			Mature phase with 220-310days	29
3	Sheyang Linhai Farm	Market	Nursery phase with 30-60days	12
			Growing phase with 60-130days	12
			Mature phase with 130-180days	12
		Breeding	Nursery phase with 30-70days	7
			Growing phase with 70-220days	7
			Mature phase with 220-310days	7
4	Siyang Nanliuji Farm	Market	Nursery phase with 30-60days	63
			Growing phase with 60-130days	62
			Mature phase with 130-180days	62
Total				436

Implementation and Monitoring frequency

The sampling process will start as soon as the target population is determined, and the sampling should be done once a month. The Sampling process will be determined by the VCS monitoring team.

The one monthly monitoring activity of the samples will be completed in the 4 swine farms during each monitoring periods.

Because the sampling activity is once a month, all the samples will be changed in the next month. The monitoring data will be collected and recorded throughout the entire crediting period. All archived data and documentation will be kept for at least 2 years after the end of the last crediting period.

Procedures for Administering Data Collection and Minimizing Non-sampling Errors

During the monthly monitoring activities, the weight of the month's sample was recorded in the weight record table by the monitoring team member in the 4 swine farms. Then average animal weight of a defined livestock population at the project site was calculated based on these data by the monitoring team member. The data will be reviewed by the project developer and VVB.

If the recorded raw data on the monitoring form are reasonable and basically consistent with the actual growth state, the raw data will be archived.

If the data record is missing or damaged or the target animal was dead during the monitoring periods, the following makeup process will be conducted:

1) The general principle is that zero value will be used for the missing or damaged data. This is most conservative approach. The monitoring personnel will be trained before the starting of the project operation to ensure that each team member is fully aware of and able to strictly follow this conservative principle. During the monitoring process, the monitoring personnel will be required to strictly abide by the above conservative principle in data recording, i.e., use zero values for all the missing or damaged data.

2) If this is due to the working error of the monitoring personnel, further train the person until he or she can perform the job properly. And in the meantime, use zero value for the missing or damaged data;

3) If this is due to the inability or attitude of a particular worker in monitoring team, dismiss such worker and re-hire those with proper ability and attitude. And in the meantime, use zero value for the missing or damaged data;

4) If some data recorded are significantly higher than the normal range and inconsistent with normal growth, the monitoring personnel should ask for the reason. If the measurement is high due to the damage of weighing scales or other measurement equipment, zero value will be used for that day's data. And need to calibrate and maintain the weighing scale or replace the measuring equipment immediately and avoid this situation in the future.

If the monitoring results are satisfactory in terms of correct reporting, data completeness and correct analysis, the data will be accepted for the monitoring report.

QA/QC Procedures

Before implementing the project, the project owner will train the personnel of monitoring teams on how to properly conduct the monitoring process.

If the data reported by the team member significantly deviates from the normal range, the monitoring personnel should write down the reasons and report to the team leader, any action is forbidden before the permission. The monitoring team will arrange research according to the attached form. At the same time, when the verification group has any doubt with the right result, they can arrange related research.

The project owner should enter all the measured data into the data sheet each month, using Excel to calculate the weighted mean value of average animal weight of a defined livestock population at the project site from all the sample, compared with the everyday normal growth state.

5 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

5.1 Baseline Emissions

As per paragraph 26 of the applied methodology, Baseline emissions are calculated as

$$BE_y = BE_{CH4,y} + BE_{N2O,y} + BE_{elec/heat,y} \quad \text{(Equation 1)}$$

where:

BE_y	Baseline emissions in year y (t CO_2/yr)
$BE_{CH4,\ y}$	Baseline CH_4 emissions in year y (t CO_2/yr)
$BE_{N2O,\ y}$	Baseline N_2O emissions in year y (t CO_2/yr)
$BE_{elec/heat,y}$	Baseline CO_2 emissions from electricity and/or heat used in the baseline (t CO_2/yr)

i) Baseline CH_4 emissions ($BE_{CH4,\ y}$)

$$BE_{CH4,y} = GWP_{CH4} * D_{CH4} * \sum_{j,LT}(MCF_j * B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_{Bl,j}) \quad \text{(Equation 2)}$$

where:

$BE_{CH4,\ y}$	Baseline CH_4 emissions in year y (t CO_2/yr)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (t CO_2e/t CH_4)
D_{CH4}	Density of CH_4 (t/m^3). 0.00067t/m^3 at room temperature (20℃) and 1am pressure.
MCF_j	Annual methane conversion factor (MCF_j) for the baseline AWMSj. IPCC 2006 Guidelines, table 10.17, chapter 10, volume 4.
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg -dm)
N_{LT}	Annual average number of animals of type LT for the year y (number)
$VS_{LT,y}$	Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
) $MS\%_{Bl,j}$	Fraction of manure handled in system j in the baseline. In this project, the baseline manure management system is uncovered anaerobic lagoon only. The amount of manure handled by the anaerobic lagoon is 100%. $MS\%_{Bl,j}$ =100%
) LT	Type of livestock
) j	Type of treatment system

Estimation of various variables and parameters for above equations:

(A) The determined of $VS_{LT,y}$

As per applied methodology, there are 4 options can be used to determine the $VS_{LT,y}$. There is no published country specific data available, and the energy intake of the swine is not available, so Option 1 and option 2 are not applied. Option 3 utilizes the average weight of the swine, this data is available and therefore Option 3 is adopted to calculate $VS_{LT,y}$. Since option 3 is preferred for determining $VS_{LT,y}$, therefore Option 4 is not needed to be taken into account.

Option 3:

Scaling default IPCC values $VS_{default}$ to adjust for a site-specific average animal weight as shown in equation below:

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}}\right) * VS_{default} * nd_y \qquad \text{(Equation 3)}$$

where:

$VS_{LT,y}$ Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)

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 (kg)

$VS_{default}$ Default value for the volatile solid excretion per day on a dry-matter basis for a defined livestock population (kg-dm/animal/day)

nd_y Number of days treatment plant was operational in year y

The calculation result of this parameter during this monitoring period is listed in the table 5-1 below.

(B) Annual average number of animals of type LT (N_{LT}) shall be determined in one of the following ways, presented in order of preference

Option 1:

$$N_{LT} = N_{da,LT} * \left(\frac{N_{p,LT}}{365}\right) \qquad \text{(Equation 4)}$$

where:

N_{LT} Annual average number of animals of type *LT* for the year *y* (number)

$N_{da,LT}$ Number of days animal of type *LT* is alive in the farm in the year *y* (number)

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

Option 2:

If the project developer can monitor in a reliable and traceable way the daily stock of animals in the farm, discounting dead animals and animals discarded from the productive process from the daily stock, then the annual average number of animals (N_{LT}) may be calculated as follows:

$$N_{LT} = \frac{\sum_1^{365} N_{AA,LT}}{365} \qquad \text{(Equation 5)}$$

where:

N_{LT} Annual average number of animals of type *LT* for the year *y* (number)

$N_{AA,LT}$ Daily stock of animals of type *LT* in the farm, discounting dead and discarded animals (number)

There are two types of swine in this project, i.e., market swine and Breeding swine. For market swine, the Option 1 is adopted. For Breeding swine, the PP can monitor the daily stock of Breeding swine in a reliable way, discounting dead Breeding swine and discarded them from the productive process from the daily stock. So, the Option 2 is adopted to calculate N_{LT} for Breeding swine.

The monitoring result of N_{LT} during this monitoring period can be seen in table 5-1.

(C) Maximum methane producing potential ($B_{0,LT}$)

According to applied methodology ACM0010 (Version 08.0), this value varies by species and diet. Default values are used, and they are taken from tables 10A-4 through 10A-9 (IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter10).

