MUYUAN WJZ AWMS GHG MITIGATION PROJECT IN HENAN PROVINCE

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

Project Title	*Muyuan WJZ AWMS GHG Mitigation Project in Henan Province*
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1 PROJECT DETAILS

1.1 Summary Description of the Project

Muyuan WJZ AWMS GHG Mitigation Project in Henan Province (hereafter referred to as the project) installs new animal waste management systems (AWMSs) to treat the manure from 7 existing swine farms in Nanyang City and Zhumadian City, Henan Province, China, which are owned by Muyuan Foods Co.,Ltd. (hereinafter called "Muyuan") 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.

All the manure and wastewater are collected and then be separated first. The solid will be treated in aerobic composting system and the organic fertilizers will be produced, the fertilizer produced in this process will be distributed to local farmers for free and the surplus will be sold in domestic market. The liquid will be treated through anaerobic digestion and the biogas generated during the treatment process will be captured for heat generation. After anaerobic digestion, the sludge produced from anaerobic digestion will be treated through aerobic composting together with the separated solid, the effluent will be used for agricultural irrigation.

The common practice for the swine farm owners to manage the manure is to have uncovered anaerobic lagoons/ponds at their farms in the region. i.e., 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. In China, the uncovered anaerobic lagoons are a manure treatment method recognized by the state[1]. In addition, since there is no legal regulation to mandate the livestock farm owners to implement anaerobic digestion, aerobic or other biological treatment techniques and to capture and/or utilize methane generated at these lagoons, therefore the continue of this common practice to treatment the manure i.e., uncovered anaerobic lagoons is the most economic, viable and reasonable for livestock farm owners.

It is estimated that approximately 1,637 tons of animal manure can be handled daily by the AWMSs. The biogas generated during the anaerobic process is collected for heat generation and $3,287.1575*10^4m^3$ of biogas are expected to produce annually. The heat production is estimated to be 657,340GJ annually. Also, the generated heat is only used for daily operation of AWMSs and 7 swine farms themselves and cannot be connected to other users. For conservativeness, baseline emissions from heat 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 319,227tCO_2e emission reductions will be produced annually and total emission reductions are

[1] https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf

3,192,270tCO_2e in the 10-year fixed crediting period covering from 15-July-2020 to 14-July-2030.

The project has been put into operation on 15-July-2020. This monitoring report is for the 1st monitoring period, which is from 15-July-2020 to 31-March-2022. Total emission reductions achieved in this monitoring period are 444,807 tCO_2e.

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 Eligibility

The scope of the VCS Program includes:

1) The six Kyoto Protocol greenhouse gases: The project activity treats manure wastes from 7 existing swine farms though installing new AWMSs and the biogas captured for heat generation which can avoid Methane (CH_4) emissions from uncovered anaerobic lagoons in the baseline scenario. Thus, the project applicable to this scope.
2) Ozone-depleting substances: Not Applicable.
3) Project activities supported by a methodology approved under the VCS Program through the methodology approval process: Not Applicable.
4) Project activities supported by a methodology approved under a VCS approved GHG program, unless explicitly excluded under the terms of Verra approval: The applied methodology ACM0010 (Version 08.0) of the project are methodologies approved under CDM Program, which is a VCS approved GHG program.
5) Jurisdictional REDD+ programs and nested REDD+ projects as set out in the VCS Program document Jurisdictional and Nested REDD+ (JNR) Requirements: Not Applicable.
   Furthermore, the project does not belong to the project activities excluded in Table 1 of VCS Standard 4.3. Therefore, the project activity is eligible under the scope of the VCS Program.

1.4 Project Design

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

The project activity involves the construction and operation 7 AWMSs in 7 existing swine farms in Henan Province owned by Muyuan. The treatment capacity of the AWMSs in this project is 1,637 tons per day. It has been designed to install one AWMS in each swine farm. Total 7 swine farms are included in this project activity, which belongs to multiple project activity instances. This project is not a grouped project.

Eligibility Criteria

The project is not a grouped project. Thus, this section is not applicable.

1.5 Project Proponent

Organization name	Muyuan Foods Co., Ltd.
Contact person	Lu Chang
Title	Project Manager
Address	Longsheng Industrial Park, Wolong District
Telephone	+86 199 6296 0254
Email	hnsinglo@sohu.com

1.6 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
Telephone	+86 21 6127 2386

Email	yanan.zhu@profitcarbon.com

1.7 Ownership

All the AWMSs were invested by Muyuan, who has the legal right to control and operate the project activity. The business license, Approval of Environmental Impact Assessment (EIA) and the equipment (boiler) purchasing contracts are evidence for the ownership of the project and carbon credits generated.

1.8 Project Start Date

As per Section 3.7 of VCS Standard (Version 4.3), the project start date of a non-AFOLU project is the date on which the project began generating GHG emission reductions or removals. The project activity is a non-AFOLU project, and 7 AWMSs had been put into operation on 15-July-2020. Thus, the project start date is 15-July-2020.

1.9 Project Crediting Period

This project adopts fixed crediting periods of 10 years. The crediting period is 10 years 0 month from 15-July-2020 to 14-July-2030 (both days included).

1.10 Project Scale and Estimated GHG Emission Reductions or Removals

The estimated volume of emission reduction from the project activity is 319,227tCO_2e, which is greater than 300,000 tonnes of CO_2e per year. As per Section 3.9.1 of the VCS Standard (Version 4.3), the scale of the project activity is under “Large Project” category.

Project Scale	
Project	
Large project	×

Year	Estimated GHG emission reductions or removals (tCO_2e)
15-July-2020-31-December-2020	148,681[3]
01-January-2021-31-December-	319,227

[3] The estimated annual volume of emission reduction from the project activity is 319,227 tCO_2e, so the values estimated emission reduction from 15-July -2020-31-December-2020 including 170days is 319,227 tCO_2e/365d*170 d=148,681tCO_2e.

2021	
01-January-2022-31-December-2022	319,227
01-January-2023-31-December-2023	319,227
01-January-2024-31-December-2024	319,227
01-January-2025-31-December-2025	319,227
01-January-2026-31-December-2026	319,227
01-January-2027-31-December-2027	319,227
01-January-2028-31-December-2028	319,227
01-January-2029-31-December-2029	319,227
01-Januray-2030-14-July-2030	170,546[4]
Total estimated ERs	3,192,270
Total number of crediting years	10
Average annual ERs	319,227

1.11 Description of the Project Activity

The project activity is to install 7 sets of new AWMSs to replace the traditional uncovered anaerobic lagoons to treat the swine manure in the 7 existing swine farms owned by Muyuan.

The project activity implemented 7 sets of AWMSs in 7 existing swine farms involving 370,860 heads of market swine, 38,500 heads of breeding swine. 597,665tons of manure and 3,287.1575*10^4m^3 of biogas are estimated to produce annually. All these 7 existing swine farms were put into operation before the implementation of this project, detailed operation start date can be referred below Table 1-1.

Table 1-1. the operation date of swine farm

Swine farm	Operation start date

[4] The estimated annual volume of emission reduction from the project activity is 319,227 tCO_2e, so the values estimated emission reduction from 01-January-2030 to 14-July-2030 including 195days is 319,227 tCO_2e/365d*195 d=170,546 tCO_2e.

Wolong 2nd farm	10-July-2015
Junzhang 26th farm	27-March-2018
Zhengyang 1st farm	11-July-2016
Zhengyang 4th farm	16-November-2017
Zhengyang 6th farm	14-December-2016
Zhengyang 9th farm	21-May-2018
Zhengyang 13th farm	26-December-2017

Baseline scenario

Prior to the implementation of the project, all manure waste produced from the existing 7 swine farms was left to decay in 7 uncovered anaerobic lagoons at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. After the implementation of the project, original 7 uncovered anaerobic lagoons had been removed, the volume for original uncovered anaerobic lagoons is described in below Table 1-2.

Project technology description

There are 7 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 1-2. The specific process is as follows:

All the manure and wastewater are collected into the collection tanks and then be separated firstly by solid and liquid separators. The solid is treated in aerobic composting system and the organic fertilizers can be produced, part of the fertilizer is distributed to local farmers for free and the others would be sold on the domestic market. The liquid is treated through anaerobic digestion and the biogas generated during the treatment process is captured for heat generation. If there is surplus biogas, then the biogas would be flared through the flaring system. After anaerobic digestion, the sludge produced from anaerobic digestion is treated through aerobic composting together with the separated solid, the effluent is used for agricultural irrigation.

The process flow diagram of this project activity is shown in Figure 1-1.

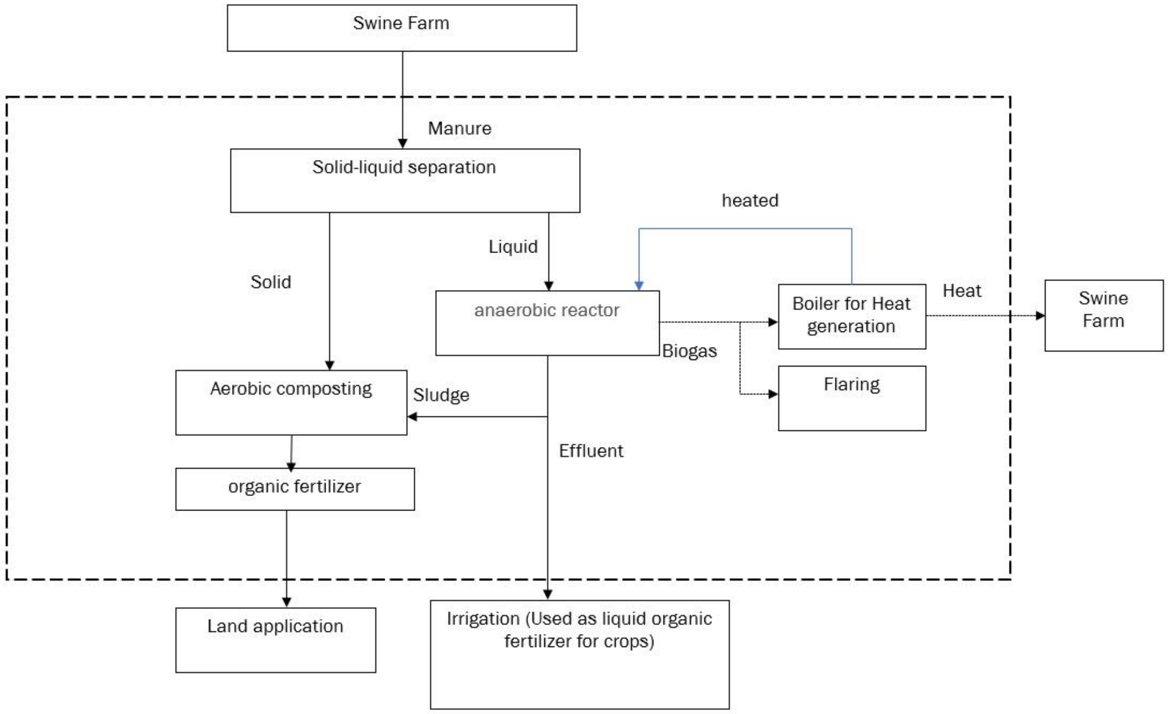

Figure 1-1 Process flow diagram of the project activity

Solid-liquid separation

After the manure waste was taken into the collection tanks, then manure wastes are pumped to solid-liquid separator through non-blocking slurry pump (in the process of solid- liquid separation, initial separation is done through the screen firstly, and then the water in the solid material of manure is extruded by a screw extruder with separation efficiency of more than 50%). the separated solid manure is sent to the aerobic composting system for organic fertilizers production, the liquid manure enters the anaerobic fermentation stage to continue processing.

Anaerobic digesters treatment process

Fully Geo-membrane enclosed anaerobic tanks are adopted to treat the manure anaerobically. High-density polyethylene (HDPE) geomembranes are integrated into the base and top membranes through anchor trenches, with anaerobic fermentation and gas storage functions therefore, fully Geo-membrane enclosed anaerobic tanks integrate fermentation and gas storage, and impermeable and high-density polyethylene HDPE geomembrane to seal the whole anaerobic tanks is applied in order to capture GHG and keep anaerobic conditions within the digester. Its manure treatment principle is the same as other anaerobic fermentation processes, relying on the metabolic function of anaerobic bacteria to degrade the organic matter in the manure and produce biogas.

The anaerobic digester is one of the few manure treatment options that reduces the environmental impact of manure and generates energy. In cold season, fully enclosed biogas digester would be heated through boilers. Therefore, it is possible to state that the external environment does not affect digester treatment, i.e., it operates independently from meteorological factors. The temperature of the anaerobic treatment unit of the project is designed as medium temperature i.e. 30 ~ 35 ℃.

Comprehensive utilization of biogas

The biogas just produced by the anaerobic fermentation system is a mixed gas containing saturated steam. In addition to CH_4 and CO_2, it also contains H_2S and suspended particulate impurities. Therefore, desulfurization and purification treatments are required. Biogas collected from the fully enclosed anaerobic pond is purified by biogas purification device firstly, then the biogas is sent to boilers for heat generation. The heat generated is used by the AWMS and the 7 swine farms. Surplus biogas would be flared (if any).

Aerobic composting process

The solid after solid-liquid separation and the sludge produced from anaerobic digestion are used to produce organic fertilizer through aerobic composting process. The aerobic composting process of this project adopts trough composting. The trough composting system is generally equipped with a vent pipe or a gas distribution device installed on the trough. When turning over, the air blower is used to supply the oxygen required for fermentation. The composting cycle of the blast trough composting system is 2-4 weeks.

For this monitoring period covering 625 days, total 333,770 heads of market swine, 34,650 heads of breeding swine are included in these 7 swine farms and total 4,678.05*$10^4 m^3$ of biogas are produced. The construction date, commissioning date and start date of operation of each farm are summarized in Table 1-3.

Table1-2 The main technical parameters of equipment involved in this project

Swine Farm Name	Wolong 2^{nd} farm	Junzhang 26^{th} farm	Zhengyang 1^{st} farm	Zhengyang 4^{th} farm	Zhengyang 6^{th} farm	Zhengyang 9^{th} farm	Zhengyang 13^{th} farm
Treatment capacities of AWMS(t/d)	400	400	100	400	400	100	200
Baseline anaerobic lagoon							
Size of baseline anaerobic lagoon(length*width*depth) (m^3)	100*90*4	100*90*4	80*50*3	100*90*4	100*90*4	80*50*3	100*60*4
Technical life	No Less than 15 years						

Boiler							
Type	WNS7-1.0-115/70-Y(Q)	WNS7-1.0-115/70-Y(Q)	WNS2.1-1.0-115/70-Y(Q)	WNS7-1.0-115/70-Y(Q)	WNS7-1.0-115/70-Y(Q)	WNS2.1-0.7-115/70-Y(Q)	WNS4.2-1.0-115/70-Y(Q)
rated heating capacity (MW)	7	7	2.1	7	7	2,1	4.2
Rated outlet temperature (℃)	115	115	115	115	115	115	115
Rated pressure (Mpa)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Equipment Quantity	1	1	1	1	1	1	1
Equipment technical life	No Less than 30 years						
Anaerobic tank							
Design capacity (m^3/d)	400	400	100	400	400	100	200
Stay time(day)	25	25	25	25	25	25	25
Design flow(m^3/d)	10000	10000	2500	10000	10000	2500	5000
Equipment Quantity	1	1	1	1	1		
Equipment technical life	No Less than 30 years						
Turnover machine							
Type	LYFP280A	LYFP280A	LYFP210	LYFP280A	LYFP280A	LYFP210	LYFP210
Handling pile width (mm)	2800-3200mm	2800-3200mm	2100mm	2800-3200mm	2800-3200mm	2100mm	2100mm
Handling pile height(mm)	1200-1500mm	1200-1500mm	800-1000mm	1200-1500mm	1200-1500mm	800-1000mm	800-1000mm
Working capacity (m^3/h)	400-2500	400-2500	300-800	400-2500	400-2500	300-800	300-800
Equipment Quantity	1	1	1	1	1	1	1
Equipment technical life	No Less than 15 years						

Flared system							
Type	Open flare	Open flare	Open flare	Open flare	Open flare	Open flare	Open flare
Treatment capacities (m^3/h)	0-100	0-100	0-100	0-100	0-100	0-100	0-100
Height (m)	4	4	4	4	4	4	4
Equipment Quantity	1	1	1	1	1	1	1
Equipment technical life	No Less than 15 years						