The project is located in Jiangsu Province, China, Asia. According to Table 10A-7 and 10A-8 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories volume 4, chapter10, the maximum methane producing potential ($B_{0,LT}$) for Market swine and Breeding swine in Asia region is 0.29 m^3 CH_4/kg VS.

(D) Annual methane conversion factor (MCFj) for the baseline $AWMS_j$

(a)The MCFj values given in table 10.17, chapter 10, volume 4, IPCC 2006 Guidelines should be used. MCFj values depend on the annual average temperature where the anaerobic manure treatment facility in the baseline existed. For this project, the ex ante annual average temperature is 15.3℃, the actual average temperature in this monitoring period is 16.8℃, so the value of 74% is applied.

(b) A conservativeness factor should be applied by multiplying MCFj values (estimated as per above bullet) with a value of 0.94, to account for the 20% uncertainty in the MCFj values as reported by IPCC 2006.

ii) Baseline N_2O emissions ($BE_{N2O,y}$)

$$\mathrm{BE}_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (E_{N2O,D,y} + E_{N2O,ID,y}) \qquad \text{(Equation 6)}$$

where：

$BE_{N2O,y}$	Annual baseline N_2O emissions in (t CO_2e/yr)
GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$E_{N2O,D,y}$	Direct N_2O emission in year *y* (kg N_2O-N/year)
$E_{N2O,ID,y}$	Indirect N_2O emission in year *y* (kg N_2O-N/year)

$$E_{N2O,D,y} = \sum_{j,LT} EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j} \qquad \text{(Equation 7)}$$

where：

$E_{N2O,D,y}$ Direct N_2O emission in year *y* (kg N_2O-N/yr)

$EF_{N2O,D,j}$ Direct N_2O emission factor for the treatment system *j* of the manure management system (kg N_2O-N/kg N). (Estimated with site-specific, regional or national data if such data is available, otherwise use default EF_3 from table 10.21, chapter 10, volume 4, in the IPCC 2006 Guidelines for National Greenhouse Gas Inventories). The site-specific, regional or national data are not available, so this project activity adopts default EF_3.

$NEX_{LT,y}$ Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2

$MS\%_{Bl,j}$ Fraction of manure handled in system *j* (fraction)

N_{LT} Annual Average number of animals of type LT for the year *y* estimated as per equation (5) or (6) (number)

$$E_{N2O,ID,y} = \sum_{j,LT} EF_{N2O,ID} * F_{gasMS,j,LT} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j} \qquad \text{(Equation 8)}$$

where:

$E_{N2O,ID,y}$ Indirect N_2O emission in year *y* (kg N_2O-N/year)

$EF_{N2O,ID}$ Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN_2O-N/kg NH_3-N and NO_X-N). (Estimated with site-specific, regional or national data if such data is available. Otherwise, default values for EF_4 from table 11.3, chapter 11, volume 4 of IPCC 2006 Guidelines for National Greenhouse Gas Inventories can be used). The site-specific, regional or national data are not available, so this project activity adopts default EF_4.

$NEX_{LT,y}$ Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2

$MS\%_{Bl,j}$ Fraction of manure handled in system *j* (fraction)

$F_{gasMS,j,LT}$ Default values for nitrogen loss due to volatilization of NH_3 and NO_X from manure management (fraction)

N_{LT} Annual Average number of animals of type LT for the year *y* estimated as per equation (5) or (6) (number)

Estimation of various variables and parameters for above equations:

(A)Procedure for estimating $NEX_{LT,y}$

As per applied methodology, there are two options can be used to estimate this parameter. While, for this project, neither specific information on Portion of that N intake nor site-specific national or regional data is available. So, the Option 2 is adopted to calculate $NEX_{LT,y}$. the procedure of option 2 is as follows:

Option 2:

In the absence of availability of project specific information on protein intake, which should be justified in the "CDM-PDD", national or regional data should be used for the nitrogen excretion $NEX_{LT,y}$, if available. In the absence of such data, default values from table 10.19 of the IPCC 2006, volume 4, chapter 10 may be used and should be corrected for the animal weight at the project site in the following way:

$$NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCC\ default} \quad \text{(Equation 9)}$$

where:

$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr)
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 (kg)
$NEX_{IPCC\ default}$	Default value for the nitrogen excretion per head of a defined livestock population (kg N/animal/year)

$$NEX_{IPCC\ default} = N_{rate(T)} * \frac{TAM}{1000} * 365^{31} \quad \text{(Equation 10)}$$

where:

$N_{rate(T)}$	the default N excretion rate, kg N/ (1000 kg animal mass)/ day, table 10.19, chapter 10, volume 4 of IPCC 2006 Guidelines
TAM	Typical animal mass for livestock in kg/animal

The calculation result of this parameter during this monitoring period can be seen in table 5-1 below.

iii) Baseline CO_2 emission from electricity and/or heat used in the baseline

$$\mathrm{BE_{elec/heat,y}} = \mathrm{BE_{EC,y}} + \mathrm{BE_{HG,y}} \quad \text{(Equation 11)}$$

where:

$BE_{elec/heat,y}$	Baseline CO_2 emissions from electricity and/or heat used in the baseline (t CO_2/yr)
$BE_{EC,y}$	Baseline emissions associated with electricity generation in year *y* (t CO_2/yr)
$BE_{HG,y}$	Baseline emissions associated with heat generation in year *y* (t CO_2/yr)

The baseline scenario of this project is uncovered anaerobic lagoon, and no heat used in the baseline, only minor electricity is used, so the emission can be excluded for simplification. In addition, the biogas generated during the treatment process in this project is captured for power generation and all the electricity generated from this project is used by the daily operation of AWMS and the 4 swine farms. The electricity generated is not connected to another user or to the regional power grid. So, the baseline CO_2 emission from electricity and/or heat used in the baseline is 0, which is conservative. So, $BE_y = BE_{CH4,y} + BE_{N2O,y}$.

[31] This formula refers to the formula 10.30 in chapter 10 volume IPCC2006.

During this monitoring period, the basic monitoring data values used in the calculation of baseline emissions and the BEy calculation results are shown in the Table 5-1 and Table 5-2 below.

Table 5-1 the basic monitoring data values used in the calculation of baseline emissions.

Time	N_{LT}	$N_{AA,LT}$	W_{site} (kg)		n_{dy}(day)	$VS_{LT,y}$ (kg-dm/ animal/year)		NEX_{IPCC} (kg N/animal/year)		$NEX_{LT,y}$ (kg N/animal/year)	
	Market swine	Breeding swine	Market swine	Breeding swine		Market swine	Breeding swine	Market swine	Breeding swine	Market swine	Breeding swine
01-January-2022 to 31-January-2022	94,226	51,851	57.6	72.0	31	19.13	23.91	0.36	0.21	0.75	0.54
01-February-2022 to 28-February-2022	94,226	51,422	57.8	74.3	28	17.34	22.29	0.33	0.19	0.68	0.50
01-March-2022 to 31-March-2022	94,226	51,878	58.6	72.4	31	19.46	24.05	0.36	0.21	0.76	0.54
01-April-2022 to 30-April-2022	94,226	51,867	58.0	71.8	30	18.64	23.08	0.35	0.20	0.73	0.52
01-May-2022 to 31-May-2022	94,226	51,807	57.9	73.4	31	19.23	24.38	0.36	0.21	0.75	0.55
01-June-2022 to 30-June-2022	94,226	51,827	58.9	72.1	30	18.93	23.18	0.35	0.20	0.74	0.52
01-July-2022 to 31-July-2022	94,226	51,818	59.1	72.2	31	19.63	23.98	0.36	0.21	0.77	0.54
01-August-2022 to 31-August-2022	94,226	51,830	58.2	72.4	31	19.33	24.05	0.36	0.21	0.76	0.54
01-September-2022 to 30-September-2022	94,226	51,018	57.4	71.4	30	18.45	22.95	0.35	0.20	0.72	0.51
01-October-2022 to 31-October-2022	94,226	51,826	57.6	73.1	31	19.13	24.28	0.36	0.21	0.75	0.54
01-November-2022 to 30-November-2022	94,226	51,806	58.1	73.8	30	18.68	23.72	0.35	0.20	0.73	0.53
01-December-2022 to 31-December-2022	94,226	51,828	58.7	73.0	31	19.50	24.25	0.36	0.21	0.76	0.54