Table 1-3. The construction, commissioning and start operation date of AWMS in each farm involved in this project

Swine farm	Construction date	Commissioning date	start Operation date
Wolong 2nd farm	10- November -2019	25-June-2020	15-July-2020
Junzhang 26th farm	24- November-2019	20- June -2020	15-July-2020
Zhengyang 1st farm	17- November -2019	24-June-2020	15-July-2020
Zhengyang 4th farm	29- November-2019	22-June-2020	15-July-2020
Zhengyang 6th farm	13- November -2019	19-June-2020	15-July-2020
Zhengyang 9th farm	01-December-2019	21-June-2020	15-July-2020
Zhengyang 13th farm	08-December-2019	17-June-2020	15-July-2020

1.12 Project Location

The project is located in Nanyang City and Zhumadian City, Henan Province, China. The location of the 7 subsidiary farms is shown in Table 1-4 and Figure 1-2:

Table1-4 The location of 7 subsidiary farms in this project

Swine farm	Location	North latitude	East longitude
Wolong 2nd farm	Shaozhuang Village, Luying township, Wolong District, Nanyang City	32° 52′9.05″	112°27′15.77″
Junzhang 26th farm	Junzhang Village, Wangdian Township, Neixiang County, Nanyang City	33° 7′55.24″	111°54′37.62″
Zhengyang 1st farm	Laodian Village, Pengqiao Township, Zhengyang County, Zhumadian City	32° 26′42.00″	114°23′13.20″
Zhengyang 4th farm	Liwa Village, Lanqing Township, Zhengyang County, Zhumadian City	32° 28′25.36″	114°13′14.56″
Zhengyang 6th farm	Liwa Village, Lanqing Township, Zhengyang County, Zhumadian City	32° 29′19.54″	114°18′12.82″
Zhengyang 9th farm	Lanqing Village, Lanqing Township, Zhengyang County, Zhumadian City	32°23'54.43"	114°36'10.94"
Zhengyang 13th farm	Xiemiao Village, Dougou Township, Zhengyang County, Zhumadian City	32° 26′37.43″	114°18′20.30″

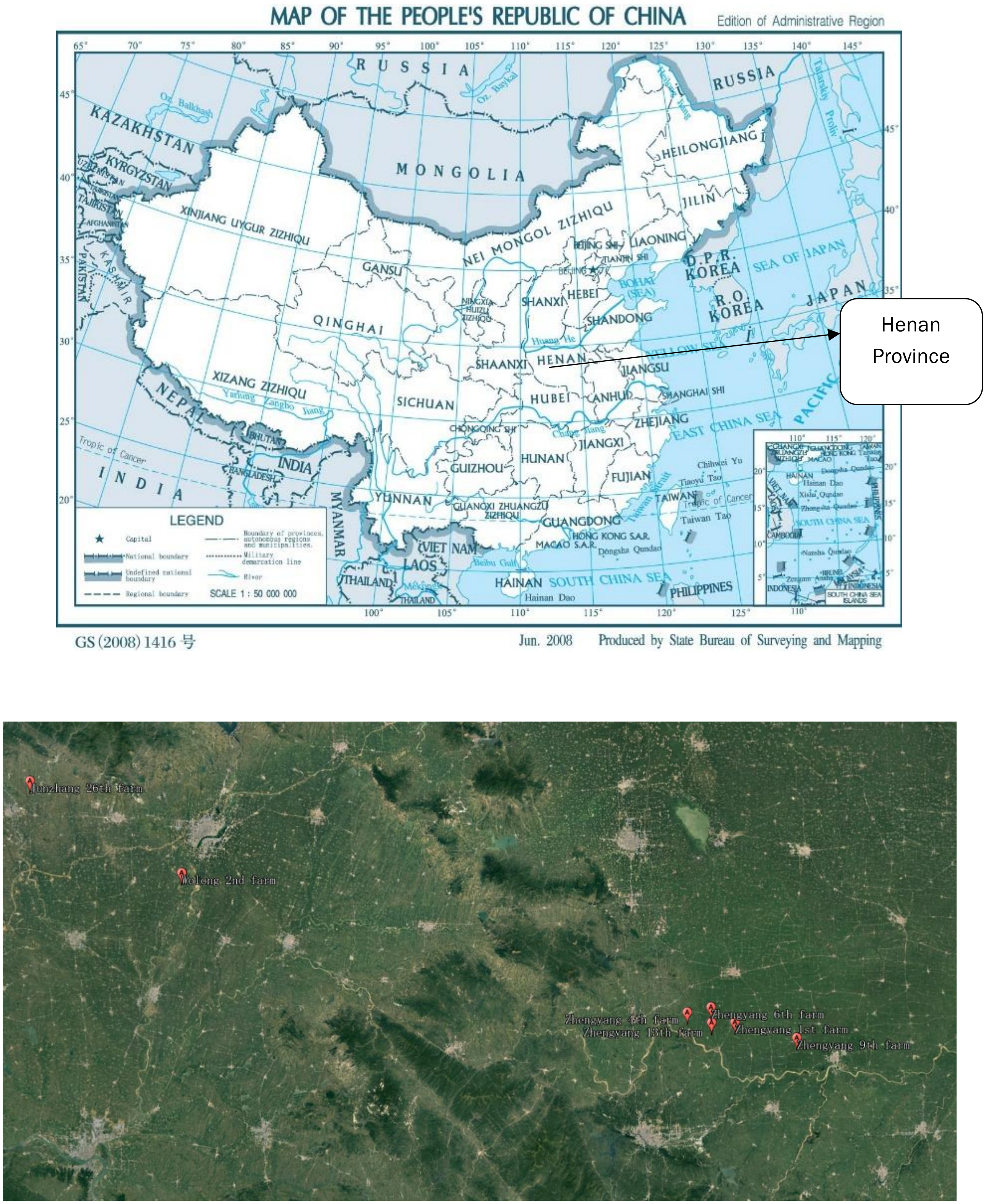

Figure1-2. The Geographic location of 7 subsidiary farms in this project

1.13 Conditions Prior to Project Initiation

The project is a Greenfield project. Thus, there are no project activities at the project sites before the construction of the project activities. The baseline scenario is the same as the conditions existing prior to the project initiation. Refer Section 3.4 of the JPM for detailed baseline scenario.

1.14 Compliance with Laws, Statutes and Other Regulatory Frameworks

According to the approval of Environmental Impact Assessment (EIA) of the project, the project complies with all Chinese relevant laws and regulations. Mainly include:

1. Environmental Protection Law of the People's Republic of China;
2. Administrative Licensing Law of the People's Republic of China;
3. Law of the People's Republic of China on Environmental Impact Assessment；
4. Regulations on Environmental Protection Management of Construction Projects;

The project obtained the EIA approval from local governmental authorities. The approvals well demonstrate that local government permits the construction of the project. Consequently, the project is compliance with laws, status and other regulatory frameworks.

1.15 Participation under Other GHG Programs

1.15.1 Projects Registered (or seeking registration) under Other GHG Program(s)

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

1.15.2 Projects Rejected by Other GHG Programs

The project activity is not participating in other environment credits, other GHG programs and has not been rejected by any other GHG Programs.

1.16 Other Forms of Credit

1.16.1 Emissions 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[5], 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

[5] http://mee.gov.cn/xxgk2018/xxgk/xxgk03/202012/W020201230736907682380.pdf

generation, petrochemicals, chemicals, building materials, non-ferrous metals, papermaking, steel and aviation[6]. As the annual GHG emissions of the project proponent will not be greater than 26,000 tCO_2e, 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. 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 has 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.

1.16.2 Other Forms of Environmental Credit

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

1.17 Sustainable development contributions

1.17.1 Sustainable Development Contributions Activity Description

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

The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from anaerobic treatment of swine manure. 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 319,227 tCO_2e emission reductions can be produced annually.

SDG 7: Affordable and Clean Energy

The biogas generated during the treatment process is captured for heat generation, the heat generated are all used by the operation of AWMSs and the 7 swine farms, which was provided by the coal-fired boiler without the proposed project. in baseline scenario. Prior to the implementation of the project, all manure waste produced from the existing 7 swine farms was left to decay in 7 uncovered anaerobic lagoons at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. Therefore, the project activity reduces of GHG and provide clean energy. $3{,}287.1575*10^4m^3$ of biogas are expected to produce annually.

SDG 8: Decent Work and Economic Growth

[6] http://www.mee.gov.cn/xxgk2018/xxgk/xxgk05/202103/t20210330_826728.html

Temporary and permanent job opportunities are created for locals during the construction and operation period of the project, 14 local residents (7 females and 7 males) are employed permanently for project implementation and monitoring activities during the operation period of the project.

1.17.2 Sustainable Development Contributions Activity Monitoring

For this monitoring period covering 625 days, the actual emission reduction is 444,807tCO_2e and 4,678.05*10^4m^3 of biogas (please refer to monitored parameter "V_f" in Section 6.1 of JPM for detail) is generated by the project. Total 14 jobs for local people were created (including 7 females and 7 males). Please see below Table 1-5 for details.

Table 1-5 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, 4,678.05*10^4m^3 of biogas is generated by the project.	This is the 1st monitoring period, therefore, from the operation start date of the project activity to the end of this monitoring period, 4,678.05*10^4m^3 of 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 14 jobs for local people were created (including 7 females and 7 males) by the project.	The project activity generates permanent job opportunities for 14 persons including 7 females and 7 males during the operation period. From the operation start date of the project activity to the end of this monitoring period, 14 jobs for local people were created (including 7 females and 7 males) by the project.
3)	13.0	Tonnes of greenhouse gas emissions avoided or	Implemented activities to increase	During this monitoring period, the project has achieved GHG emission reductions of 444,807 tCO_2e.	This is the 1st monitoring period, therefore, from the operation start date of the project activity to the end of this monitoring period, the project has achieved GHG

		removed			emission reductions of 444,807 tCO_2e.

1.18 Additional Information Relevant to the Project

Leakage Management

The leakage involved in this project includes the leakage of anaerobic digestion in a digester and the leakage of organic fertilizer into the soil. The project participants have no authority, intervention or control over the leakage of organic fertilizer into the soil. Moreover, this leakage has been included in the emission reductions calculation as per the applied methodology and tool.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

Not applicable.

2 SAFEGUARDS

2.1 No Net Harm

The Environmental Impact Assessment (EIA) Report for the Project has been approved by local governmental authorities. Every aspect of environmental impact has been considered in the EIA report with corresponding measures during project development, the construction of the project is in line with national policies and no net harm has been detected. Meanwhile, the implementation of the project will improve local-socio economic development through creating career opportunities.

2.2 Local Stakeholder Consultation

Local stakeholder consultation was conducted by project owner before the construction of the project and during the monitoring period through the means of meeting and questionnaire.

Local stakeholder consultation before the construction of the project

In order to solicit the opinions and attitudes of various stakeholders on the construction of this project, the project owner issued a stakeholder survey opinion form at each project site from 06-January-2020 to 10-January-2020 investigate the opinions of local residents on the construction of this project. Since the farm has been in operation for a long time, local stakeholders or farmers have a better understanding of the situation of the farm. Therefore, for the stakeholder investigation of the project which can bring economic and environment benefits to the local people, the Local stakeholders or farmers is more willing to participate in the survey. The questionnaire mainly contains the following content:

1. Do you know the purpose of this project?
2. What do you think is the impact of the implementation of this project on the local environment?
3. What impact do you think the implementation of this project will have on your life?
4. Do you think the implementation of this project is in harmony with the local ecosystem?
5. What impact do you think the implementation of this project will have on the social economy?
6. What effect do you think the implementation of this project will have on local sustainable development?
7. What effect do you think the implementation of this project will have on local employment?
8. Do you think other regions should also vigorously promote this type of technology?
9. Do you support the construction and implementation of this project?
10. Do you have any suggestions and comments on this project?

A total of 105 questionnaires were issued for this project, 15 copies for each project site, and 105 copies were collected. The basic information about the survey respondents is listed in Table 2-1.

Table 2-1 Structure of stakeholder survey

Items		**Amount**
Gender	Male	57
	female	48
Age	<25	11
	25-55	80
	>55	14
Education	Junior high school or below	10
	Senior high school	78
	College or above	17
Occupation	Worker	21
	Farmer	54
	Management personnel	17
	Civil servant	13

The survey results are as follows:

1. 97% of the respondents understand this project, 3% don't know much about this project.
2. 100% of the respondents believe that the implementation of this project has reduced environmental pollution and is an environmental protection project.
3. 100% of the respondents believe that the implementation of the project will bring economic benefits to their lives, because they get free organic fertilizer.
4. 97% of the respondents believe that the implementation of the project is in harmony with the local ecosystem; 3% of the respondents are not sure whether it is in harmony.
5. 100% of the respondents believe that the implementation of the project has a good impact on the social economy.

6. 100% of the respondents believe that the construction of this project can promote energy conservation and emission reduction, improve environmental quality and investment environment, and promote the sustainable development of the local economy.
7. 94% of the respondents believe that the implementation of this project can promote employment growth; 6% of the respondents believe that it has no impact on local employment.
8. 100% of respondents believe that AWMS technology can be vigorously promoted.
9. 100% of respondents support this project.

The project owner carefully listened to and accepted the suggestions and opinions of stakeholders and stated that it would implement environmental protection facilities (AWMS) in strict accordance with the requirements in the environmental impact report form and the approval opinions of the local environmental protection bureau. Protect the environment and promote local sustainable development. There is no suggestion about the project design.

Local stakeholder consultation during the monitoring period

During this monitoring period, mean of a questionnaire survey was adopted for stakeholder consultation. From 09-August-2021 to 13-August-2021, the project proponent put up public announcements at the villages near the project site; also, the project proponent contacted the local authorities (mainly the Ecology and Environment Bureau, Agriculture and Rural Affairs Bureau) by phone. The general information about the introduction of project, the date and the purpose of the questionnaire survey as well as the project proponent's phone number and email address were clearly conveyed via these public announcements and phone calls. A questionnaire survey was conducted by project proponent from 30-August-2020 to 03-September-2020. Total 70 questionnaires were distributed and all questionnaires have been recollected. The basic information about the survey respondents is listed in Table 2-2. Responses and comments from these questionnaires are summarized in Table 2-3

Table 2-2 Structure of stakeholder survey

Items		Amount
Gender	Male	37
	female	33
Age	<25	7
	25-55	53
	>55	10
Education	Junior high school or below	8
	Senior high school	51
	College or above	11
Occupation	Worker	14
	Farmer	36
	Management personnel	12
	Civil servant	8

Table 2-3 Summary of the survey results in monitoring period

No	Question	Response	Amount	Percentage

1	Do you know the purpose of this project?	Very much	65	93%
		A little	5	7%
		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	42	60%
		Improve water quality	16	23%
		Reduce waste pollution	12	17%
		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	23	33%
		providing employment opportunities	25	36%
		Free use of fertilizer	22	31%
4	Are you satisfied with the environmental protection measures that the proposed project has made?	Satisfied	70	100%
		Dissatisfied	0	0%
		Indifferent	0	0%
5	What do you think is the impact of the proposed project on local employment?	*Positive*	66	94%
		Negative	0	0%
		None	4	6%
6	What do you think is the impact of the proposed project on local economy?	Positive	66	94%
		Negative	0	0%
		None	4	6%
7	In general, what is your attitude towards the Project construction?	Supportive	70	100%
		Against	0	0%
		Indifferent	0	0%
8	Do you think other regions should also vigorously promote this type of technology?	Yes	60	86%
		No	0	0%
		No idea	10	14%

In all, all the villagers and local government that attending the meeting and 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.

Finally, in order to set up the mechanism for on-going communication with local stakeholders, a grievance book was put at the entrance of each swine farm. All stakeholders are allowed to record their grievances or comments in the book at any time. No any grievances or comments were received during this monitoring period.

2.3 Environmental Impact

The Environmental Impact Assessment (EIA) Report for the project has been approved by local governmental authorities. The environmental impacts and mitigation measures during the construction period and the operation period are summarized as follows.

Construction period

Air pollution

For dust-generating points such as excavation, filling, and temporary storage yards, measures should be taken to reduce dust by watering; the transportation of powdered materials such as cement, dust, and sand should be closed or covered, and the speed of vehicles should be limited to reduce the generation of dust.