Table 5-2 The calculation result of BE_y

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
GWP_{CH4}	28	28	tCO_2/tCH_4
D_{CH4}	0.00067	0.00067	t/m^3
MCF_j	74%	74%	%
Conservative Factor	0.94	0.94	/
MCF with cons. Factor	0.6956	0.6956	/
$B_{0,LT}$	0.29	0.29	m^3 CH_4 /kg_dm
N_{LT}	Refer to Table 5-1		
W_{site}	Refer to Table 5-1		
$W_{default}$	28	28	kg
$VS_{default}$	0.3	0.3	Kg-dm/animal/day
$VS_{LT,y}$	Refer to Table 5-1		
$MS\%_{Bl,j}$	100%	100%	%
n_{dy}	Refer to Table 5-1		
$BE_{CH4,y}$ in this monitoring period	**136,717**		**tCO_2e**
$EF_{N2O,D,j}$	0	0	kg N_2O-N/kg N
$EF_{N2O,ID,j}$	0.01	0.01	kg N_2O-N/kg N
$N_{rate(T)}$	0.42	0.24	kg N/1000kg animal mass/day
$NEX_{IPCC\ default}$	Refer to Table 5-1		
$NEX_{LT,y}$	Refer to Table 5-1		
TAM	28.00	28.00	kg
$F_{gasMS,j,LT}$	40%	40%	/
GWP_{N2O}	265	265	tCO_2/t N_2O
$CF_{N2O,N-N}$	1.57	1.57	Conversion Factor N_2O-N to N_2O
$BE_{N2O,y}$ in this monitoring period	**1,947**		**tCO_2e**
BE_y in this monitoring period	**138,664**		**tCO_2e**

5.2 Project Emissions

Two stages are involved in the manure treatment for the project activity: (1) anaerobic digester; (2) aerobic composting. As per applied methodology, project emissions are estimated as follows:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y} + PE_{EC/FC,y} \quad \text{(Equation 12)}$$

where：

PE_y	Project emissions in year y
$PE_{AD,y}$	Project emissions associated with the anaerobic digester in year y (t CO_2e/yr)
$PE_{Aer,y}$	Project CH_4 emissions from aerobic AWMS treatment (t CO_2e/yr)
$PE_{N2O,y}$	Project N_2O emissions in year y (t CO_2/yr)
$PE_{EC/FC,y}$	Project emissions from electricity consumption and fossil fuel combustion (t CO_2e/yr)

i) Project emissions associated with the anaerobic digester in year y ($PE_{AD,y}$)

For $PE_{AD,y}$, according to the Tool14" Project and leakage emissions from anaerobic digesters (Version 02.0)", the project emissions associated with the anaerobic digester ($PE_{AD,y}$) are determined by

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y}$$ (Equation 13)

where:

$PE_{AD,y}$	Project emissions associated with the anaerobic digester in year y (t CO_2e)
$PE_{EC,y}$	Project emissions from electricity consumption associated with the anaerobic digester in year y (t CO_2e)
$PE_{FC,y}$	Project emissions from fossil fuel consumption associated with the anaerobic digester in year y (t CO_2e)
$PE_{CH4,\ y}$	Project emissions of methane from the anaerobic digester in year y (t CO_2e)
$PE_{flare,y}$	Project emissions from flaring of biogas in year y (t CO_2e)

Since the electricity consumption of the anaerobic digestion system cannot be measured separately from the entire AWMS, so the project emissions from electricity consumption associated with the anaerobic digester and that is not related to the anaerobic digester will be calculated together.

The project emissions from electricity consumption calculated according to the tool 05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation",

$$PE_{EC,y} = \sum_{\mathrm{j,LT}} EC_{\mathrm{PJ,J,y}} * \mathrm{EF}_{\mathrm{EF,j,y}} * (1 + \mathrm{TDL}_{\mathrm{j,y}})$$ (Equation 14)

Where：

$PE_{EC,y}$	Project emissions from electricity consumption in year y (t CO_2e)
$EG_{PJ,J,y}$	Quantity of electricity consumed by the project electricity consumption source *j* in year *y* (MWh/yr)
$EF_{EF,j,\ y}$	Emission factor for electricity generation for source *j* in year *y* (t CO_2/MWh)
$TDL_{j,y}$	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*

During the monitoring period, the actual electricity consumption from the region grid of the AWMS is determined according to the actual electricity settlement with the grid company, the actual electricity consumption from the region grid and the calculated result of $PE_{EC,y}$ is listed in table 5-3 below.

Table 5-3 the calculation result of $PE_{EC,y}$

Time	$EC_{PJ,j,y}$ (MWh)	$EF_{EF,j,y}$ (tCO_2/MWh)	$TDL_{j,y}$	$PE_{EC,y}$(tCO_2e)
01-January-2022 to 31-January-2022	35.42451	0.58955	20%	26
01-February-2022 to 28-February-2022	37.98294	0.58955	20%	27

01-March-2022 to 31-March-2022	36.82105	0.58955	20%	27
01-April-2022 to 30-April-2022	37.09454	0.58955	20%	27
01-May-2022 to 31-May-2022	35.60149	0.58955	20%	26
01-June-2022 to 30-June-2022	30.87975	0.58955	20%	22
01-July-2022 to 31-July-2022	37.54392	0.58955	20%	27
01-August-2022 to 31-August-2022	33.85002	0.58955	20%	24
01-September-2022 to 30-September-2022	34.94843	0.58955	20%	25
01-October-2022 to 31-October-2022	31.64299	0.58955	20%	23
01-November-2022 to 30-November-2022	36.86195	0.58955	20%	27
01-December-2022 to 31-December-2022	35.99579	0.58955	20%	26
Total in this MP	424.64738	/	/	307

For $PE_{FC,y}$, since the anaerobic digestion process of this project does not involve the use of fossil fuels, so the project emissions from fossil fuel consumption associated with the anaerobic digester is 0, i.e., $PE_{FC,y}$=0.

In case, there is residual gas stream which is be flared by flaring and the project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the tool 06 " Project emissions from flaring"(version 04.0).

The calculation procedure in this tool determines the project emissions from flaring the residual gas ($PE_{flare,y}$) based on the flare efficiency ($\eta_{flare,m}$) and the mass flow of methane to the flare ($F_{CH4,RG,m}$). The flare efficiency is determined for each minute m of year y based either on monitored data or default values.

The calculation procedure of project emissions from flaring is given in the following steps:

STEP 1: Determination of the methane mass flow of the residual gas;

STEP 2: Determination of the flare efficiency;

STEP 3: Calculation of project emissions from flaring.

Step 1: Determination of the methane mass flow in the residual gas

The Tool 08 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream" shall be used to determine the following parameter $F_{CH4,m}$:

The following requirements apply:

(a) The gaseous stream to which the tool is applied is the residual biogas for flaring;

(b) The flow of the gaseous stream shall be measured continuously;

(c) CH_4 is the greenhouse gas *i* for which the mass flow should be determined;

(d) The simplification offered for calculating the molecular mass of the gaseous stream is valid (equations 3 and 17 in the tool); and

(e) The time interval *t* for which mass flow should be calculated is every minute *m*.