Wastewater

The wastewater during the construction period of the project is mainly generated from the domestic sewage of construction workers, groundwater during foundation excavation and rinsing water after pouring concrete. Oil separation and sedimentation tanks should be set up in the construction site so that the production wastewater can be reused for construction after oil separation and sedimentation. The groundwater and rinsing water will be intercepted and treated centrally. The domestic sewage can be collected in a septic tank and treated centrally, and then used as fertiliser for the surrounding farmland after precipitation and clarification.

Therefore, the wastewater generated during the construction of the project has little impact on the surrounding environment.

Noise

Noise during the construction period is mainly generated by the construction machineries and vehicles. Use advanced low-noise equipment as much as possible, and construction is prohibited at night; corresponding noise reduction, sound insulation and shock absorption measures shall be adopted for noise sources.

Solid waste

Solid waste during the construction period includes construction waste and domestic waste. Domestic wastes are collected in trash cans and disposed of by the sanitation department. Construction wastes are promptly removed and transported to construction waste landfill sites designated by local government departments for disposal.

Operation period

Wastewater

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.

Air pollution

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. All biogas residues are used for organic fertilizer production.

Solid waster

Strengthen solid waste management. All digestate is used for organic fertiliser 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.

In conclusion, the project will not have a significant negative impact on the surrounding environment during both construction and operation period. On the contrary, the implementation of the project will significantly improve the quality of the local environment, achieve environmentally sound treatment of agricultural organic waste, reduce the impact of agricultural organic waste on surface water and groundwater, and reduce greenhouse gas emissions. In addition, biogas incineration saves fossil fuels used to generate heat and contributes to sustainable development.

2.4 Public Comments

The Project (VCS ID: 2876) was open for public comments for a month from 17-March-2022 to 16-April-2022 on the website of Verra Registry[7]. No comments were received for the Project.

2.5 AFOLU-Specific Safeguards

Not applicable.

3 APPLICATION OF METHODOLOGY

3.1 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)".

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(version07.0)"

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

Tool 06:" Project emissions from flaring (Version 04.0)"

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

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

Tool 24:" Common practice (Version 03.1)"

[7] https://registry.verra.org/app/projectDetail/VCS/2876

All above methodology and tool can be available from:
http://cdm.unfccc.int/methodologies/PAmethodologies/approved
https://cdm.unfccc.int/Reference/tools/index.html

3.2 Applicability of Methodology

Justification for the choice of the selected methodology is shown in the following table:

ACM0010 (Version 08.0)" GHG emission reductions from manure management systems"	
Applicability Criteria	**Justification**
This methodology applies to project activities that include destruction of methane emissions and displacement of a more GHG-intensive service in manure management of livestock farms by introducing a new animal waste management system or a combination of animal waste management systems that result in less GHG emissions.	This project installs new AWMSs to treat the manure and wastewater from the 7 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons and the biogas generated during the treatment process is captured for heat generation, which result in less GHG emissions.
This methodology is applicable to manure management on livestock farms where the existing anaerobic manure treatment system, within the project boundary, is replaced by one or a combination of more than one animal waste management systems (AWMSs) that result in less GHG emissions compared to the existing system. The methodology is also applicable to Greenfield facilities.	The project activity replaces the current open anaerobic lagoons with 7 new AWMSs. After solid-liquid separation, the solid are treated in aerobic composting system, which are used as fertilizer. The liquid is treated through anaerobic digestion and the biogas generated during the treatment process is captured for heat generation, the sludge produced from anaerobic digestion are treated through aerobic composting together with the separated solid, the effluent is used for agriculture irrigation. The project activity reduces of GHG in the atmosphere through avoiding methane emissions from anaerobic treatment of swine manure.
This methodology is applicable to manure management projects under the following conditions: (a) Farms where livestock populations, comprising of cattle, buffalo, swine, sheep, goats, and/or poultry, is managed under confined conditions; (b) Farms where manure is not discharged into natural water resources (e.g. rivers or estuaries); (c) In case of anaerobic lagoons treatments systems, the depth of the lagoons used for manure management under the baseline scenario should be at least 1 m; (d)The annual average ambient temperature at the site where the anaerobic manure treatment facility in the baseline existed is higher than 5°C; (e) In the baseline case, the minimum retention time of manure waste in the anaerobic treatment system is greater than one month; (f) The AWMS(s) in the project case results in no leakage of manure waste into ground water, for example the lagoon should have a non-permeable	(a) This project introduces new AWMSs to a group of 7 swine farms owned by Muyuan[8], which is publicly listed on the Shenzhen Stock Exchange in 2014, is a Nanyang-headquartered agricultural and animal husbandry enterprise, which integrates pig breeding, slaughtering and processing. All the swine farms of the project had obtained the licenses for production and operation of the breeding livestock and poultry issued by local government and livestock and poultry housing layout in each farm should be reasonable as per the requirement of this license. Therefore, all swine is managed under confined conditions. (b)The swine manure is dumped into open anaerobic lagoons and it is prohibited to discharge into any natural water resources without treatment according to Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming. (c) The open anaerobic lagoons considered in the baseline scenario are designed for deep storage and has a depth of 3-5 meters in accordance with the" design code for wastewater stabilization ponds (GJJ/T54-93)".

[8] http://www.muyuanfoods.com/

layer at the lagoon bottom.	(d) The annual average ambient temperature at the site is15°C[9], which is higher than 5°C. (e)The minimum retention time of manure waste in the open anaerobic lagoons is about 60 days and not more than 90 days. This was discussed with the farm owners. (f) Fully Geo-membrane enclosed anaerobic tanks applied in the project is sealed by HDPE geomembrane, which is impermeable and leak-proof, and laying HDPE impermeable membranes inside the excavated soil pit. The construction of anaerobic tanks is consistent with local standard of Henan Province" the Wastewater Treatment Technical Specification for Geo-membrane enclosed anaerobic tanks".

Tool 02: "Combined tool to identify the baseline scenario and demonstrate additionality(version07.0)"	
The tool is applicable to all types of proposed project activities. However, in some cases, methodologies referring to this tool may require adjustments or additional explanations as per the guidance in the respective methodologies. This could include, inter alia, a listing of relevant alternative scenarios that should be considered in Step 1, any relevant types of barriers other than those presented in this tool and guidance on how common practice should be established.	The project activity is designed to install new AWMSs to a group of 7 swine farms to treat the swine manure to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. Alternative scenarios, barrier analysis, investment analysis and common practice analysis is carried out based on Tool 02. Refer to Section 3.4 and 3.5 of the JPM for more details.

Tool 05: "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)"	
If emissions are calculated for electricity consumption, the tool is only applicable if one out of the following three scenarios applies to the sources of electricity consumption: (a) Scenario A: Electricity consumption from the grid. The electricity is purchased from the grid only, and either no captive power plant(s) is/are installed at the site of electricity consumption or, if any captive power plant exists on site, it is either not operating or it is not physically able to provide electricity to the electricity consumer; (b) Scenario B: Electricity consumption from (an) off-grid fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants are installed at the site of the electricity consumer and supply the consumer with electricity. The captive power plant(s) is/are not connected to the electricity grid; or (c) Scenario C: Electricity consumption from the grid and (a) fossil fuel fired captive power plant(s). One or more fossil fuel fired captive power plants operate at the site of the electricity consumer. The captive power plant(s) can provide electricity to the electricity consumer. The captive	All the electricity used by the project is supplied by Central China Power Grid (CCPG)[10], which falls under scenario A of Tool 05 (Version 03.0). Therefore, emissions related to electricity consumption need to be calculated based on Tool 05.

[9] http://www.weather.com.cn/cityintro/101180701.shtml, http://www.weather.com.cn/cityintro/101181601.shtml
[10] https://www.mee.gov.cn/ywgz/ydqhbh/wsqtkz/202012/t20201229_815386.shtml

power plant(s) is/are also connected to the electricity grid. Hence, the electricity consumer can be provided with electricity from the captive power plant(s) and the grid.	
This tool can be referred to in methodologies to provide procedures to monitor amount of electricity generated in the project scenario, only if one out of the following three project scenarios applies to the recipient of the electricity generated: (a) Scenario I: Electricity is supplied to the grid; (b) Scenario II: Electricity is supplied to consumers/electricity consuming facilities; or (c) Scenario III: Electricity is supplied to the grid and consumers/electricity consuming facilities.	This methodological tool is applied for calculating for emission by electricity consumption in project activity. So, this criterion is not applicable.
This tool is not applicable in cases where captive renewable power generation technologies are installed to provide electricity in the project activity, in the baseline scenario or to sources of leakage. The tool only accounts for CO_2 emissions.	Tool 05 is only used to calculate project emissions of electricity consumption supplied by CCPG. Only CO_2 emissions will be accounted.

Tool 06: "Project emissions from flaring (version04.0)"	
This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and project participants should document in the CDM-PDD the type of flare used in the project activity.	The biogas generated during the treatment process is captured for heat generation and the residual biogas will be flared (if any). One opened flare was installed in each swine farm and total 7 flares are used by the project activity.
This tool is applicable to the flaring of flammable greenhouse gases where: (a) Methane is the component with the highest concentration in the flammable residual gas; and (b) The source of the residual gas is coal mine methane or a gas from a biogenic source (e.g. biogas, landfill gas or wastewater treatment gas).	The source of the residual biogas of the project activity is from anaerobic treatment process of the swine manure (biogenic source). As Project evaluation report, methane accounts for 60% of the biogas, which is the highest concentration in the flammable residual gas.
The tool is not applicable to the use of auxiliary fuels and therefore the residual gas must have sufficient flammable gas present to sustain combustion. For the case of an enclosed flare, there shall be operating specifications provided by the manufacturer of the flare.	No auxiliary fuels is used by the flaring system. As per Project evaluation report of the project, methane accounts for 60% of the biogas. And methane is a kind of flammable gas. For this project activity, opened flare was installed in each swine farm.

Tool 08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version03.0)"	
Typical applications of this tool are methodologies where the flow and composition of residual or flared gases or exhaust gases are measured for the determination of baseline or project emissions.	The amount of biogas produced from the anaerobic digestion was collected and monitored. Refer to section 5.2 of the JPM for more details.
Methodologies where CO_2 is the particular and only gas of interest should continue to adopt material balances as the means of flow determination and may not adopt this tool as material balances are the cost-effective way of monitoring flow of CO_2	The biogas generated during the treatment process including CH_4, H_2S 、 O_2 and etc, therefore this tool is adopted used for determining the mass flow of a greenhouse gas.

The underlying methodology should specify: (a) The gaseous stream the tool should be applied to; (b) For which greenhouse gases the mass flow should be determined; (c) In which time intervals the flow of the gaseous stream should be measured; and (d) Situations where the simplification offered for calculating the molecular mass of the gaseous stream (equations (3) or (17) is not valid (such as the gaseous stream is predominantly composed of a gas other than N_2).	a) Methodological tool" Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is applied in the JPM. b) The mass flow is determined in the monitoring plan of the JPM. c) The flow of the gaseous stream will be measured continuously. d) The gaseous stream is dry, equation (18) and (19) are used to calculate the mass flow of greenhouse gas.

Tool 14: "Project and leakage emissions from anaerobic digesters (Version 02.0)"	
The following sources of project emissions are accounted for in this tool: (a) CO_2 emissions from consumption of electricity associated with the operation of the anaerobic digester; (b) CO_2 emissions from consumption of fossil fuels associated with the operation of the anaerobic digester; (c) CH_4 emissions from the digester (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); and (d) CH_4 emissions from flaring of biogas.	The electricity consumption of the project was supplied by the grid company, and the anaerobic digestion process of this project does not involve the use of fossil fuels. 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, most of the fertilizer is distributed to local farmers for free and only a small portion are sold as fertilizer. The liquid is treated through anaerobic digestion and the biogas generated during the treatment process are captured for heat generation. The sludge produced from anaerobic digestion are treated through aerobic composting together with the solid, the effluent is supplied to the farmers living around free for agriculture irrigation. If any, the surplus biogas will be sent to the flaring system to be destroy. So, the project meets the (a), (c) and (d).
The following sources of leakage emissions are accounted for in this tool: (a) CH_4 and N_2O emission from composting of digestate; (b) CH_4 emissions from the anaerobic decay of digestate disposed in a SWDS or subjected to anaerobic storage, such as in a stabilization pond.	After anaerobic digestion, the sludge produced from anaerobic digestion was treated through aerobic composting together with the solid. In this project, there was no additional storage yard to store the sludge produced from anaerobic digestion. Therefore The leakage emissions associated with the anaerobic digester ($LE_{AD,y}$) should not be taken into account for this project.
Emission sources associated with N_2O emissions from physical leakages from the digester, transportation of feed material and digestate or any other on-site transportation, piped distribution of the biogas, aerobic treatment of liquid digestate and land application of the digestate are neglected because these are minor emission sources or because they are accounted in the methodologies referring to this tool.	Emission sources associated with N_2O emissions from physical leakages from the digester, transportation of feed material and digestate or any other on-site transportation, piped distribution of the biogas, aerobic treatment of liquid digestate and land application of the digestate are neglected because these are minor emission sources.

Tool 24: "common practice (version03.1)"	
This methodological tool is applicable to project activities	Combined tool to identify the baseline scenario and

that apply the methodological tool "Tool for the demonstration and assessment of additionality", the methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality", or baseline and monitoring methodologies that use the common practice test for the demonstration of additionality.	demonstrate additionality (Version07.0) is applied to identify the baseline scenario by the project.
In case the applied approved baseline and monitoring methodology defines approaches for the conduction of the common practice test that are different from those described in this methodological tool, the requirements contained in the methodology shall prevail.	The latest version of Combined tool to identify the baseline scenario and demonstrate additionality is referred by ACM0010 methodology.

3.3 Project Boundary

As per ACM0010" GHG emission reductions from manure management systems" (version 08.0), the spatial extent of the project boundary encompasses the site of the AWMS(s), including the flare or energy and/or heat generation equipment and the power/heat source.

The project boundary considers the GHG emissions that come from AWMSs, including the GHG emissions from the anaerobic digesters, GHG emissions from the heat generation equipment, GHG emissions from sludge treatment by aerobic composting and GHG emissions from flaring system in 7 swine farms. The baseline situation is shown in Figure 3-1 below.

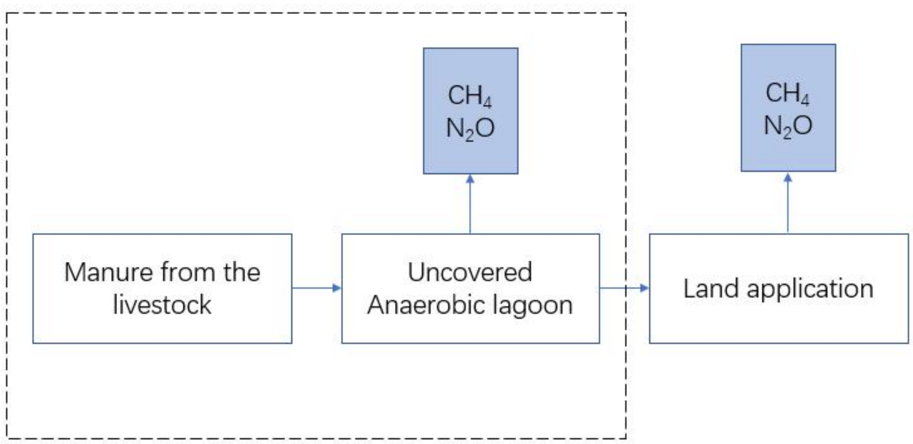

Figure 3-1. The baseline situation in the swine farms

The project activity boundary is defined as Figure 3-2 below.