$F_{CH4,m}$, which is measured as the mass flow during minute *m*, shall then be used to determine the mass of methane in kilograms fed to the flare in minute *m* ($F_{CH4,RG,m}$). $F_{CH4,m}$ shall be determined on a dry basis.

Therefore, option A is adopted to calculate the mass flow of the residual biogas for flaring as per Too 08 "Tool to determine the mass flow of a greenhouse gas in a gaseous stream"

As per paragraph 23 of Tool 8:" Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version 03.0)", the way to prove that the gaseous stream is dry needs to demonstrate that the temperature of the gaseous stream (Tt) is less than 60ºC (333.15 K) at the flow measurement point. For this project, the flowmeters installed in the outlet of the anaerobic tanks and the temperature of the anaerobic treatment unit of this project is designed as medium temperature, and the optimal temperature range is 35 ~ 38ºC. Therefore, the gas temperature measured by the flowmeter does not exceed 60 ºC, it can be demonstrated that the gaseous stream is dry.

The mass flow of greenhouse gas i ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,db} * \upsilon_{i,t,db} * \rho_{i,t} \qquad \text{(Equation 15)}$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \qquad \text{(Equation 16)}$$

where:

$F_{i,t}$	Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m³ dry gas/h)
$\upsilon_{i,t,db}$	Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis (m³ gas *i*/m³ dry gas)
$\rho_{i,t}$	Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m³ gas *i*)
P_t	Absolute pressure of the gaseous stream in time interval *t* (Pa)
MM_i	Molecular mass of greenhouse gas *i* (kg/kmol)
R_u	Universal ideal gases constant (Pa.m³/kmol.K)
T_t	Temperature of the gaseous stream in time interval *t* (K)

Step 2: Determination of flare efficiency

The flare efficiency depends on the efficiency of combustion in the flare and the time that the flare is operating. For determining the efficiency of combustion of enclosed flares there is the option to apply a default value or determine the efficiency based on monitored data. For open flares a default value must be applied. The time the flare is operating is determined by monitoring the flame using a flame detector and, for the case of enclosed flares, in addition the monitoring requirements provided by the manufacturer's specifications for operating conditions shall be met.

The flare in this project belongs to open flares. According to Tool 06 paragraph 18: in the case of open flares, the flare efficiency in the minute m ($\eta_{flare,m}$) is 50% when the flame is detected in the minute m (*$Flame_m$*), otherwise $\eta_{flare,m}$ is 0%.

Since the flame is not detected in the minute, therefore, fixed value of 0% for the flare efficiency will be applied for this project, and this is for conservative.

Step 3: Calculation of project emissions from flaring

Project emissions from flaring are calculated as the sum of emissions for each minute m in year y, based on the methane mass flow in the residual gas ($F_{CH4,RG,m}$) and the flare efficiency ($\eta_{flare,m}$), as follows:

$$PE_{flare,y} = GWP_{CH4,y} * \sum_{m=1}^{525600} F_{CH4,GR,m} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad \text{(Equation 17)}$$

Where:

$PE_{flare,y}$	Project emissions from flaring of the residual gas in year *y* (tCO_2e)
GWP_{CH4}	Global warming potential of methane valid for the commitment period (tCO_2e/tCH_4)
$F_{CH4,RG,m}$	Mass flow of methane in the residual gas in the minute *m* (kg)
$\eta_{flare,m}$	Flare efficiency in minute *m*

As described above, $F_{CH4,RG,m}$ will be determined according to equation 15 and 16 above, so the Project emissions from flaring can be calculated by:

$$PE_{flare,y} = GWP_{CH4,y} * V_{t,db} * \upsilon_{i,t,db} * \rho_{i,t} * \left(1 - \eta_{flare,m}\right) * 10^{-3} \quad \text{(Equation 18)}$$

Where:

$V_{t,db}$	Volumetric flow of the residual gas for flaring in time interval *t* on a dry basis (m^3 dry gas/h)
$\upsilon_{i,t,db}$	Volumetric fraction of greenhouse gas *i* in the gaseous stream for flaring in a time interval *t* on a dry basis (m^3 gas *i*/m^3 dry gas)
$\rho_{i,t}$	Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m^3 gas *i*)

Since the gaseous stream will be distributed though the same pipeline, and the temperature and pressure of gaseous stream can be stable. Therefore the $\upsilon_{i,t,db}$ *and* $\rho_{i,t}$ of residual gas will be same with the biogas produced in the anaerobic digester.

During this monitoring period, as all the biogas generated in the AWMSs is collected for power generation, so no biogas is flared, i.e., $PE_{flare,y}$ =0 tCO_2e.

Determination of project emissions of methane from the anaerobic digester ($PE_{CH4,y}$)

$PE_{CH4,y}$ was determined following the step 4 of the applied tool "Project and leakage emissions from anaerobic digesters(Version 02.0)".Project emissions of methane from the anaerobic digester include emissions during maintenance of the digester, physical leaks through the roof and side walls, and release through safety valves due to excess pressure in the digester. These emissions are calculated using a default emission factor ($EF_{CH4,\ default}$), as follows:

$$PE_{CH4,y} = Q_{CH4,y} * EF_{CH4,default} * GWP_{CH4} \quad \text{(Equation 19)}$$

where:

$PE_{CH4,\ y}$	Project emissions of methane from the anaerobic digester in year y (t CO_2e)
$Q_{CH4,y}$	Quantity of methane produced in the anaerobic digester in year y (t CH_4)
$EF_{CH4,default}$	Default emission factor for the fraction of CH_4 produced that leak from the anaerobic digester (fraction)
GWP_{CH4}	Global warming potential of CH_4 (t CO_2 / t CH_4)

Estimation of various variables and parameters for above equations:

(A) Quantity of methane produced in the anaerobic digester *$Q_{CH4,y}$*

According to the TOOL14" Project and leakage emissions from anaerobic digesters (Version 02.0)". There are two different procedures to determine the quantity of methane produced in the digester in year y ($Q_{CH4,y}$). For large scale projects defined by CDM only Option 1 shall be used. For small scale projects defined by CDM, project participants may choose between Option 1 or Option 2. The proposed project belongs to large scale projects defined by CDM, so $Q_{CH4,y}$ was determined following step 1 and Option 1 of the applied tool. Below is the formula used for the calculation of $Q_{CH4,y}$.

Option1: Procedure using monitored data

$Q_{CH4,y}$ shall be measured using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream". When applying the tool, the following applies:

(a) The gaseous stream to which the tool is applied is the biogas collected from the digester.

(b) CH_4 is the greenhouse gas i for which the mass flow should be determined; and

(c) The flow of the gaseous stream should be measured on an hourly basis or a smaller time interval; and then accumulated for the year y. Please note that units need to be converted to tons, when applying the results in this tool.

The biogas is produced and collected from anaerobic digestion process. The flowmeters are installed at the outlet of the biogas digesters and the measured on an hourly basis time interval. So the quantity of methane produced in the digester in year y ($Q_{CH4,y}$) is the accumulation of the mass flow of methane in the gaseous stream in an hourly basis time interval. i.e., $Q_{CH4,y} = \sum_{i=1}^{8760} F_{i,t}$.

The mass flow of greenhouse gas *i* ($F_{i,t}$) is determined as follows:

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \qquad \text{(Equation 20)}$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \qquad \text{(Equation 21)}$$

where:

$F_{i,t}$ Mass flow of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas/h)

$V_{t,db}$ Volumetric flow of the gaseous stream in time interval *t* on a dry basis (m^3 dry gas/h)

$v_{i,t,db}$ Volumetric fraction of greenhouse gas *i* in the gaseous stream in a time interval *t* on a dry basis (m^3 gas *i*/m^3 dry gas)

$\rho_{i,t}$ Density of greenhouse gas *i* in the gaseous stream in time interval *t* (kg gas *i*/m^3 gas *i*)

P_t Absolute pressure of the gaseous stream in time interval *t* (Pa)

MM_i Molecular mass of greenhouse gas *i* (kg/kmol)

R_u Universal ideal gases constant (Pa.m^3/kmol.K)

T_t Temperature of the gaseous stream in time interval *t* (K)

During this monitoring period, the amount of biogas captured from the anaerobic tank and the calculated result of PE_{CH4} can be seen in table 5-4 below.

Table 5-4 the calculation result of $PE_{CH4,y}$

Time	GWP_{CH4} (tCO_2/tCH_4)	$EF_{CH4,default}$ (tCH_4 leaked / tCH_4 produced)	$Q_{CH4,y}$ (tCH_4)	**$PE_{CH4,y}$(tCO_2e)**
01-January-2022 to 31-January-2022	28	0.05	413.73	579.22
01-February-2022 to 28-February-2022	28	0.05	376.53	527.15
01-March-2022 to 31-March-2022	28	0.05	422.99	592.20
01-April-2022 to 30-April-2022	28	0.05	402.70	563.78
01-May-2022 to 31-May-2022	28	0.05	418.06	585.28
01-June-2022 to 30-June-2022	28	0.05	404.08	565.72
01-July-2022 to 31-July-2022	28	0.05	422.69	591.78
01-August-2022 to 31-August-2022	28	0.05	409.68	573.55
01-September-2022 to 30-September-2022	28	0.05	408.99	572.59
01-October-2022 to 31-October-2022	28	0.05	419.39	587.15
01-November-2022 to 30-November-2022	28	0.05	410.39	574.56

01-December-2022 to 31-December-2022	28	0.05	423.13	592.38
Total in this monitoring period			4,932.36	6,906

In summary, the Project emissions associated with the anaerobic digester in year y (t CO_2e) is calculated by $PE_{AD,y}$= $PE_{CH4,y}$+$PE_{EC,y}$. The calculation result of $PE_{AD,y}$ are shown in Table 5-5.

Table 5-5 the calculation result of $PE_{AD,y}$

Period	$PE_{EC,y}$ (tCO_2e)	$PE_{CH4,y}$ (tCO_2e)	$PE_{AD,y}$ (tCO_2e)
2nd monitoring period from 01-January-2022 to 31-December-2022	307	6,906	7,213

ii) Project CH_4 emissions from aerobic AWMS treatment ($PE_{Aer, y}$)

IPCC guidelines specify emissions from aerobic lagoons as 0.1 per cent of total methane generating potential of the waste processed, which can be used as a default for all types of aerobic AWMS treatment.

$$PE_{Aer,y} = GWP_{CH4} * D_{CH4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}\left(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j\right) + PE_{sl,y}$$

(Equation 22)

where:

GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
$R_{VS,n}$	Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to waste being treated (fraction)
D_{CH4}	Density of CH_4 (t/m^3)
F_{Aer}	Fraction of volatile solid directed to aerobic system (fraction)
LT	Type of livestock
$B_{o,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg dm)
$VS_{LT,y}$	Annual volatile solid excretion livestock type LT entering all AWMS on a dry matter weight basis in (kg -dm/animal/yr)
N_{LT}	Annual average number of animals of type LT for the year y (number) as estimated in equation (4) or (5)
$PE_{sl,y}$	Project CH_4 emissions from sludge disposed of in storage pit prior to disposal during the year y (t CO_2e/yr)
$MS\%_j$	Fraction of manure handled in system j in the project activity (fraction)

All sludge produced from the aerobic composting is used for land application, which is calculated as leakage emission, so the $PE_{sl,y}$=0. So,

$$PE_{Aer,y} = GWP_{CH4} * D_{CH4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}\left(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j\right)$$

(Equation 23)

where:

GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)
$R_{VS,n}$	Fraction of volatile solid degraded in AWMS treatment method n of the N treatment steps prior to waste being treated (fraction)
D_{CH4}	Density of CH_4 (t/m^3)
F_{Aer}	Fraction of volatile solid directed to aerobic system (fraction)
LT	Type of livestock
$B_{o,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg dm)
$VS_{LT,y}$	Annual volatile solid excretion livestock type LT entering all AWMS on a dry matter weight basis in (kg -dm/animal/yr)
N_{LT}	Annual average number of animals of type LT for the year y (number) as estimated in equation (4) or (5)
$MS\%_j$	Fraction of manure handled in system j in the project activity (fraction)

The specific calculation results of this monitoring period are shown in Table 5-6.

Table 5-6 the calculation result of $PE_{Aer,y}$

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
GWP_{CH4}	28	28	tCO_2/tCH_4
D_{CH4}	0.00067	0.00067	t/m^3
	0.001	0.001	kg N/1000kg animal mass/day
F_{Aer}	100%	100%	/
$1\text{-}R_{vs,1}$	20%	20%	/
$B_{0,LT}$	0.29	0.29	m^3CH_4/kg-dm
N_{LT}	Refer to Table 5-1		
$VS_{LT,y}$	Refer to Table 5-1		
$MS\%_j$	100%	100%	
$PE_{Aer,y}$ in this monitoring period	**40**		**tCO_2e**

iii) Project N_2O emissions in year y ($PE_{N2O,y}$)

$$PE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (E_{N2O,D,y} + E_{N2O,ID,y}) \quad \text{(Equation 24)}$$

where:

$PE_{N2O,y}$	Project N_2O emissions in year y (t CO_2/yr)
GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$E_{N2O,D,y}$	Direct N_2O emission in year y (kg N_2O-N/year)
$E_{N2O,ID,y}$	Indirect N_2O emission in year y (kg N_2O-N/year)

There are two options to estimate the $E_{N2O,D,y} and\ E_{N2O,ID,y}$, since the same method used to estimate the emissions in the baseline should be used to estimate the project emissions of nitrous oxide, so the Option 1 is used.

Option1:

$$E_{N2O,D,y} = \sum_{j,LT} EF_{N2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_j \qquad \text{(Equation 25)}$$

where：

$E_{N2O,D,y}$	Direct N_2O emission in year *y* (kg N_2O-N/yr)
$EF_{N2O,D,j}$	Direct N_2O emission factor for the treatment system *j* of the manure management system (kg N_2O-N/kg N)
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2
$MS\%_j$	Fraction of manure handled in system *j* (fraction)
N_{LT}	Annual Average number of animals of type LT for the year *y* estimated as per equation (4) or (5) (number)

$$E_{N2O,ID,y} = \sum_{j,LT} EF_{N2O,ID} * F_{gasMS,j,LT} * NEX_{LT,y} * N_{LT} * MS\%_j \qquad \text{(Equation 26)}$$

where:

$E_{N2O,ID,y}$	Indirect N_2O emission in year *y* (kg N_2O-N/year)
$EF_{N2O,ID}$	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN_2O-N/kg NH_3-N and NO_X-N)
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in appendix 2
$MS\%_j$	Fraction of manure handled in system *j* (fraction)
$F_{gasMS,j,LT}$	Default values for nitrogen loss due to volatilisation of NH_3 and NO_X from manure management (fraction)
N_{LT}	Annual Average number of animals of type LT for the year *y* estimated as per equation (4) or (5) (number)

The specific calculation result in this monitoring period is shown in Table 5-7.