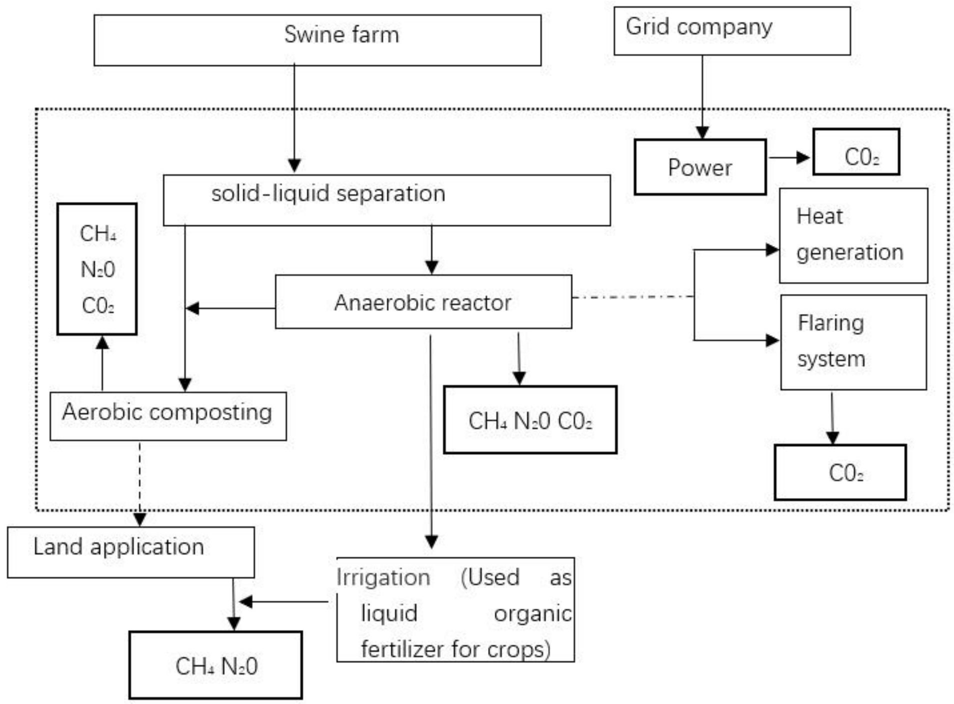

Figure 3-2. The project boundary of the project

The greenhouse gases included or excluded from the project boundary are summarized in Table 3-1 below.

Table 3-1. Emissions sources included in or excluded from the project boundary

Source		Gas	Included?	Justification/Explanation
Baseline	Emissions from the waste treatment processes	CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Yes	The major source of emissions in the baseline
		N_2O	Yes	Direct and indirect N_2O emissions are accounted
	Emissions from electricity consumption/ generation	CO_2	No	Excluded for simplification. This is conservative.
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
	Emissions	CO_2	No	Excluded for simplification. This is

Source		Gas	Included?	Justification/Explanation
	from thermal energy generation			conservative.
		CH_4	No	Excluded for simplification. This is conservative
		N_2O	No	Excluded for simplification. This is conservative
Project	Emissions from thermal energy use	CO_2	No	Excluded for simplification. This project does not use thermal energy.
		CH_4	No	Excluded for simplification. This project does not use thermal energy.
		N_2O	No	Excluded for simplification. This project does not use thermal energy.
	Emissions from on-site electricity use	CO_2	Yes	May be an important emission source. If electricity is consumed from the grid company
		CH_4	No	Excluded for simplification.
		N_2O	No	Excluded for simplification.
	Emissions from the waste treatment processes	N_2O	Yes	Direct and indirect N_2O emissions are accounted
		CO_2	No	CO_2 emissions from the decomposition of organic waste are not accounted
		CH_4	Yes	The emission from anaerobic digesters and aerobic treatment[11]

3.4 Baseline Scenario

Baseline scenario has been identified using the methodological tool 02 "Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)" considering the requirements of the methodology and assessing the possible waste management options as described in 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4, Chapter 10, Table 10.17).

The most plausible baseline scenario is identified in the following steps:

Step 0. Demonstration that a proposed project activity is the First-of-its-kind;

[11] As per the paragraph 43 of applied methodology, Project emission associated with the anaerobic digester in year y ($PE_{AD,y}$) should be determined using ***Tool 14: "Project and leakage emissions from anaerobic digesters"***. While according to paragraph 13 of Tool 14(Version 02.0),$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y}$. So, CH_4 flaring is included in the emissions form the waste treatment processes.

Step 1. Identification of alternative scenarios;
Step 2. Barrier analysis;
Step 3. Investment analysis (if applicable);
Step 4. Common practice analysis.

Step 0: As per Tool 02"Combined tool to identify the baseline scenario and demonstrate additionality" (Version07.0), this step is optional. So, it is not necessary to analyse this step.

Step1: Identification of alternative scenarios

Step 1a: Define alternative scenarios to the proposed CDM project activity

Prior to the implementation of the project, all manure waste produced from the existing 7 swine farms was left to decay in 7 uncovered anaerobic lagoons at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. The uncovered anaerobic lagoons were replaced by 7 sets of AWMSs in these 7 swine farms for this project. Therefore, it belongs to the existing facilities.

According to methodology, baseline alternatives for managing the manure for the existing facilities, shall take into consideration, inter alia, the complete set of existing/possible manure management systems listed in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 4, Chapter 10, Table 10.17).

The baseline and available alternatives for the manure management are listed as below table as 2006 IPCC:

No.	IPCC Alternatives	Applicability	Justification
1	The manure is collected from the pasture/Range/Paddock	Not Applicable	The swine in this project is bred in confined barns rather than pasture/range/paddock, so this alternative is excluded.
2	Daily spread: Manure removed from confinement and applied to pasture within 24 hours of excretion	Not Applicable	For a large-scale swine farm, it is highly labor intensive to remove the manure and apply on a daily basis. Therefore, this manure management system is not in an economically attractive prospect. So, the exclusion of this potential baseline scenario can be justified.
3	Solid Storage: The manure is disposed by solid storage.	Not Applicable	This involves the storage of manure, typically for a period of several months, in unconfined piles or stacks. It is only a storage method of manure, not a disposal method. In addition, it is suitable for small family farms. The proposed project involves large-scale swine farms and the use of a scraping and flushing approach to remove manure which has large volumes of water. So, this manure management system is not a potential alternative baseline scenario.
4	Dry lot	Not Applicable	In dry climates animals may be kept on unpaved feedlots where the manure is allowed to dry until it is periodically removed. Upon removal the manure may be spread on fields. This system is not applicable to the conditions of

			the swine farms in the project. This method is only a storage method of manure, not a disposal method. So, this system is excluded.
5	The manure is disposed as liquid/slurry.	Not Applicable	This method is only a storage method of manure, not a disposal method. Manure is stored as excreted or with some minimal addition of water in either tanks or earthen ponds outside the animal housing. Since the amount of discharged manure is very large even on a daily bases, storing the liquid manure in the tank to distribute them to the farmland requires a lot of labour work. Therefore, it is unrealistic to implement such a task for the farms under the competition of the market. Therefore, this option faces significant barrier and is excluded from the baseline scenario.
6	Uncovered anaerobic lagoon	Applicable	As per "Technical specification for sanitation treatment of livestock and poultry manure", the uncovered anaerobic lagoon is a kind of harmless treatment of liquid manure. After being treated in the uncovered anaerobic pond, the liquid can be used for agricultural irrigation, the solid can be composted, and the fertilizer can be used by local farmers for farming. Animal waste that has been treated by uncovered anaerobic lagoon can satisfy the above regulations. However, these regulations have not yet imposed any restrictions on GHG emissions. So, the uncovered anaerobic lagoon is a alternatives baseline scenario.
7	Pit storage below animal confinements, <1month	Not Applicable	This method is only a storage method of manure, not a disposal method. The farms involved in this project are large-scale livestock farm and the manure quantity produced is too large to implement pit storage structure under the barns. In addition, the manure stored in below animal confinements were removed within 1 month requires a lot of labour work. so, this scenario is excluded.
	Pit storage below animal confinements,>1month	Not Applicable	This method is only a storage method of manure, not a disposal method. The farms involved in this project are large-scale livestock farm and the manure quantity produced is too large to implement pit storage structure under the barns. In addition, the excreted volume accumulated under the barns produces enteric fermentation gas, if it is not discharged out of the barns in time, the swine will be quickly killed by the accumulation of toxic fumes.
8	Anaerobic digester（Anaerobic digester-Aerobic Treatment system）	Applicable	A single Anaerobic digester is suitable for treating manure, but to implement such technology need high invest compared to Uncovered anaerobic lagoon, which is the most common and economic method. However, a single anaerobic process is not yet able to meet the

			requirements for the use of the waste and must be followed up with disposal, which requires the use of a combination of aerobic and anaerobic processes together. At present a combine Anaerobic Digester-Aerobic Treatment system is considered to be one of the most advanced manure management systems, but to implement such technology need high invest and the proposed project will not be invested and constructed without being registered as a VCS project.
9	Burned for fuel	Not Applicable	The farms involved in this project are large scale swine farm, the manure is flushed to the anaerobic digester, the dung and urine generated from the farm is too large even on a daily basis, so it is unlikely to dry the dung before using as fuel.
10	Cattle and Swine deep Bedding, <1month	Not Applicable	This method is only a storage method of manure, not a disposal method. The deep bedding is laborious and this is counter to achieving economies of scale associated with large animal counts. The concentration of nocuous gas in the bedding is high enough to poison swine if it is disposed inappropriately, and it is favorable for the survival and breeding of vermin and microorganisms due to its high temperature and humidity. So, the deep bedding practice is excluded from consideration. This system is more applicable to small scale farms.
	Cattle and Swine deep Bedding, >1month	Not Applicable	
11	Composting - In-vessel	Not Applicable	It is suitable to treat solid manure and is not applicable to the manure with large amount of water. Manure in this project is collected by using scraping and flushing system. Manure in this project is in liquid with large volume of water. Therefore, it is excluded from the possible baseline scenario.
12	Composting - Static pile	Not Applicable	Composting in piles with forced aeration but no mixing will consume a great deal of electricity for forced aeration because of the large quantity of swine manure. It is suitable to solid treat manure, not applicable for manure with larger volume of water. Therefore, it is excluded from the list of possible baseline scenarios.
13	Composting - Intensive windrow	Not Applicable	Composting in windrows with regular turning for mixing and aeration emits a large quantity of odor and GHGs during turning and consumes a lot of electricity for the aeration operation. It is suitable to treat solid manure. So, it is excluded from the list of possible baseline scenarios.
14	Composting – Passive windrow	Not Applicable	Composting in windrows with infrequent turning for mixing and aeration takes a long time and occupies a large area of land. This kind of solid manure management system emits strong odors and GHGs during turning. For this reason, it is excluded from the list

			of possible baseline scenarios.
15	Poultry manure with litter	Not Applicable	The farms involved in this project are large-scale swine farm, not the Poultry farm, so no poultry manure produced. This system is excluded.
16	Poultry manure without litter	Not Applicable	The farms involved in this project are large-scale swine farm, not the Poultry farm, so no poultry manure produced. This system is excluded.
17	Aerobic treatment （Anaerobic digester-Aerobic Treatment system）	Applicable	A single aerobic treatment technique is not suitable for treating low concentration organic wastewater in wastewater. This kind of wastewater contains a large amount of highly concentrated organic wastewater, which is difficult to be treated by the aerobic method and does not meet the Chinese environmental quality standards and pollutant discharge standards for discharge to water bodies. At present a combine Anaerobic Digester-Aerobic Treatment system is considered to be one of the most advanced manure management systems, but to implement such technology need high invest and the proposed project will not be invested and constructed without being registered as a VCS project.

Outcome of Step 1a: In summary, the alternatives to the baseline scenario are identified by the tool 02:” Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0)”as:

Scenario 6: “The manure is disposed in an uncovered anaerobic lagoon”

Scenario 8&17: Anaerobic Digester-Aerobic Treatment i.e., the project activity not being registered as a VCS project activity.

Step 1b: Consistency with mandatory applicable laws and regulations

There is no legal law and regulation to mandate the livestock farm owners to implement anaerobic digestion, aerobic or other biological treatment techniques to treat the animal manure in China. Only the manure is prohibited to discharge directly into environment without any treatment as per Regulations on Prevention and Control of Pollution from Livestock and Poultry Farming[12] issued by the State Council in Nov.2013.

According to “Technical specification for sanitation treatment of livestock and poultry manure[13]”, in China, the uncovered anaerobic lagoon is a kind of manure treatment method recognized by the state, which need minimum financial cost and is compliance with laws and regulations. Therefore, it is the most economic, viable and reasonable for livestock farm owners.

As per “Specifications for the construction of manure resource utilization facilities for large-scale livestock and poultry farms (for trial implementation)[14]”, anaerobic digester, aerobic

[12] http://politics.people.com.cn/n/2013/1126/c1001-23662445.html

[13] https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf

[14] http://www.moa.gov.cn/gk/tzgg_1/tfw/201801/t20180111_6134801.htm

treatment or other biological treatment techniques methods to dispose manure waste are encouraged by the state and not mandatory.

Therefore, the Scenario 6: "The manure is disposed in an uncovered anaerobic lagoon" and Scenario 8&17: Anaerobic Digester-Aerobic Treatment are all consistency with mandatory laws and regulations. So, the outcome of Step 1b is unchanged from Step 1a.

Step 2: Barrier analysis

There are no technology barriers, acceptability barriers and financial barriers that may prevent these two alternative scenarios to occur. As per Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0), go to Step 3 investment analysis.

Step 3: Investment analysis

Undertake investment analysis of all the alternatives that don't face any barriers, as identified in Step II. For each alternative, all costs and economic benefits attributable to the waste management scenario should be illustrated in a transparent and complete manner. Table 3-2 shows the investment analysis results of the uncovered anaerobic lagoon.

Table 3-2 Investment analysis of the uncovered anaerobic lagoon (10^4 RMB)

Costs and benefits	**1**	**2-15**	**16**
Cash inflow	**0.00**	**0.00**	**0.00**
Revenues from organic fertilizers sales	0.00	0.00	0.00
Subsidy income	0.00	0.00	0.00
Fixed assets residue value	0.00	0.00	0.00
Recovered current capital	0.00	0.00	0.00
Cash outflow	**63.00**	**7.00**	**7.00**
Construction investment	56.00	0.00	0.00
Current capital	0.00	0.00	0.00
O&M cost	7	7	7
Sales tax and associate charge	0.00	0.00	0.00
Net cash flow	**-63.00**	**-7.00**	**-7.00**
NPV (discount rate=9%)	**-109.56**		
IRR	**undefined**		

There are no potential revenues involved in the baseline scenario. There are only negative flows in the baseline scenario, so the Internal Rate of Return (IRR) cannot be calculated, and the economic comparison should be based on the Net Present Value (NPV) indicator.

Table 3-3 summaries the results of financial analysis of Anaerobic Digester-Aerobic Treatment without VCU revenues.

Table 3-3 Investment analysis of the Anaerobic Digester-Aerobic Treatment without VCU revenues (10^4 RMB)

Costs and benefits	1	2	3	4	5	6	7	8	9	10	11-15	16
Cash inflow	0.00	1,930.50	1,930.50	1,831.61	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	2,170.97
Revenues from organic fertilizers sales	0.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00	1,650.00
Subsidy income	0.00	280.50	280.50	181.61	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fixed assets residue value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	370.97
Recovered current capital	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	150.00
Cash outflow	7,301.31	1,121.71	971.71	971.71	971.71	971.71	971.71	971.71	971.71	971.71	971.71	971.71
Construction investment	7,301.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Current capital	0.00	150.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
O&M cost	0.00	938.05	938.05	938.05	938.05	938.05	938.05	938.05	938.05	938.05	938.05	938.05
Sales tax and associate charge	0.00	33.66	33.66	33.66	33.66	33.66	33.66	33.66	33.66	33.66	33.66	33.66
Adjustment of income tax	0.00	63.16	71.00	54.39	0.00	0.00	0.00	36.87	43.84	51.05	52.10	52.10
Net cash flow (after tax)	-7,301.31	745.63	887.78	805.51	678.29	678.29	678.29	641.42	634.45	627.24	626.19	1,147.16
NPV (discount rate=9%)	**-1,401.61**											
IRR	**5.19%**											

As shown in above table, the NPV of both the project activity and the uncovered anaerobic lagoon are negative and the NPV of the project activity without VCU revenues is far more negative than that of the uncovered anaerobic lagoon which means the cost of the project activity without VCS revenues is much higher than the uncovered anaerobic lagoon, so the uncovered anaerobic lagoon is the most attractive course of action and is considered to be the baseline scenario.

Anaerobic digester system is considered to be one of the most advanced manure management systems in the world. High costs involved in the investment compared to other available systems is required to implement such technology. the IRR of the project activity is lower than the average level and it is difficult for the project proponents to get loans from the banks. Only the project proponents can prove that they can get revenues from VCS, it can attract the banks to provide loans for this project. For these reasons, without the revenues, PP is willing to adopt other manure management systems of lower costs which will lead to more GHG emissions.

The project uses benchmark analysis method (option III) based on the consideration that benchmark, Project IRR is available.

According to the "Notice on adjusting financial benchmark rate of return of construction projects in some industries" issued by NDRC and Ministry of Housing and Urban-Rural Development of PRC, the financial benchmark of animal industry for Project IRR (after tax) is 9.5%.