Table 5-7 the calculation result of $PE_{N2O,y}$

Parameter	Value		Unit
species	**Market Swine**	**Breeding Swine**	
$EF_{N2O,D,j}$	0	0	kg N_2O-N/kg N
$NEX_{LT,y}$	Refer to Table 5-1		
N_{LT}	Refer to Table 5-1		
$MS\%_j$	100%	100%	/
$E_{N2O,D,y}$ in this monitoring period	**0**		**kg N_2O-N/year**
$EF_{N2O,D,j}$	0.006	0.006	kg N_2O-N/kg N
$NEX_{LT,y}$	Refer to Table 5-1		

N_{LT}	Refer to Table 5-1		
$MS\%_j$	100%	100%	/
$E_{N20,D,y}$ in this monitoring period	**7,029**		**kg N_2O-N/year**
$EF_{N20,iD,j}$	0.01	0.01	kg N_2O-N/kg NH_3 and NO_X-N
$F_{gasMS,j,LT}$	0.4	0.4	/
$NEX_{LT,y}$	Refer to Table 5-1		
N_{LT}	Refer to Table 5-1		
$MS\%_j$	100%	100%	%
GWP_{N20}	265	265	tCO_2/tN_2O
$E_{N20,ID,y}$ in this monitoring period	**4,690**		**kg N_2O-N/year**
$EF_{N20,iD,j}$	0.01	0.01	kg N_2O/kg N
$F_{gasMS,j,LT}$	0.45	0.45	/
$NEX_{LT,y}$	Refer to Table 5-1		
N_{LT}	Refer to Table 5-1		
$MS\%_j$	100%	100%	%
GWP_{N20}	265	265	tCO_2/t N_2O
$E_{N20,ID,y}$ in this monitoring period	**5,273**		**kg N_2O-N/year**
$PE_{N20,y}$ in this monitoring period	**7,076**		**tCO_2e**

iV) Project emissions from use of heat and/or electricity ($PE_{elec/heat}$)

$$PE_{EC/FC,y} = PE_{EC,y} + \sum_j PE_{FC,j,y} \qquad \text{(Equation 27)}$$

where:

$PE_{EC,y}$ Project emissions from electricity consumption in year y. The project emissions from electricity consumption will be calculated following the latest version of the “Tool to calculate baseline, project and/or leakage emissions from electricity consumption”. In case, the electricity consumption is not measured then the electricity consumption shall be estimated as follows $EC_{PJ,y} = \sum_i CP_{i,y} * 8760$, where $CP_{i,y}$ is the rated capacity (in MW) of electrical equipment i used for the project activity.

$PE_{FC,y}$ Project emissions from fossil fuel combustion in process j during the year y. The project emissions from fossil fuel combustion will be calculated following the latest version of the “Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion”. For this purpose, the processes j in the tool corresponds to all fossil fuel combustion in the AWMS (not including fossil fuels consumed for transportation of feed material and sludge or any other on-site transportation).

These emissions should only be considered for consumption of electricity or heat that is not related to the anaerobic digester. As described in above, since the electricity consumption that is not related to the anaerobic digester cannot be separated from the total electricity consumption, therefore the emission for consumption of electricity is calculated in $PE_{EC,y}$.

No fossil fuel was consumed in process that is not related to the anaerobic digester, so $PE_{FC,y}$=0

Therefore, $PE_{elec/heat}$ that is not related to the anaerobic digester =0.

In summary, the project emission of the project in this monitoring period are summarized in Table 5-8.

Table 5-8 the calculation result of project emissions in this monitoring period

Period	$PE_{AD,y}$ (tCO_2e)	$PE_{Aer,y}$ (tCO_2e)	$PE_{N2O,y}$ (tCO_2e)	PE_y (tCO_2e)
2nd monitoring period from 01-January-2022 to 31-December-2022	7,213	40	7,076	14,329

5.3 Leakage

Leakage covers the emissions from land application of treated manure as well as the emissions related to anaerobic digestion in a digester, occurring outside the project boundary. These emissions are estimated as net of those released under project activity and those released in the baseline scenario. Net leakage is only considered if they are positive.

$$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y}) + LE_{AD,y} \quad \text{(Equation 28)}$$

Where:

$LE_{PJ,N2O,y}$ Leakage N_2O emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)

$LE_{BL,N2O,y}$ Leakage N_2O emissions released during baseline scenario from land application of the treated manure in year y (t CO_2e/yr)

$LE_{PJ,CH4,y}$ Leakage CH_4 emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)

$LE_{BL,CH4,y}$ Leakage CH_4 emissions released during baseline scenario from land application of the treated manure in year y (t CO_2e/yr)

$LE_{AD,y}$ Leakage emissions associated with the anaerobic digester in year y (t CO_2e)

i) Estimation of leakage N_2O emissions released during baseline scenario from land application of the treated manure in year y, $LE_{BL,N2O,y}$

$$LE_{BL,N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}) \quad \text{(Equation 29)}$$

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 30)}$$

$$LE_{N2O,runoff,y} = EF_5 * F_{leach} * \prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 31)}$$

$$LE_{N2O,vol,y} = EF_4 * \prod_{n=1}^{N}(1 - R_{N,n}) * F_{gasm} * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 32)}$$

where:

GWP_{N2O} Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)

$CF_{N2O-N,N}$ Conversion factor N_2O-N to N_2O (44/28)

$LE_{N2O,land,y}$ Leakage N_2O emissions from application of manure waste in year y (kg N_2O-N/year)

$LE_{N2O,runoff,y}$ Leakage N_2O emissions due to leaching and run-off in year y (kg N_2O-N/year)

$LE_{N2O,vol,y}$	Leakage N_2O emissions due to volatilization in year y (kg N_2O-N/year)
F_{gasm}	Fraction of N lost due to volatilization (fraction)
N_{LT}	Annual average number of animals of type LT estimated as per equation (5) or (6) (number)
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/year) estimated as described in appendix 2
EF_1	Emission factor for N_2O emissions from N inputs (kg N_2O-N/kg N input)
EF_5	Emission factor for N_2O emissions from N leaching and runoff in (kg N_2O-N/kg N leached and runoff)
EF_4	Emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, [kg N- N_2O/ (kg NH_3-N + NO_X-N volatilized)]
F_{leach}	Fraction of all N added to/mineralized in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (fraction)
$R_{N,n}$	Nitrogen reduction factor (fraction)

ii) Estimation of leakage N_2O emissions released during project activity from land application of the treated manure in year y, $LE_{PJ,\ N2O}$

$$LE_{PJ,N2O} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}) \quad \text{(Equation 33)}$$

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N}\left(1 - R_{N,n}\right) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 34)}$$

$$LE_{N2O,runoff,y} = EF_5 * F_{leach} * \prod_{n=1}^{N}\left(1 - R_{N,n}\right) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 35)}$$

$$LE_{N2O,vol,y} = EF_4 * \prod_{n=1}^{N}\left(1 - R_{N,n}\right) * F_{gasm} * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 36)}$$

where:

GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N2O,land,y}$	Leakage N_2O emissions from application of manure waste in year y (kg N_2O-N/year)
$LE_{N2O,runoff,y}$	Leakage N_2O emissions due to leaching and run-off in year y (kg N_2O-N/year)
$LE_{N2O,vol,y}$	Leakage N_2O emissions due to volatilization in year y (kg N_2O-N/year)
F_{gasm}	Fraction of N lost due to volatilization (fraction)
N_{LT}	Annual average number of animals of type LT estimated as per equation (5) or (6) (number)
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/year) estimated as described in appendix 2
EF_1	Emission factor for N_2O emissions from N inputs (kg N_2O-N/kg N input)
EF_5	Emission factor for N_2O emissions from N leaching and runoff in (kg N_2O-N/kg N leached and runoff)
EF_4	Emission factor for N_2O emissions from atmospheric deposition of N on soils and water surfaces, [kg N- N_2O/ (kg NH_3-N + NO_X-N volatilized)]
F_{leach}	Fraction of all N added to/mineralized in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (fraction)

$R_{N,n}$ Nitrogen reduction factor (fraction)