(a) Basic parameters

item	value	source
Annual organic fertilizers sales	55,000t	Project evaluation report
Total static investment	7,301.31*10^4RMB	Project evaluation report
O&M cost	938.05*10^4RMB	Project evaluation report
Operation period	15 years	Project evaluation report
Emission reduction	319,227tCO_2e	Calculated
VCU Price	10 RMB/ tCO_2e	Expected

(b) Comparison of the project IRR for the proposed project and the benchmark following table.

Without income from selling VCUs, the IRR of the proposed project is 5.19%, lower than the benchmark IRR 9.5% and the project is financially unacceptable because of its low profitability. While considering such income, the IRR of the proposed project is 11.41%, higher than the benchmark, and the project is financially acceptable.

Item	Without income from VCUs	Benchmark IRR	With income from VCUs
The Project IRR	5.19%	9.5%	11.41%

Sensitivity analysis

The purpose of this step is to examine whether the conclusion regarding the financial attractiveness is robust to reasonable variations of the critical assumptions.

According to Para 27 of methodological tool 27" Investment Analysis" (Version 11.0), the "variables, including the initial investment cost, that constitute more than 20% of either total project costs or total project revenues should be subjected to reasonable variation". Therefore, the total static investment, and organic fertilizers sales were taken as uncertain factors for sensitive analysis. Furthermore, the O&M cost which was widely included in the sensitivity analysis for projects in China was also examined in the analysis. As a result, the following parameters are selected for the analysis:

- Total static investment
- Annual organic fertilizers sales
- O&M cost

The results of sensitivity analysis of the three parameters of the proposed project are shown in the Table 3-4:

Table 3-4. Sensitivity analysis of the Anaerobic Digester-Aerobic Treatment without VCU revenues (10^4 RMB)

Item	-10%	-5%	0	5%	10%
Total static investment	6.84%	5.98%	5.19%	4.47%	3.79%
Annual organic fertilizers sales	2.91%	4.05%	5.19%	6.31%	7.40%
O&M cost	6.30%	5.75%	5.19%	4.63%	4.06%

The sensitivity analysis was further conducted, and the project IRR (after tax) could reach the benchmark of 9.5% if one of the following conditions can be achieved:

- Total static investment: decrease 23.1%.
- Annual organic fertilizers sales: increase 19.9%.
- O&M cost: decrease 40.6%

Since all the data used for the investment analysis was sourced from the Project evaluation report, which was completed by an authorized entity. Therefore, the data used in the investment analysis are believed to be reliable and credible and none of above conditions can be achieved:

Total static investment decreasing about 23.1%: According to the publicly latest available sources, on the whole, the price indices for steel, fuel, power and construction materials and price indices for fixed asset investment in China have been increasing in the past years, and this trend seems unlikely to be changed before the project construction is completed. In addition, the project was put into operation. As per general design and construction contract, purchase agreement of boilers and purchase agreement of solid-liquid separators, the actual investment costs of the project have reached to 8,793.77*10^4RMB, which is higher than that of the estimated value based on the project evaluation report (7,301.31*10^4RMB). As a result, the IRR cannot reach the benchmark through decreasing the total static investment.

Annual organic fertilizers sales increasing 19.9%: the organic fertilizers are produced through the aerobic composting system, which is determined by the manure of the swine farm. Since the scale of the swine farm will stay stable in the future, at the same time, sales of organic fertilizers are only part of the total organic fertilizers' generation and the price of organic fertilizers is determined by the raw material, production technology, the quality of organic fertilizer and so on. The organic fertilizers produced by the project belong to semi-finished Products (or called compost), which is harmless but not reaching the Chinese organic fertilizer standard. It can be directly applied to farmland or sold to commercial organic fertilizer plants for further processing. The price of the semi-finished products is lower than the commercial organic fertilizers. And according to the sale agreement of organic fertilizer, the organic fertilizer is sold to local organic fertilizer plant with the fixed price i.e. 300RMB/ton, which is consistent with the estimated price based on the project evaluation report (300RMB/ton). Therefore, the increase of annual organic fertilizers sales to threshold is impossible to achieve,

O&M cost decreasing 40.6%: However, the decrease of it is not likely to occur. The O&M cost encompasses sub-items of maintenance cost, salary & welfare and insurance of fixed assets. Since the cost of materials, power and fuel and labors keep increasing in recent years based on "China Statistical Yearbook, 2021"[15]. Moreover, the equipment is getting more and more with the abrasion, which means the maintenance cost is increasing in the coming years. As a result, the drastic decreasing of 40.6% in O&M cost is not realistic.

As shown in the sensitivity analysis above, the project IRR (after tax) will not reach the benchmark of 9.5% within reasonable fluctuation range, and the fluctuation scenario of the uncertain factors which could make the project financially feasible is unlikely to occur. Therefore, the conclusion regarding the infeasibility of the project is robust to reasonable variations of the critical assumptions.

In summary, the NPV of both the project activity and the uncovered anaerobic lagoon are negative and the NPV of the project activity is far more negative than that of the uncovered anaerobic lagoon which means the cost of the project activity without VCS revenues is much

[15] http://www.stats.gov.cn/tjsj/ndsj/2021/indexch.htm

higher than the uncovered anaerobic lagoon, so, Alternative 6, i.e., the uncovered anaerobic lagoon is the most attractive course of action and is considered to be the baseline scenario.

3.5 Additionality

Additionality for the project activity is demonstrated using Tool 02 Combined tool to identify the baseline scenario and demonstrate additionality (Version 07.0). Step 1-3 were already done in section 3.4 of this JPM.

As per Tool 24 Common practice (Version 03.1), Step 4 common practice analysis will be conducted as follows:

Step 4: Common practice analysis

The project will achieve obvious greenhouse gas (GHG) emission reductions through capturing methane generated during the swine manure treatment process and the biogas can be used for heat generation. Therefore, according to the Tool 24"Common practice (version 03.1), the measure of the project belongs to "Methane formation avoidance". Thus, sub-steps are adopted to take the common practice analysis.

Sub-step 4a. The proposed CDM project activity(ies) applies measure(s) that are listed in the definitions section above.

The project is belonged to type (D) measure listed in the latest version of the Tool 24 common practice (version 03.1)", i.e., Methane formation avoidance (example: use of biomass that would have been left to decay in a solid waste disposal site resulting in the formation and emission of methane, for energy generation). As per additionality tool, the Tool 24"Common practice (version03.1) available on the UNFCCC website is applied as below:

Sub-step 4a.1: calculate applicable capacity or output range as +/-50% of the total design capacity or output of the proposed project activity.

For this project, 7 swine farms involving 370,860 heads of market swine, 38,500 heads of breeding swine in stock are included, and are estimated to produce 597,665 tons of manure every year, Therefore, the project belonging to "Methane formation avoidance" that can handle manure from 298,832.5 tons to 896,497.5 tons are included.

Sub-step 4a.2: identify similar projects (both CDM and non-CDM) which fulfill all of the following conditions:

(a) The projects are located in the applicable geographical area;

The common practice analysis is limited to the provincial level as the provincial government is at the highest level of local governments. Local regulatory frameworks are generally set by local governments (e.g., price regulation, investment policy). only the activities in the same province could be regarded as sharing the same "comparable environment". Therefore, Henan Province is considered to be a geographical area with comparable investment climate and is selected for geographical boundaries of common practice analysis.

(b) The project applies the same measure as the proposed project activity;

As described above, the project installs new AWMSs to treat the manure from 7 existing swine farms, which can avoid methane emissions generated in the baseline uncovered anaerobic lagoons. And the measure of the project belongs to "Methane formation avoidance" as per Tool 24"Common practice (version03.1).

(c) The projects use the same energy source/fuel and feedstock as the proposed project activity, if a technology switch measure is implemented by the proposed project activity;

The project is to treat the manure from the 7 existing swine farms avoid methane emissions generated in the baseline uncovered anaerobic lagoons through installing new 7 set of AWMSs. The biogas captured for heat generation, which is used for swine farms.

(d) The plants in which the projects are implemented produce goods or services with comparable quality, properties and applications areas (e.g., clinker) as the proposed project plant;

597,665 tons of animal manure waste can be treated annually and the biogas captured for heat generation. If the similar projects can treat the manure waste and produce heat should be considered as the comparable service.

(e) The capacity or output of the projects is within the applicable capacity or output range calculated in Step 1;

Based on the calculation in Sub-step 4a.1, the output/capacity ranges of similar project are that can handle manure from 298,832.5 tons to 896,497.5 tons annually.

(f) The projects started commercial operation before the project design document (CDM-PDD) is published for global stakeholder consultation or before the start date of proposed project activity, whichever is earlier for the proposed project activity.

The similar project stared commercial operation before the start date of the project at 15-July-2020, which is earlier date.

Based on above analysis, it can conclude the project belonging to "Methane formation avoidance" with treatment of manure operated before 15-July-2020, that can handle manure from 298,832.5 tons to 896,497.5 tons annually in Henan Province is the similar project as the project activity.

Sub-step 4a.3: within the projects identified in Step 2, identify those that are neither registered CDM project activities, project activities submitted for registration, nor project activities undergoing validation. Note their number N_{all}.

Through searching UNFCC website, CDM website, China CER exchange info-platform, GS website, VCS website, Development and Reform Commission of Henan Province[16] and Department of Agriculture and Rural Affairs of Henan Province[17], there are no similar projects, therefore N_{all}=0.

Sub-step 4a.4: within similar projects identified in Step 3, identify those that apply technologies different that the technology applied in the proposed project activity. Note their number N_{diff}.
N_{diff}=0

Sub-step 4a.5: calculate factor F=1-N_{diff}/N_{all} representing the share of similar projects (penetration rate of the measure/technology) using a measure/technology similar to the measure/technology used in the proposed project activity that deliver the same output or capacity as the proposed project activity.

According to the analysis above, N_{all}= N_{diff} =0, and the factor F=1-N_{diff}/N_{all}=1-1 =0< 0.2. Therefore, the result of common practice assessment is: N_{all}-N_{diff}=0 < 3 Therefore, the project activity is not a common practice in the region.

Conclusion of the assessment and demonstration of additionality
To summarize, “the project is undertaken without being registered as a VCS project activity” is not financially attractive to investors, thus it is not feasible. Being registered as a VCS project, the VCUs revenues can alleviate the identified barriers, therefore the project is additional.

3.6 Methodology Deviations

There is no methodology deviation for the project.

[16] https://fgw.henan.gov.cn/
[17] https://nynct.henan.gov.cn/

4 ESTIMATED GHG EMISSION REDUCTIONS AND REMOVALS

4.1 Baseline Emissions

This section details the applicable formulas from the methodologies applied to the project Activity.

The baseline is the AWMS identified through the baseline selection procedure in Section 3.4 of this JPM. As per paragraph 26 of the applied methodology,

Baseline emissions are：

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

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 ($BE_{CH4,\,y}$)

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

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

(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, since there is no way to trace the daily stock, so the Option 1 is adopted to calculate N_{LT} for market swine. 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.

(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 Henan 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 annual average temperature is 15°C and 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 ($BE_{N20,y}$)

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

where：

$BE_{N20,y}$	Annual baseline N_2O emissions in (t CO_2e/yr)
GWP_{N20}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N20-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$E_{N20,D,y}$	Direct N_2O emission in year *y* (kg N_2O-N/year)
$E_{N20,ID,y}$	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：

$E_{N20,D,y}$	Direct N_2O emission in year *y* (kg N_2O-N/yr)
$EF_{N20,D,j}$	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 (4) or (5) (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 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)

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:

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

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)

$$NEX_{IPCC\ default} = N_{rate(T)} * \frac{TAM}{1000} * 365^{18} \qquad \text{(Equation 10)}$$

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

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

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

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 will be used, so the emission can be excluded for simplification. In addition, the biogas generated during the treatment process in this project is captured for heat generation and all the heat generated from this project is used by the daily operation of AWMSs and the 7 swine farms. The heat generated cannot be connected to another user. So, the baseline CO_2 emission from electricity and/or heat used in the baseline is 0, which is conservative.

Therefore, Baseline emissions are calculated as below:

$$BE_y = BE_{CH4,y} + BE_{N2O,y} \text{ (Equation 12)}$$

As description above, the value for each parameter can be referred below Table.

Parameter	Value	Source/clarification
GWP_{CH4}	28tCO_2/tCH_4	IPCC Fifth Assessment Report according to the requirement described in Section 3.14.4 of VCS Standard (V4.3).
D_{CH4}	0.00067 t/m^3	ACM0010(Version 08.0)

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

MCF_j	74%	For this project, the annual average temperature is 15℃ and the value of 74% is applied according to Table 10.17, chapter 10, volume 4, IPCC 2006
Conservative Factor	0.94	ACM0010(Version 08.0)
MCF_j with cons. Factor	0.6956(74%*0.94)	Calculated as per ACM0010(Version 08.0)
$B_{o,LT}$	0.29 m^3 CH_4 /kg_dm	Default values in Table 10A-7, chapter 10, volume 4, IPCC 2006
N_{LT}	Market swine: 370,860 No of heads Breeding swine: 38,500 No of heads	The values are sourced from PER for ex ante calculation. N_{LT} for Market swine and breeding swine should be calculated according to Equation 5 and 6 during the monitoring period
W_{site}	Market swine: 60.0kg Breeding swine: 90.okg	The values are sourced from PER for ex ante calculation. W_{site} for Market swine and breeding swine should be monitored according to the ACM0010(Version 08.0)
$W_{default}$	28 kg	Default values in Table 10A-7, chapter 10, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
$VS_{default}$	0.3 Kg-dm/animal/day	Default values in Table 10A-7, chapter 10, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
$VS_{LT,y}$	Market swine: 234.64=(60.0/28)*0.3*365 kg-dm/animal/yr(Breeding swine: 351.96=(90.0/28)*0.3*365 kg-dm/animal/yr	Calculated as per Option 3 for determining $VS_{LT,y}$
$MS\%_{Bl,j}$	100%	All manure is handled by the uncovered anaerobic lagoon in baseline scenario.
nd_y	365 days	There are 365 days in a year
$EF_{N2O,D,j}$	0 kg N_2O-N/kg N	Default values in Table 10.21, chapter 10, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
$EF_{N2O,ID}$	0.01 kg N_2O-N/kg N	Default values in Table 11.3, chapter 11, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
$N_{rate(T)}$	Market swine: 0.42 kg N/1000kg animal mass/day Breeding swine: 0.24 kg N/1000kg animal mass/day	Default values in Table 10.19, chapter 10, volume 4, IPCC 2006
$NEX_{IPCCdefault}$	Market swine: 4.29=0.42*28/1000*365 kg N/animal/year Breeding swine:	Calculated as formula 10.30 in chapter 10 volume IPCC2006

	2.45=0.24*28/1000*365 kg N/animal/year	
TAM	28 kg	Default values in Table 10A-7, chapter 10, volume 4, IPCC 2006
$NEX_{LT,y}$	Market swine: 9.20=60.0/28*4.29 kg N/animal/yr Breeding swine: 7.88=90.0/28*2.45 kg N/animal/yr	Calculated as per Option 2 for determining $NEX_{LT,y}$
$F_{gasMS,j,LT}$	40%	Default values in Table 10.22, chapter 10, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
GWP_{N2O}	265	IPCC Fifth Assessment Report according to the requirement described in Section 3.14.4 of VCS Standard (V4.3).
$CF_{N2O,N-N}$	1.57	ACM0010(Version 08.0)

4.2 Project Emissions

Two stages are involved in the manure treatment for the project activity: (1) anaerobic digester; (2) aerobic composting.

Project emissions are estimated as follows:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y} + PE_{EC/FC,y} \qquad \text{(Equation 13)}$$

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 ($PE_{AD,y}$)

Based on the methodology ACM0010" GHG emission reductions from manure management systems (Version 08.0)". $PE_{AD,y}$ is determined using the methodological tool 14 "Project and leakage emissions from anaerobic digesters".