It is possible to measure the quantity of manure applied to land in kg manure/yr (Q_{DM}) and the nitrogen concentration in kg N/kg manure (N_{DM}) in the manure to estimate the total quantity of nitrogen applied to land. In this case, $\prod_{n=1}^{N}(1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT}$ should be substituted by$Q_{DM} * N_{DM}$.

iii) Estimation of leakage CH4 emissions from land application of the treated manure

The calculation of methane emissions from land application of manure in the baseline and project cases are estimated as below:

$$LE_{BL,CH4,y} = GWP_{CH4} * D_{CH4} * MCF_d * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad \text{(Equation 37)}$$

$$LE_{PJ,CH4,y} = GWP_{CH4} * D_{CH4} * MCF_d * \left[\prod_{n=1}^{N}(1 - R_{VS,n})\right] * \sum_{j,LT}(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad \text{(Equation 38)}$$

where:

$LE_{BL,CH4,y}$ Leakage CH_4 emissions released during baseline scenario from land application of the treated manure in year *y* (t CO_2e/yr)

$LE_{PJ,CH4,y}$ Leakage CH_4 emissions released during project activity from land application of the treated manure in year *y* (t CO_2e/yr)

$R_{VS,n}$ Fraction of volatile solid degraded in AWMS treatment method *n* of the *N* treatment steps prior to sludge being treated

GWP_{CH4} Global Warming Potential (GWP) of CH_4 (t CO_2e/tCH_4)

D_{CH4} Density of CH_4 (t/m^3)

$B_{0,LT}$ Maximum methane producing potential of the volatile solid generated by animal type LT (m^3CH_4/kg dm)

N_{LT} Annual average number of animals of type *LT* estimated as per equation (5) or (6), expressed (number)

$VS_{LT,y}$ Annual volatile solid excretions for livestock *LT* entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)

$MS\%_j$ Fraction of manure handled in system *j* in the project activity (fraction)

MCF_d Methane conversion factor (MCF) assumed to be equal to 1

iV) Estimation of leakage emissions associated with the anaerobic digester

$LE_{AD,y}$ is determined using the methodological tool 14 "Project and leakage emissions from anaerobic digesters(Version 02.0).

The leakage emissions associated with the anaerobic digester ($LE_{AD,y}$) depend on how the digestate is managed. They include emissions associated with storage and composting of the digestate and are determined as follows:

$$LE_{AD,y} = LE_{storage,y} + LE_{comp,y} \quad \text{(Equation 39)}$$

where:

$LE_{AD,y}$	Leakage emissions associated with the anaerobic digester in year *y* (t CO_2e)
$LE_{storage,y}$	Leakage emissions associated with storage of digestate in year *y* (t CO_2e)
$LE_{comp,y}$	Leakage emissions associated with composting digestate in year *y* (t CO_2e)

For subsequent treatment stages, the reduction of the nitrogen during a treatment stage is estimated based on referenced data for different treatment types. Emissions from the next treatment stage are then calculated following the approach outlined above, but with nitrogen adjusted for the reduction from the previous treatment stages by multiplying by (1-R_N), where R_N is the relative reduction of nitrogen from the previous stage. The relative reduction (R_N) of nitrogen depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in appendix 1 (values for T_N).

The anaerobic digestion process of this project is carried out in a fully enclosed system. The biogas generated during the treatment process was captured for power generation or flared (if any). The Emissions from combustion will be calculated in project emissions (if any). After anaerobic digestion, the fermented sludge was treated in aerobic composting system, which was used as fertilizer. Wastewater from the new animal waste management systems was treated aerobically and then used for agriculture irrigation. So, the Estimation of leakage emissions associated with the anaerobic digester is 0. i.e., $LE_{AD,y}$ =0.

The calculation result of $LE_{BL,N2O,y}$, $LE_{PJ,N2O,y}$, $LE_{BL,CH4,y}$ and $LE_{PJ,CH4,y}$ in this monitoring period are shown in Table 5-9.

Table 5-9 the calculation result of $LE_{BL,N2O,y}$, $LE_{PJ,N2O,y}$, $LE_{BL,CH4,y}$ and $LE_{PJ,CH4,y}$

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
N_{LT}	Refer to Table 5-1		
$NEX_{LT,y}$	Refer to Table 5-1		
$R_{N,n}$	80%	80%	/
EF_1	0.01	0.01	kg N_2O-N/kg N
EF_5	0.0075	0.0075	kg N_2O-N/kg N
EF_4	0.01	0.01	KgN-N_2O-N/kg NH_3-N+NO_X-N
F_{leach}	0.3	0.3	/
F_{gasm}	0.2	0.2	/
GWP_{N2O}	265	265	tCO_2/t N_2O
$LE_{N2O,land,y}$ in this monitoring period	2,327		kg N_2O-N/year
$LE_{N2O,runoff,y}$ in this monitoring period	513		kg N_2O-N/year
$LE_{N2O,vol,y}$ in this monitoring period	458		kg N_2O-N/year
$LE_{BJ,N2O,y}$ in this monitoring period	**1,373**		**tCO_2e**
N_{LT}	Refer to Table 5-1		
NEX_{LT}	Refer to Table 5-1		
R_N	5%	5%	/
R_N	25%	25%	
EF_1	0.01	0.01	kg N_2O-N/kg N
EF_5	0.0075	0.0075	kg N_2O-N/kg N

EF_4	0.01	0.01	$KgN\text{-}N_2O\text{-}N/kg\ NH_3\text{-}N+NO_X\text{-}N$
F_{leach}	0.3	0.3	/
F_{gasm}	0.2	0.2	/
$LE_{N20,land,y}$ in this monitoring period	8,344		kg N_2O-N/year
$LE_{N20,runoff,y}$ in this monitoring period	1,889		kg N_2O-N/year
$LE_{N20,vol,y}$ in this monitoring period	1,680		kg N_2O-N/year
$LE_{PJ,N20,y}$ in this monitoring period	**4,961**		**tCO_2e**
GWP_{CH4}	28	28	$tCO_2e/t\ CH_4$
D_{CH4}	0.00067	0.00067	t/m^3
MCF_d	1	1	/
$VS_{LT,y}$	Refer to Table 5-1		
N_{LT}	Refer to Table 5-1		
$B_{0,LT}$	0.29	0.29	$m^3\ CH_4/kg\text{-}VS$
R_{VS}	85%	85%	/
$MS\%_j$	100%	100%	/
$LE_{BL,CH4,y}$ in this monitoring period	**29,473**		**tCO_2e**
GWP_{CH4}	28	28	tCO_2/tCH_4
D_{CH4}	0.00067	0.00067	t/m^3
MCF_d	1	1	/
$VS_{LT,y}$	Refer to Table 5-1		
NLT	Refer to Table 5-1		
B_0	0.29	0.29	$m^3\ CH_4/kg\text{-}VS$
R_{VS}	80%	80%	/
R_{VS}	20%	20%	
$MS\%_j$	100%	100%	/
$LE_{PJ,CH4,y}$ in this monitoring period	**31,463**		**tCO_2e**

Table 5-10 The calculation result of leakage emission

Period	$LE_{PJ,CH4,y}$ (tCO_2e)	$LE_{BL,CH4,y}$ (tCO_2e)	$LE_{BL,N20,y}$ (tCO_2e)	$LE_{PJ,N20,y}$ (tCO_2e)	LE_y (tCO_2e/yr)
2nd monitoring period from 01-January-2022 to 31-December-2022	31,463	29,473	1,373	4,961	5,578

5.4 Net GHG Emission Reductions and Removals

The emission reduction ER_y by the project activity during a given year y is the difference between the baseline emissions (BE_y) and the sum of project emissions (PE_y) and leakage, as follows:

$$ER_y = BE_y - PE_y - LE_y \qquad \text{(Equation 40)}$$

Further, in estimating emissions reduction for claiming certified emissions reductions, if the calculated CH_4 baseline emissions from anaerobic lagoons are higher than the measured CH_4 generated in the anaerobic digester in the project situation ($Q_{CH4,y}$ in the tool "Project and leakage emissions from anaerobic digesters"), then the latter shall be used to calculate the emissions reduction for claiming certified emissions reductions. Therefore, the actual methane captured from an anaerobic digester shall be compared to the ($BE_{CH4,y}$ - $PE_{AD,y}$ in the tool "Project and leakage emissions from anaerobic digesters") and if found lower, then ($BE_{CH4,y}$ - $PE_{AD,y}$) (which is a component of BE_y -PE_y) in Equation (40) is replaced by $Q_{CH4,y}$.