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 as follows:

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y} \qquad \text{(Equation 14)}$$

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",

$$PE_{EC,y} = \sum_{\mathrm{j,LT}} EC_{\mathrm{PJ,J,y}} * \mathrm{EF_{EF,j,y}} * (1 + \mathrm{TDL_{j,y}}) \quad \text{(Equation 15)}$$

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*

All thermal energy used by the project is supplied by the new installed boilers, which is utilizing biogas generated during the treatment process in this project for heat generation. No other thermal energy from outside source is used for the project. And 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 30 ~ 33ºC. 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:

$$F_{i,t} = V_{t,db} * \upsilon_{i,t,db} * \rho_{i,t} \qquad \text{(Equation 16)}$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \qquad \text{(Equation 17)}$$

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 flares 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:

$$PE_{flare,y} = GWP_{CH4,y} * \sum_{m=1}^{525600} F_{CH4,GR,m} * (1 - \eta_{flare,m}) * 10^{-3} \quad \text{(Equation 18)}$$

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 16 and 17, so the Project emissions from flaring can be calculated by:

$$PE_{flare,y} = GWP_{CH4,y} * V_{t,db} * \upsilon_{i,t,db} * \rho_{i,t} * (1 - \eta_{flare,m}) * 10^{-3} \quad \text{(Equation 19)}$$

Where:

$V_{t,db}$	Volumetric flow of the residual gas for flaring 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 for flaring 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*)

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.

As all the biogas generated in the AWMSs is collected for heat generation, so no biogas is flared in pre-calculation. In the monitoring period, the project emissions from flaring of biogas should be calculated according to the actual situation.

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:

$$PE_{CH4,y} = Q_{CH4,y} * EF_{CH4,default} * GWP_{CH4} \qquad \text{(Equation 20)}$$

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 leaks 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:

$$F_{i,t} = V_{t,db} * \upsilon_{i,t,db} * \rho_{i,t} \qquad \text{(Equation 21)}$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \qquad \text{(Equation 22)}$$

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)

In summary, the project emissions associated with the anaerobic digester in year y (t CO_2e) is the sum of the project emissions of methane from the anaerobic digester in year y (t CO_2e), the project emissions from electricity consumption associated with the anaerobic digester (if any) and that is not related to the anaerobic digester and the project emission from flaring the biogas (if any). i.e., $PE_{AD,y} = PE_{CH4,y} + PE_{EC,y} + PE_{flare,y}$.

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.

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

(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)
$PE_{sl,y}$	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 24)

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)

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

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

(Equation 25)

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:

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

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)

$$E_{N2O,ID,y} = \sum_{j,LT} \mathrm{EF_{N2O,ID}} * \mathrm{F_{gasMS,j,LT}} * \mathrm{NEX_{LT,y}} * \mathrm{N_{LT}} * \mathrm{MS\%_j} \quad \text{(Equation 27)}$$

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)

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

$$PE_{EC/FC,y} = PE_{EC,y} + \sum_j PE_{FC,j,y} \quad \text{(Equation 28)}$$

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 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 $PE_{FC,y}$. please refer to above $PE_{FC,y}$ calculation.
No fossil fuel is used for the project, therefore $PE_{FC,y}$=0
Therefore, $PE_{elec/heat}$=0

As description above, the value for each parameter can be referred below Table.

Parameter	Value	Source/Clarification
$EC_{PJ,j,y}$	81.87 MWh/yr	The values are sourced from PER for ex ante calculation. The parameter will be monitored during operation period.
$EF_{EF,j,y}$	0.57205tCO_2/MWh	Published by Ministry of Ecology and Environment of the People's Republic of China, which is the DNA of China
$TDL_{j,y}$	20%	Tool 05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation
$EF_{CH4,default}$	0.1	Tool 14: Project and leakage emissions from anaerobic digesters
$Q_{CH4,y}$	13,214.34 t CH_4=3,287.1575*10^4*60%*0.00067	Calculated by the amount of biogas, the density of biogas and the content of methane, which are sourced from PER for ex ante calculation. The value of the amount of biogas, the temperature and pressure of biogas and the content of methane will be monitored during operation period.
$\eta_{flare,m}$	0	Tool 06: Project emissions from flaring
$Q_{CH4,y}$ (flaring)	0 t CH_4	No surplus biogas for flaring as PER. The amount of biogas flared will be monitored during operation period.
F_{Aer}	100%	PER
Rvs,n	80%	Appendix 1 of ACM0010(Version 08.0)
$MS\%_j$	65% and 50%	65% and 50% for ex-estimated sourced from PER. To be conservative, the value of this parameter in the emission reduction calculation in the monitoring period is 100%.
$EF_{N20,D,j}$	0 kg N_2O-N/kg N 0.006 kg N_2O-N/kg N	Default values in Table 10.21, Chapter 10, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
$EF_{N20,iD}$	0.01 kg N_2O-N/kg NH_3 and NO_X-N 0.01 kg N_2O-N/kg NH_3 and NO_X-N	Default values in Table 11.3, Chapter 11, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
$F_{gasMS,j,LT}$	0.4 0.45	Default values in Table 10.22, Chapter 10, volume 4, IPCC 2006 as per ACM0010(Version 08.0)

4.3 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.

$$LE_y = \left(LE_{PJ,N2O,y} - LE_{BL,N2O,y}\right) + \left(LE_{PJ,CH4,y} - LE_{BL,CH4,y}\right) + LE_{AD,y} \qquad \text{(Equation 29)}$$

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, $LE_{BL,\,N2O,\,y}$

$$LE_{BL,N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}) \qquad \text{(Equation 30)}$$

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N}\left(1 - R_{N,n}\right) * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad \text{(Equation 31)}$$

$$LE_{N2O,runoff,\,y} = EF_5 * F_{leach} * \prod_{n=1}^{N}\left(1 - R_{N,n}\right) * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad \text{(Equation 32)}$$

$$LE_{N2O,vol,\,y} = EF_4 * \prod_{n=1}^{N}\left(1 - R_{N,n}\right) * F_{gasm} * \sum_{LT} NEX_{LT,y} * N_{LT} \qquad \text{(Equation 33)}$$

where:

GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O\text{-}N,N}$	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 volatilisation 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 (4) or (5) (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/mineralised 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, $LE_{PJ,\ N2O}$

$$LE_{PJ,N2O} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}) \quad \text{(Equation 34)}$$

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^{N} \left(1 - R_{N,n}\right) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 35)}$$

$$LE_{N2O,runoff,\,y} = EF_5 * F_{leach} * \prod_{n=1}^{N} \left(1 - R_{N,n}\right) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 36)}$$

$$LE_{N2O,vol,\,y} = EF_4 * \prod_{n=1}^{N} \left(1 - R_{N,n}\right) * F_{gasm} * \sum_{LT} NEX_{LT,y} * N_{LT} \quad \text{(Equation 37)}$$

where:

GWP_{N20}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N20-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N20,land,y}$	Leakage N_2O emissions from application of manure waste in year y (kg N_2O-N/year)
$LE_{N20,runoff,y}$	Leakage N_2O emissions due to leaching and run-off in year y (kg N_2O-N/year)
$LE_{N20,vol,y}$	Leakage N_2O emissions due to volatilisation 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 (4) or (5) (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/mineralised in managed soils in regions where leaching/runoff occurs that is lost through leaching and runoff (fraction)
$R_{N,n}$	Nitrogen reduction factor (fraction)

iii) Estimation of leakage CH_4 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:

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

$$LE_{PJ,CH4,y} = GWP_{CH4} * D_{CH4} * MCF_d * \left[\prod_{n=1}^{N} \left(1 - R_{VS,n}\right)\right] * \sum_{j,LT} \left(B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j\right) \quad \text{(Equation 39)}$$

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

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).

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:

$$LE_{AD,y} = LE_{storage,y} + LE_{comp,y} \quad \text{(Equation 40)}$$

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)

The anaerobic digestion process of this project is carried out in a fully enclosed system. The biogas generated during the treatment process is captured for heat generation or flared (if any). The emissions from combustion is calculated in project emissions (if any). After anaerobic digestion, the fermented sludge is treated in aerobic composting system and organic fertilizer can be produced. Wastewater from the new AWMSs is 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.

As description above, the value for each parameter can be referred below Table.

Parameter	Value	Source/Clarification

$R_{N,n}$	5%,25%,80%,	Appendix 1 of ACM0010(Version 08.0)
EF_1	0.01 kg N2O-N/kg N	Default values in Table 11.1, Chapter 11, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
EF_5	0.0075 kg N2O-N/kg N	Default values in Table 11.3, Chapter 11, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
EF_4	0.01KgN-N2O-N/kg NH3-N+NOX-N	Default values in Table 11.3, Chapter 11, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
F_{leach}	0.3	Default values in Table 11.3, Chapter 11, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
F_{gasm}	0.2	Default values in Table 11.3, Chapter 11, volume 4, IPCC 2006 as per ACM0010(Version 08.0)
MCF_d	1	ACM0010(Version 08.0)
R_{VS}	20%,80%,85%	Appendix 1 of ACM0010(Version 08.0)
$MS\%_j$	100%	All the manure flew into uncovered anaerobic lagoon/AWMSs to be treated in the baseline and project activity; no any manure is discharged outside.

4.4 Estimated 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:

$$ER_y = BE_y - PE_y - LE_y \qquad \text{(Equation 41)}$$

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 (41) is replaced by $Q_{CH4,y}$.

As described above, emission reductions of the project are as below：

Calculation of the baseline emission:

$$BE_y = BE_{CH4,y} + BE_{N2O,y}$$

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_j with cons. Factor	0.6956	0.6956	/
$B_{o,LT}$	0.29	0.29	m^3 CH_4 /kg_dm
N_{LT}	370,860	38,500	No of heads
W_{site}	60.0	90.0	kg
$W_{default}$	28	28	kg
$VS_{default}$	0.3	0.3	Kg-dm/animal/day
$VS_{LT,y}$	234.64	351.96	kg-dm/animal/yr
$MS\%_{Bl,j}$	100%	100%	%
nd_y	365	365	days
Sub total	329,312	51,280	tCO_2e
$BE_{CH4,y}$	**380,592**		tCO_2e

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$EF_{N2O,D,j}$	0	0	kg N_2O-N/kg N
$EF_{N2O,ID}$	0.01	0.01	kg N_2O-N/kg N
$N_{rate(T)}$	0.42	0.24	kg N/1000kg animal mass/day
$NEX_{IPCCdefault}$	4.29	2.45	kg N/animal/year
W_{site}	60.0	90.0	kg
TAM	28.00	28.00	kg
$W_{default}$	28	28	kg
$NEX_{LT,y}$	9.20	7.88	kg N/animal/yr
N_{LT}	370,860	38,500	No of heads
$MS\%_{Bl,j}$	100%	100%	/
$F_{gasMS,j,LT}$	40%	40%	/
GWP_{N2O}	265	265	tCO_2/tN_2O
$CF_{N2O,N-N}$	1.57	1.57	Conversion Factor N_2O-N to N_2O
$BE_{N2O,y}$	**6,187**		tCO_2e

Baseline Emissions: $BE_{CH4,y}$+ $BE_{N2O,y}$ =308,592 tCO_2e +6,187tCO_2e =386,779 tCO_2e

Calculation of the project emission

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y}$$

$$PE_{AD,y} = PE_{EC,y} + PE_{CH4,y} + PE_{flare,y}$$

Parameter	Value	Unit
$EC_{PJ,j,y}$	81.87	MWh/yr
$EF_{EF,j,y}$	0.57205	tCO_2/MWh

$TDL_{j,y}$	20%	/
$PE_{EC,y}$	**56**	tCO_2e

Parameter	Value	Unit
GWP_{CH4}	28	tCO_2/tCH_4
$EF_{CH4,default}$	0.1	/
$Q_{CH4,y}$	13,214.34	t CH_4
$PE_{CH4,y}$	**37,000**	tCO_2e

Parameter	Value	Unit
GWP_{CH4}	28	tCO_2/tCH_4
$\eta_{flare,m}$	0	/
$Q_{CH4,y}$ (flaring)	0	t CH_4
$PE_{flare,y}$	**0**	tCO_2e

$PE_{AD,y}= PE_{EC,y}+ PE_{CH4,y}+PE_{flare,y}$ =56 tCO_2e +37,000 tCO_2e +0 tCO_2e =37,056 tCO_2e

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	/
F_{Aer}	100%	100%	/
$1-R_{vs,1}$	20%	20%	/
$B_{0,LT}$	0.29	0.29	m^3 CH_4 /kg VS
N_{LT}	370,860	38,500	No of heads
$VS_{LT,y}$	234.64	351.96	kg-dm/animal/yr
$MS\%_j$	65%	65%	/
Sub total	62	10	tCO_2e
$PE_{Aer,y}$	72		tCO_2e

Parameter	**Value**		**Unit**
species	**Market Swine**	**Breeding Swine**	
$EF_{N2O,D,j}$	0	0	kg N_2O-N/kg N
$NEX_{LT,y}$	9.20	7.88	kg N/animal/yr
N_{LT}	370,860	38,500	No of heads
$MS\%_j$	50%	50%	/
Sub total	**0.00**	**0.00**	kg N_2O-N/year
$E_{N2O,D,y}$	0		kg N_2O-N/year

Parameter	Value	Unit

species	Market Swine	Breeding Swine	
$EF_{N20,D,j}$	0.006	0.006	kg N_2O-N/kg N
$NEX_{LT,y}$	9.20	7.88	kg N/animal/yr
N_{LT}	370,860	38,500	No of heads
$MS\%_j$	65%	65%	/
Sub total	13,303.56	1,183.78	kg N_2O-N/year
$E_{N20,D,y}$	**14,487**		kg N_2O-N/year

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$EF_{N20,iD}$	0.01	0.01	kg N_2O-N/kg NH_3 and NO_X-N
$F_{gasMS,j,LT}$	0.4	0.4	/
$NEX_{LT,y}$	9.20	7.88	kg N/animal/yr
N_{LT}	370,860	38,500	No of heads
$MS\%_j$	50%	50%	%
GWP_{N20}	265	265	tCO_2/tN_2O
Sub total	6,822.34	607.07	kg N_2O-N/year
$\mathbf{E_{N20,ID,y}}$	7,429		kg N_2O-N/year

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$EF_{N20,iD}$	0.01	0.01	kg N_2O-N/kg NH_3 and NO_X-N
$F_{gasMS,j,LT}$	0.45	0.45	/
$NEX_{LT,y}$	9.20	7.88	kg N/animal/year
N_{LT}	370,860	38,500	No of heads
$MS\%_j$	65%	65%	%
GWP_{N20}	265	265	tCO_2/tN_2O
Sub total	9,978	888	kg N_2O-N/year
$\mathbf{E_{N20,ID,y}}$	**10,868**		kg N_2O-N/year
$PE_{N20,y}$	**13,651**		tCO_2e

Project emission: $PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N20,y}$=37,056 tCO_2e +72 tCO_2e +13,651 tCO_2e =50,780 tCO_2e

Calculation of leakage

$$LE_y = \left(LE_{PJ,N20,y} - LE_{BL,N20,y}\right) + \left(LE_{PJ,CH4,y} - LE_{BL,CH4,y}\right)$$

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
N_{LT}	370,860	38,500	No of heads
$NEX_{LT,y}$	9.20	7.88	kg N/animal/yr
$R_{N,n}$	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_{N20}	265	265	tCO_2/tN_2O
$LE_{N20,land,y}$	6,822	607	kg N_2O-N/year
	7,429		kg N_2O-N/year
$LE_{N20,runoff,y}$	1,535	136	kg N_2O-N/year
	1,671		kg N_2O-N/year
$LE_{N20,vol,y}$	1,364	121	kg N_2O-N/year
	1,485		kg N_2O-N/year
$LE_{BL,N20,y}$	**4,408**		tCO_2e

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
N_{LT}	370,860	38,500	No of heads
NEX_{LT}	9.20	7.88	kg N/animal/yr
R_N	25%	25%	/
R_N	5%	5%	/
EF_1	0.01	0.01	kg N2O-N/kg N
EF_5	0.0075	0.0075	kg N2O-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	/
$LE_{N20,land,y}$	24,305	2,163	kg N_2O-N/year
	26,468		kg N_2O-N/year
$LE_{N20,runoff,y}$	5,469	487	kg N_2O-N/year
	5,956		kg N_2O-N/year
$LE_{N20,vol}$	4,861	433	kg N_2O-N/year
	5,293		kg N_2O-N/year
$LE_{PJ,N20,y}$	**15,707**		tCO_2e

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_d	1	1	/
$VS_{LT,y}$	234.64	351.96	kg-dm/animal/yr
N_{LT}	370,860	38,500	No of heads
$B_{0,LT}$	0.29	0.29	m^3 CH4/kg-VS
R_{VS}	85%	85%	/
$MS\%_j$	100%	100%	/
$LE_{BL,CH4,y}$	71,013	11,058	tCO_2e
Total	**82,071**		tCO_2e