Biogas captured during monitoring period is 12,931,814.76 m^3, which equals to 138,105 tCO_2e[32]. Baseline methane emission ($BE_{CH4,y}$) in this monitoring period is 136,717 tCO_2e. Project emissions associated with anaerobic digester in this monitoring period is ($PE_{AD,y}$) is 7,213 tCO_2e. Actual methane captured from anaerobic digesters (138,105 tCO_2e) is higher than the difference of $BE_{CH4,y}$ and $PE_{AD,y}$ (129,504 tCO_2e =136,717 tCO_2e -7,213 tCO_2e). Therefore, the equation ($BE_{CH4,y}$ - $PE_{AD,y}$) can be used to calculate emission reduction. So, the Net GHG Emission Reductions and Removals can be calculated using Equation 40 above. The Net GHG Emission Reductions and Removals in this monitoring period is shown in following table.

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
01-January-2022-31-December-2022	138,664	14,329	5,578	118,757
Total	**138,664**	**14,329**	**5,578**	**118,757**

The estimated ex-ante GHG emission reductions and removals and the achieved emission reductions and removals for this monitoring period is shown in below Table.

Ex-ante emissions reductions/removals	Achieved emissions reductions/removals	Percent difference	Justification for the difference
150,212 tCO_2e	118,757 tCO2e	-20.94%	The difference between the estimated value and actual values is mainly due to the number of animals in the swine farm and the average animal weight is lower than the estimated values in the registered JPM.

[32] Biogas captured during this monitoring period is 12,931,814.76 m^3. The quality of methane is 4,932.36tCH_4, which can be calculated by the amount of biogas, the density of biogas and the content of methane in this monitoring period. Then the quality of methane multiplied by the global warming Potential of CH_4 i.e.,28 tCO_2e/tCH_4 is the result of 138,105tCO_2e.

APPENDIX 1: <EVIDENCE OF ACHIEVED SDGS>

Supporting evidence for contribution to SDG 13.0 Tons of greenhouse gas emissions avoided or removed

The project has estimated that 150,212 tCO_2e emission reductions will be produced annually. This is the 2nd monitoring period, which is covering from 01-January-2022 to 31-December-2022 and the emission reductions of the 2nd monitoring period is 118,757 tCO_2e. please see Section 5 of this Monitoring Report for details.

Table showing the emission reductions during the 2nd monitoring period

Year	Baseline emissions or removals (tCO_2e)	Project emissions or removals (tCO_2e)	Leakage emissions (tCO_2e)	Net GHG emission reductions or removals (tCO_2e)
01-January-2022 to 31-December-2022	138,664	14,329	5,578	118,757
Total	138,664	14,329	5,578	118,757

Supporting evidence for contribution to SDG 7.2 Renewable energy share in the total final energy consumption

19,254 MWh electricity are expected to be generated annually. This is the 2nd monitoring period, which is covering from 01-January-2022 to 31-December-2022 and during this monitoring period 17,086.59 MWh electricity is generated by the project.

双胞胎江苏片区养殖场粪便资源化利用项目2022年度发电量统计表						
时间	泗阳爱园养殖场	东台弶港养殖场	射阳临海猪场	泗阳南刘集养殖场	总发电量(KWh)	总发电量(MWh)
Jan-22	262110.45	405253.91	193472.53	589090.22	1449927.11	1449.93
Feb-22	232539.66	366073.44	174721.11	534755.32	1308089.53	1308.09
Mar-22	262305.32	405264.31	193555.93	590274.31	1451399.87	1451.40
Apr-22	253833.42	392130.77	187271.87	574670.97	1407907.03	1407.91
May-22	261948.04	405003.65	193420.4	593234.62	1453606.71	1453.61
Jun-22	253550.5	391898.70	187372.78	570660.25	1403482.23	1403.48
Jul-22	262088.78	405055.78	193347.4	590866.36	1451358.32	1451.36
Aug-22	261904.69	405170.51	193535.06	587906.13	1448516.39	1448.52
Sep-22	248143.78	392140.86	184174.22	575243.92	1399702.78	1399.70
Oct-22	262067.11	405118.38	193389.14	593826.67	1454401.30	1454.40
Nov-22	253393.33	392070.23	187140.7	572952.12	1405556.38	1405.56
Dec-22	262012.96	405180.91	193399.54	592050.53	1452643.94	1452.64
sum	3075898.04	4770361.45	2274800.68	6965531.42	17086591.59	17086.59

Supporting evidence for contribution to SDG 8.5 Unemployment rate, by sex, age and persons with disabilities

The project activity generates permanent job opportunities for 18 persons including 9 females and 9 males during the operation period. During this monitoring period, total 18 jobs for local people were created (including 9 females and 9 males) by the project.

双胞胎江苏片区养殖场粪便资源化利用项目员工花名册

序号	姓名	职位名称	性别	入职日期	工作状态	所属养殖场	身份证号	年龄
1	吕伟长	环保监督员	男	2020.6.1	正常	泗阳爱园养殖场	321323198911052813	33
2	李桂莲	环保监督员	女	2020.6.1	正常	泗阳爱园养殖场	321323198812267468	34
3	唐飞	环保监督员	男	2020.6.1	正常	泗阳爱园养殖场	321323198009193217	42
4	王美贤	环保监督员	女	2020.6.1	正常	泗阳爱园养殖场	320981199502252644	27
5	王灿灿	环保监督员	女	2020.6.1	正常	东台弶港养殖场	320981198803254043	34
6	李卫华	环保监督员	男	2020.6.1	正常	东台弶港养殖场	32098119830315651X	39
7	汤海强	环保监督员	男	2020.6.1	正常	东台弶港养殖场	320981199307287335	29
8	赵晓彤	环保监督员	女	2020.6.1	正常	东台弶港养殖场	320981199502252644	27
9	孔庆林	环保监督员	男	2020.6.1	正常	东台弶港养殖场	320981198605154798	36
10	康志东	环保监督员	男	2020.6.1	正常	射阳临海养殖场	320924199302202634	29
11	迪向东	环保监督员	男	2020.6.1	正常	射阳临海养殖场	320924198308145994	39
12	周婷	环保监督员	女	2020.6.1	正常	射阳临海养殖场	320924199503095083	27
13	赵嘉禾	环保监督员	女	2020.6.1	正常	射阳临海养殖场	320924197904027728	43
14	彭伟	环保监督员	男	2020.6.1	正常	泗阳南刘集养殖场	321323198503205211	37
15	曹云雷	环保监督员	男	2020.6.1	正常	泗阳南刘集养殖场	321323198804146476	34
16	秦芷雪	环保监督员	女	2020.6.1	正常	泗阳南刘集养殖场	321323199306233708	29
17	孔艳玲	环保监督员	女	2020.6.1	正常	泗阳南刘集养殖场	321323198807304682	34
18	张芸	环保监督员	女	2020.6.1	正常	泗阳南刘集养殖场	3213231987060.062968	35