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_d	1	1	/
$VS_{LT,y}$	234.64	351.96	kg-dm/animal/yr
N_{LT}	370,860	38,500	No of heads
$B_{0,LT}$	0.29	0.29	m^3 CH_4/kg-VS
R_{VS}	80%	80%	/
R_{VS}	20%	20%	/
$MS\%_j$	100%	100%	/
$LE_{PJ,CH4,y}$	75,748	11,796	tCO_2e
Total	**87,544**		tCO_2e

$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y})$ = (15,707tCO_2e-4,408tCO_2e) +(87,544tCO_2e -82,071tCO_2e) =16,772 tCO_2e

Emission Reduction: $ER_y=BE_y-PE_y-LE_y$=386,779tCO_2e-50,780tCO_2e-16,772tCO_2e =319,227tCO_2e

Year	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
15-July-2020-31-December-2020	180,143	23,650	7,812	148,681
01-January-2021-31-December-2021	386,779	50,780	16,772	319,227
01-January-2022-31-December-2022	386,779	50,780	16,772	319,227
01-January-2023-31-December-2023	386,779	50,780	16,772	319,227
01-January-2024-31-December-2024	386,779	50,780	16,772	319,227
01-January-2025-31-December-2025	386,779	50,780	16,772	319,227

01-January-2026-31-December-2026	386,779	50,780	16,772	319,227
01-January-2027-31-December-2027	386,779	50,780	16,772	319,227
01-January-2028-31-December-2028	386,779	50,780	16,772	319,227
01-January-2029-31-December-2029	386,779	50,780	16,772	319,227
01-Januray-2030-14-July-2030	206,636	27,130	8,960	170,546
Total	**3,867,790**	**507,800**	**167,720**	**3,192,270**

5 MONITORING

5.1 Data and Parameters Available at Validation

Data / Parameter	GWP_{CH4}
Data unit	tCO_2/tCH_4
Description	Global Warming Potential of CH4
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[19], which complies with the requirement described in Section 3.14.4 of VCS Standard (V4.3).
Purpose of Data	Calculation of baseline emissions and project emissions
Comments	N/A

Data / Parameter	GWP_{N2O}

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

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 3.14.4 of VCS Standard (V4.3).
Purpose of Data	Used in project emission/baseline calculations
Comments	N/A

Data / Parameter	D_{CH4}
Data unit	t/m^3
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/m^3 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	MCFj value for uncovered anaerobic lagoon (baseline AWMS) is chosen.

and procedures applied	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 ℃ 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	$MS\%_{Bl,j}$
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 volatilisation 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 leaks from the anaerobic digester (fraction)
Source of data	Tool 14:" Project and leakage emissions from anaerobic digesters (version 02.0)"
Value applied	0.1[20]
Justification of choice of data or description of measurement methods and procedures applied	Digesters with unlined concrete/ferrocement/brick masonry arched type gas holding section; monolithic fixed dome digesters, covered anaerobic lagoon
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 5.2 of JPM.

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 Appendix 1 of methodology ACM0010 (version 08.0)

[20] According the description above, fully Geo-membrane enclosed anaerobic tanks, which is covered by HDPE geomembranes are adopted to treat the manure anaerobically. Therefore, the value of 0.1 t CH_4 leaked / t CH_4 produced is applied for this project. It is also upper range of the IPCC values.

Value applied	$R_{VS,n}$, aerobic treatment and anaerobic digester[21]: 20%, 80% for leakage N_2O emission released during project activity $R_{VS,n}$, one cell lagoon[22]: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	$R_{N,n}$
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%[23] $R_{N,n}$, uncovered anaerobic lagoon : 80%[24]
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

[21] For the project, prior to the sludge being treated, it undergoes two stages of homogenization pretreatment, and anaerobic fermentation, which similar to the anaerobic treatment of underfloor pit storage and covered first cell of two cell lagoon. Therefore, the corresponding RVS of each stage is 20% and 80% respectively as Appendix 1 of the methodology.

[22] For the 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.

[23] Since R_{VS} of each stage is 20% and 80%. Therefore $R_{N,n}$ is 5% and 25% corresponding as Appendix 1 of applied methodology ACM0010 (version 08.0).

[24] For the 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.

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
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/mineralised 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[25]
Value applied	0.57205[26]
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
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	Value is fixed as Tool 08

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

measurement methods and procedures applied	
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 measurement methods and procedures applied	0% is the conservative value.
Purpose of Data	Calculation of project emission
Comments	/

5.2 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.
Frequency of monitoring/recording	Monthly

Value applied	370,860 heads of market swine used for ex-estimated which is the annual number of swine (N_{LT}) and this value sourced from Project evaluation report. N_{LT} is the design scale of swine farms and it is also the maximum population of swine in the swine farms. Based on 180days of swine alive in the farm, 752,021 head of market swine can be produced annually ($N_{p,LT}$) as per equation 5 above.
Monitoring equipment	*N/A*
QA/QC procedures to be applied	The sale records will be crosschecked during the monitoring period and archive electronically during project plus 5 years.
Purpose of 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	Indirect information (sale records) will be crosschecked.

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	Monitored monthly.
Value applied	180 days which sourced from Project evaluation report, and this value is in line with the number of days for pigs to be slaughtered by existing large-scale breeding groups in China[27].
Monitoring equipment	N/A
QA/QC procedures to be applied	The sale records will be crosschecked during the monitoring period and archive electronically during project plus 5 years.

[27] https://zhuanlan.zhihu.com/p/38676811
http://finance.people.com.cn/n1/2017/1121/c1004-29658996.html

Purpose of 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	Indirect information (sale records) will be crosschecked.

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 applied	38,500 heads of Breeding swine were used to ex-estimated. And this value is sourced from Project evaluation report, which is the design scale of swine farms and it is also the maximum population of swine in the swine farms.
Monitoring equipment	N/A
QA/QC procedures to be applied	Archive electronically during project plus 5 years
Purpose of 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	The project proponents monitor the population of breeding swine through the auto tracking device, which is connected to the Data Collection System (DCS). Therefore, the data of $N_{AA,\ LT}$ can be obtained through DCS.

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 applied	60.0kg for market swine and 90.0kg for breeding swine which sourced from Project evaluation report.
Monitoring equipment	weight measurer
QA/QC procedures to be applied	This parameter is used in equation 4 for estimating $VS_{LT,y}$ using option 3, and in equation 2 (Appendix 2) for estimating $NEX_{LT,y}$ when using IPCC 2006 default values. Sampling procedures will be used to estimate this variable, taking into account the following guidance: (a) To ensure representativeness, each defined livestock population should be classified into a minimum of three age categories; (b) For each defined livestock population, a minimum of one monthly sample per age category should be taken; (c) When estimating baseline emissions and emissions released during baseline scenario from land application of the treated manure in the leakage section, the lower bound of the 95% confidence interval obtained from the sampling measurements should be used; (d) When estimating project emissions and emissions released during project activity from land application of the treated manure in the leakage section, the upper bound of the 95% confidence interval obtained from the sampling measurements should be used. The weight measurer will be calibrated annually to ensure the reliability of the parameter.
Purpose of data	Used for estimating $VS_{LT,y}$
Calculation method	*N/A*
Comments	Sampling procedures and method is described in Section 5.3 of

	JPM.

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 will be applied during the monitoring period due to not monitored in operation period.
Frequency of monitoring/recording	Annually
Value applied	100% for ex ante estimation, which sourced from Project evaluation report. As this parameter is not monitored in the actual operation. So, in the monitoring period, to be conservative, the value of this parameter in the emission reduction calculation is 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 data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	n_{dy}
Data unit	number
Description	Number of days treatment plant was operational in year y.
Source of data	Project proponents
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 applied	365 days for ex ante estimation. The actual number of days treatment plant was operational used in the monitoring periods will be recorded by project proponents
Monitoring equipment	N/A
QA/QC procedures to be applied	The daily readout of flowmeter installed at the outlet of the anaerobic digestion can be crosscheck that the treatment plant is operational.
Purpose of 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 proponents
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 applied	$3,287.1575*10^4 m^3$ of biogas are expected to be generated by the project annually which sourced from Project evaluation report.
Monitoring equipment	flow meters
QA/QC procedures to be applied	The calibration of flow meters, including the frequency of calibration, should be done per two years in accordance with national standards or requirements.
Purpose of 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 heat generation, so the biogas produced from the anaerobic digestion, the amount of biogas used for heat generation and the amount of biogas flared (if any) will be monitored through the flow meter.

Data / Parameter	$EC_{PJ,j,y}$
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 meters installed at the electricity consumption sources.
Frequency of monitoring/recording	Continuous measurement and at least monthly recording
Value applied	81.87 MWh for ex ante estimation, which sourced from Project evaluation report. During the monitoring period, the electricity consumption supplied by the gird company will be determined as per the electricity meters monitoring and cross-check with the grid statement.
Monitoring equipment	electricity meters
QA/QC procedures to be applied	The value will be cross-check with the grid statement. The calibration of meters, including the frequency of calibration, should be done in accordance with national standards or requirements.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

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

Data / Parameter	$V_{t,db}$
Data unit	m^3 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 applied	Biogas were estimated according to the amount of manure for Ex ante estimation and will be monitored in the monitoring period.
Monitoring equipment	Flowmeters
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory for all projects applying large scale methodology(ies). Calibration and frequency of

	calibration is according to manufacturer's specifications
Purpose of 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 applied	CH_4 fraction of biogas is 60% in pre-estimated which sourced from Project evaluation report. In monitoring period, this value will be monitored by the gas analysers.
Monitoring equipment	Gas analysers
QA/QC procedures to be applied	Calibration should include zero verification with an inert gas (e.g., N_2) and at least one reading verification with a standard gas (single calibration gas or mixture calibration gas). All calibration gases must have a certificate provided by the manufacturer and must be under their validity period.
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	N/A

Data / Parameter	T_t
Data unit	K
Description	Temperature of the gaseous stream in time interval t

Source of data	Measured by flow meters
Description of measurement methods and 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.
Frequency of monitoring/recording	Continuous measurement and the data can be obtained from this system and the monthly data was exported by the staff at the beginning of next month and then recorded in monthly operation report. Daily and monthly temperature was calculated based on the 24-hour average and daily average temperature.
Value applied	293.15K was used in the pre-calculation for the density of CH_4 as the applied methodology ACM0010 (Version08.0), in actual monitoring period, the temperature of the gaseous stream will be monitored by the recordable electronic signal. The temperature T_t(K) is calculated as the equation T(K)=t(°C) +273.15
Monitoring equipment	Continuous measurement
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency)

Data / Parameter	P_t
Data unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	Measured by flow meters
Description of measurement methods and 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.

Frequency of monitoring/recording	Continuous measurement and the data can be obtained from this system and the monthly data was exported by the staff at the beginning of next month and then recorded in monthly operation report. Daily and monthly temperature was calculated based on the 24-hour average and daily average temperature.
Value applied	101.325 kPa for the pre-calculation for the density of CH_4 as the applied methodology ACM0010 (Version08.0), in actual monitoring period, the temperature of the gaseous stream will be monitored by the recordable electronic signal.
Monitoring equipment	Continuous measurement
QA/QC procedures to be applied	Periodic calibration against a primary device provided by an independent accredited laboratory is mandatory. Calibration and frequency of calibration is according to manufacturer's specifications
Purpose of data	Calculation of project emissions
Calculation method	N/A
Comments	Provided all parameters are converted to normal conditions during the monitoring process, this parameter may not be needed except for moisture content determination and therefore it should be metered only when performing such measurements (with same frequency)

Data / Parameter	$\rho_{i,t}$
Data unit	kg gas i/m^3 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 applied	0.67 kg/m^3 for ex-estimated. In monitoring period, this parameter will be calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t
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 JPM
Comments	N/A

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; no any manure will be discharged outside. Therefore, the value of this parameter is 100% or total MS%j in different treatment system is 100%.
Frequency of monitoring/recording	Annually
Value applied	65% and 50% for ex-estimated[28], which was sourced from project evaluation report. As this parameter is not monitored in the actual operation. so, in the monitoring period, to be conservative, the value of this parameter in the emission reduction calculation is 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	N/A

[28] For this project, all of the manure and wastewater (50% solid material and 50% liquid material in raw materials) are collected and then be separated first. The separated liquid is treated through anaerobic digestion, during the anaerobic digestion, not only the biogas was generated, but also, biogas residue (15% of materials) also be generated. And then the biogas residue was treated by aerobic compost together with the separated solid (50% of raw material), Therefore, for this project, the materials entering the anaerobic treatment process account for 50% of the total materials, and the materials entering the aerobic stage account for 65% of the total materials. However, since the parameter is not monitored in actual operation, in the monitoring period, to be conservative, the value of this parameter applied in the emission reduction calculation in the two phases are both 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[29],which is higher. Therefore 0.29 m^3CH_4/kg -dm applied in monitoring period is conservative.
Frequency of monitoring/recording	Annually
Value applied	$B_{0,\ LT}$ (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.
Purpose of Data	Used in project emission/baseline calculations
Calculation method	N/*A*
Comments	N/A

Data / Parameter	$NEX_{LT,y}$
Data unit	kg N/animal/year
Description	Annual average nitrogen excretion per head of a defined livestock population estimated as described in Appendix 2

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

Source of data	Calculated as the equation of option 2 in Appendix 2: $NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCC\ default}$ While, $NEX_{IPCC\ default}$ calculated as equation 30 of the IPCC 2006, volume 4, chapter 10 $NEX_{IPCC\ default} = N_{rate(T)} * TAM/1000*365$
Description of measurement methods and procedures to be applied	$W_{default}$, $N_{rate(T)}$ and TAM are default value from IPCC 2006. The measurement methods and procedures for Wsite, please refer to the monitoring parameter Wsite
Frequency of monitoring/recording	Annually
Value applied	$NEX_{LT,y}$(Market swine) =9.20 $NEX_{LT,y}$ (Breeding swine) =7.88
Monitoring equipment	N/A
QA/QC procedures to be applied	The parameter is calculated as the equation of option 2 in Appendix 2 of methodology ACM0010 Version 08 and the value of other parameter applied in the equation is taken from published sources (2006 IPCC). The value should be updated on latest available public data source. QA/QC procedure for Wsite, please refer to the monitoring parameter Wsite
Purpose of Data	Used in project emission/baseline calculations
Calculation method	Calculated as the equation of option 2 in Appendix 2.
Comments	N/A

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 applied	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
Source of data	Official public information
Description of measurement methods and procedures to be applied	The data published by Official public information can prove that the annual average ambient temperature at project site.
Frequency of monitoring/recording	monthly
Value applied	15 °C for ex-ante estimated
Monitoring equipment	N/A
QA/QC procedures to be applied	The actual Annual average ambient temperature at project site from Official public information during this monitoring period will be compared with the value of ex-ante estimated, i.e., 15°. 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.
Purpose of Data	Used to select the annual MCFj from IPCC 2006 Guidelines
Calculation method	N/A
Comments	N/A

5.3 Monitoring Plan

The monitoring plan presented in this JPM assures that real, measurable, long term GHG emission reductions can be monitored, recorded and reported. It is a crucial procedure to identify the final VCUs of the project. This monitoring plan will be implemented by the project owner during the project operation. 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 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:

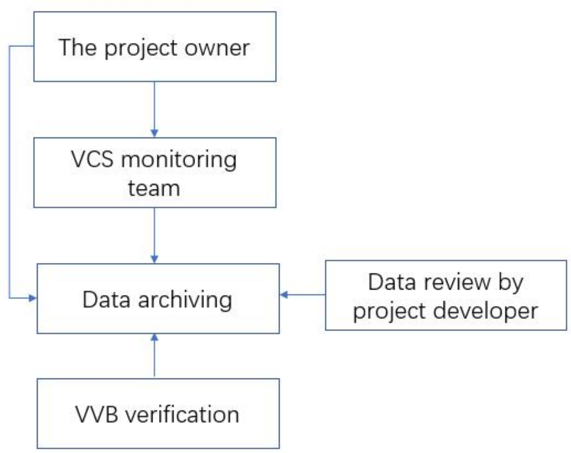

Figure 5-1 The Organization Structure of the Monitoring Team

2.Monitoring equipment and installation

Installation and configuration of meters are shown as Figure 5-2. 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.

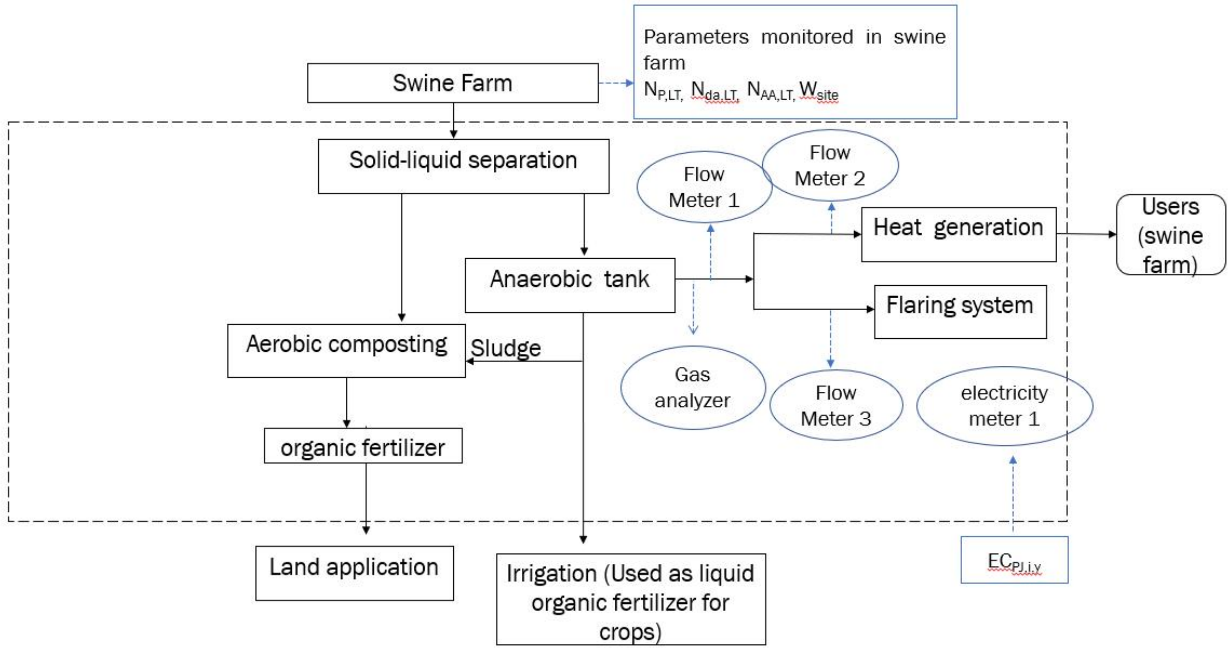

Figure 5-2 Installation and Configuration of Meters (Same monitoring system for each farm)

3. Principle of Monitoring

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

4. Parameters to be monitored

The monitoring requirements for this methodology include the monitoring of parameters for 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 this JPM

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

Item	Parameter to be monitored	Method to monitor/record
a	Number of animals of type LT produced annually for the year y, $N_{p,LT}$	recorded monthly by the technicians in farms and monthly sale records for each farm can be crosschecked during this monitoring period.
b	Number of days animal of type LT is alive in the farm in the year y, $N_{da,LT}$	recorded monthly by the technicians in farms and monthly sale records for each farm can be crosschecked during this monitoring period.

c	Daily stock of animals in the farm, discounting dead and discarded animals, $N_{AA,LT}$	recorded daily by the technicians in swine farms.
d	Average animal weight of a defined livestock population at the project site, W_{site}	Conducted by sampling in the three age groups of Nursery phase, Growing phase and Mature phase in each swine farm at least one monthly. Please refer to "sample plan" below for details. Measured by the weight measurers in the end of each month and recorded by the technicians in farms.
e	Number of days treatment plant was operational in year y, n_{dy}	Monitored by PP and sourced from data logged in each of the manure treatment plant.
f	Quantity of electricity consumed by the proposed project in year y, $EC_{PJ,j,y}$	Measured continuously by the meters installed in project site in each farm and recorded daily by the staff. The grid statement issued by the grid company can be cross-checked.
g	Average technical transmission and distribution losses for providing electricity to source *j* in year *y*, $TDL_{j,y}$	Sourced from tool 05" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (version 03.0)". This value will be renewed once the tool is updated.
h	Biogas flow, V_f	Continuously measurement by the biogas flowmeters (biogas flowmeter 1 installed at the outlet of the anaerobic digestion, biogas flowmeter 2 installed at the inlet of boiler and biogas flowmeter 3 installed in the inlet of flare and record hourly and saved automatically in DCS system.
i	Volumetric flow of the gaseous stream in time interval t on a dry basis, $V_{t,db}$	Measured by the same flowmeters that monitor parameter V_f, which can record hourly and saved automatically in the DCS system since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously.
j	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis, m³ gas i/m³ dry gas, $V_{i,t,db}$	Continuously measurement and record hourly by online gas analyser installed at the outlet of the anaerobic digester and saved automatically in the DCS system.
k	Temperature of the gaseous stream in time interval t, T_t	Measured by the same flowmeters that monitor parameter V_f, which can record hourly and saved automatically in the DCS system since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously.
l	Pressure of the gaseous stream in time interval t, P_t	Measured by the same flowmeters that monitor parameter V_f, which can record

		hourly and saved automatically in the DCS system since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously.
m	Density of greenhouse gas i in the gaseous stream in time interval t, $\rho_{i,t}$	calculated based on the temperature and pressure of the gaseous stream in time interval t. the monitor of the temperature and pressure of the gaseous stream, please refer the description of the above two parameters.
n	Fraction of volatile solids directed to aerobic treatment, F_{Aer}	According to the methodology, F_{Aer} should be monitored annually. However, there is no equip installed in the project activity to monitor the influent into anaerobic digestion and aerobic system during this monitoring period, therefore the value of F_{Aer} is applied as 100%, which is conservative.
o	Fraction of manure handled in system j in project activity, $MS\%_j$	According to the methodology, $MS\%_j$ should be monitored annually. However, there is no equip installed in the project activity to monitor. Therefore, to be conservative, the value of this parameter in the emission reduction calculation is 100%.
p	Maximum methane producing potential of the volatile solid generated by animal type *LT,* $B_{0,\ LT}$	Not monitored during this monitoring period since the value is taken from IPCC 2006, which is a published source. The parameter value will be updated on latest available public data source.
q	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.
r	Annual average ambient temperature at project site, T	The data can be sourced from Official public information. During the monitoring period, corresponding MCF_j 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.
s	Annual average nitrogen excretion per head of a defined livestock population estimated as described in Appendix 2, $NEX_{LT,y}$	The parameter is calculated as the equation of option 2 in Appendix 2 of methodology ACM0010 Version 08.0 and the value of other parameter applied in

		the equation is taken from IPCC 2006, which is a published source. The parameter value will be updated on latest available public data source. While for parameter W_{site}, it is monitored during this MR, please refer to monitoring parameter W_{site}

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.

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.

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	Wsite
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 409,360 swine (370,860 Market swine and 38,500 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 370,860 Market swine and 38,500 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 maximum and also conservative.
Sampling method	As this project involved 7 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 7 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 7 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. 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;

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

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 409,360;

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;

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 409,360, N in the calculation of sample size is 409,360, and the calculation result is as follows:

Z	*V*	*e*	*N*	*B*	*r*
1.96	1	10%	409,360	1	100%
n_1	Z^2V^2/e^2	384			
n_2	$n_1N/(N+n_1)$	384			
n_3	Bn_2	384			
n_4	n_3/r	384			
n	n_4 (110%)	423			

The calculation result of n is 423. Therefore, 423 samples should be sufficient to satisfy the desired confidence and precision. 423 samples will be selected from the sampling frame according to the stratified sampling method every month.

As the applied value of 370,860 Market swine and 38,500 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 maximum and also conservative.

Stratified sampling (with samples of 423) 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 7 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 7 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 ten subsidiary farms is adjusted to be integer value. As a result, 437 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	Sample number	Marketing swine			Breeding swine		
			Nursery phase	Growing phase	Mature phase	Nursery phase	Growing phase	Mature phase
1	Wolong 2nd farm	79	19	19	20	5	7	9
2	Junzhang 26th farm	76	23	27	26	0	0	0
3	Zhengyang 1st farm	14	0	0	0	3	5	6
4	Zhengyang 4th farm	103	33	34	36	0	0	0
5	Zhengyang 6th farm	113	37	37	39	0	0	0
6	Zhengyang 9th farm	9	0	0	0	2	3	4
7	Zhengyang 13th farm	43	13	14	16	0	0	0
Total		437	125	131	137	10	15	19

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 7 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 7 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.

6 ACHIEVED GHG EMISSION REDUCTIONS AND REMOVALS

6.1 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
Value applied:	Data source: Monthly production record of market swine

Time	$N_{p,LT}$(heads of market swine)
15-July-2020-31-July-2020	53,022
01-August-2020-31-August-2020	52,372
01-September-2020-30-September-2020	51,156
01-October-2020 - 31-October-2020	50,937
01-November-2020 - 30-November-2020	51,866
01-December-2020 - 31-December-2020	53,590
01-January-2021-31-January-2021	53,835
01-February-2021- 28-February-2021	55,857
01-March-2021 - 31-March-2021	59,666
01-April-2021 - 30-April-2021	53,696
01-May-2021 - 31-May-2021	53,095
01-June-2021 - 30-June-2021	57,288
01-July-2021 - 31-July-2021	66,362
01-August-2021-31-August-2021	57,327
01-September-2021-30-September-2021	54,893
01-October-2021 - 31-October-2021	56,513
01-November-2021 - 30-November-2021	53,935
01-December-2021 - 31-December-2021	54,343
01-January-2022 - 31-January-2022	57,219
01-February-2022- 28-February-2022	56,430
01-March-2022 - 31-March-2022	55,548
15-July-2020-31-March-2022	1,158,950

Comments	Based on the Equation 5, the calculated N_{LT} is 333,770 heads ((1,158,950 heads/20.5484months*12months) *180days/365days)[31]. 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 333,770 heads. According to the conservative principle, the 333,770 heads was applied in the calculations of emission reductions in MR. $N_{p,LT}$ has been crosschecked through the monthly sale records of 7 swine farms during this monitoring period and according to the monthly sale records of 7 swine farms, total 1,158,950 head of marketing swine is produced and sold into the market, which is consistent with the value from Monthly production record of market swine. 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
Value applied:	(see table below)

Time	$N_{da,LT}$
15-July-2020-31-July-2020	180 days
01-August-2020-31-August-2020	180 days
01-September-2020-30-September-2020	180 days
01-October-2020 - 31-October-2020	180 days
01-November-2020 - 30-November-2020	180 days
01-December-2020 - 31-December-2020	180 days
01-January-2021 - 31-January-2021	180 days
01-February-2021- 28-February-2021	180 days
01-March-2021 - 31-March-2021	180 days
01-April-2021 - 30-April-2021	180 days
01-May-2021 - 31-May-2021	180 days
01-June-2021 - 30-June-2021	180 days
01-July-2021 - 31-July-2021	180 days
01-August-2021-31-August-2021	180 days
01-September-2021-30-September-2021	180 days
01-October-2021 - 31-October-2021	180 days
01-November-2021 - 30-November-2021	180 days

[31] For the monitoring period 22-June-2020-31-March-2022, it is 21.3months. therefore, the annual swine produced can be averaged according to the total quantity of swine produced during this monitoring period.

	01-December-2021 - 31-December-2021 | 180 days 01-January-2022 - 31-January-2022 | 180 days 01-February-2022- 28-February-2022 | 180 days 01-March-2022 - 31-March-2022 | 180 days
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 180days as per monthly production 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 7 swine farms during this monitoring period. and it can be concluded that the data is consistent. In addition, this value is in line with the number of days for pigs to be slaughtered by existing large-scale breeding groups in China[32].

Data / Parameter	$N_{AA.LT}$
Data unit	Number
Description	Daily stock of animals in the farm, discounting dead and discarded animals
Value applied:	Data source: Daily stock record of breeding swine

Time	$N_{AA.LT}$ (heads of breeding swine)
15-July-2020-31-July-2020	34,622
01-August-2020-31-August-2020	34,658
01-September-2020-30-September-2020	34,645
01-October-2020 - 31-October-2020	34,646
01-November-2020 - 30-November-2020	34,614
01-December-2020 - 31-December-2020	34,602
01-January-2021 - 31-January-2021	34,686
01-February-2021- 28-February-2021	34,570
01-March-2021 - 31-March-2021	34,720
01-April-2021 - 30-April-2021	34,606
01-May-2021 - 31-May-2021	34,679
01-June-2021 - 30-June-2021	34,676
01-July-2021 - 31-July-2021	34,644

32 https://zhuanlan.zhihu.com/p/38676811
http://finance.people.com.cn/n1/2017/1121/c1004-29658996.html

	01-August-2021-31-August-2021	34,622
	01-September-2021-30-September-2021	34,731
	01-October-2021 - 31-October-2021	34,644
	01-November-2021 - 30-November-2021	34,653
	01-December-2021 - 31-December-2021	34,687
	01-January-2022 - 31-January-2022	34,730
	01-February-2022- 28-February-2022	34,582
	01-March-2022 - 31-March-2022	34,633
	15-July-2020-31-March-2022 (average)	**34,650**
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
Value applied:	Data source: Weight record

Time	Market swine	Breeding swine
15-July-2020-31-July-2020	54.9	90.7
01-August-2020-31-August-2020	54.7	88.9
01-September-2020-30-September-2020	54.9	90.2
01-October-2020 - 31-October-2020	55.3	91.4
01-November-2020 - 30-November-2020	55.2	88.9
01-December-2020 - 31-December-2020	54.8	89.1
01-January-2021 - 31-January-2021	55.4	89.6
01-February-2021- 28-February-2021	55.3	88.1
01-March-2021 - 31-March-2021	54.5	89.4
01-April-2021 - 30-April-2021	55.5	90.0
01-May-2021 - 31-May-2021	55.3	90.3
01-June-2021 - 30-June-2021	55.4	89.8
01-July-2021 - 31-July-2021	55.4	88.3
01-August-2021-31-August-2021	55.7	88.0
01-September-2021-30-September-2021	54.5	90.6
01-October-2021 - 31-October-2021	55.0	89.6

	01-November-2021 - 30-November-2021	55.2	87.3
	01-December-2021 - 31-December-2021	56.1	92.2
	01-January-2022 - 31-January-2022	54.5	87.8
	01-February-2022- 28-February-2022	54.8	89.1
	01-March-2022 - 31-March-2022	55.2	87.9

Comments

Measured by the weight measurers and recorded by the technical staff in each farm monthly. Weight measurers were calibrated on 11-May-2020, 07-May-2021 and 02-May-2022 by an officially accredited entity in compliance with JJG539-2016 "Verification Regulation of Digital Indicating Weighting Instruments" in China.

Swine farm	Type	Accuracy	Series number	Calibration date	Validity
Wolong 2nd farm	XK3190-A12+E	III level	2015072142	11-May-2020 07-May-2021 02-May-2022	1 year
Junzhang 26th farm			2015072146		
Zhengyang 1st farm			2015072150		
Zhengyang 4th farm			2015072153		
Zhengyang 6th farm			2015072158		
Zhengyang 9th farm			2015072164		
Zhengyang 13th farm			2015072169		

Data / Parameter	F_{Aer}
Data unit	Fraction
Description	Fraction of volatile solids directed to aerobic treatment
Value applied:	100%
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 maximum and also conservative.

Data / Parameter	n_{dy}
Data unit	number
Description	Number of days treatment plant was operational in year y.
Value applied:	The actual number of days 7 treatment plants that was operational are 648 days during this monitoring period.

Time	n_{dy} (days)
15-July-2020-31-July-2020	17
01-August-2020-31-August-2020	31

	01-September-2020-30-September-2020	30
	01-October-2020 - 31-October-2020	31
	01-November-2020 - 30-November-2020	30
	01-December-2020 - 31-December-2020	31
	01-January-2021 - 31-January-2021	31
	01-February-2021- 28-February-2021	28
	01-March-2021 - 31-March-2021	31
	01-April-2021 - 30-April-2021	30
	01-May-2021 - 31-May-2021	31
	01-June-2021 - 30-June-2021	30
	01-July-2021 - 31-July-2021	31
	01-August-2021-31-August-2021	31
	01-September-2021-30-September-2021	30
	01-October-2021 - 31-October-2021	31
	01-November-2021 - 30-November-2021	30
	01-December-2021 - 31-December-2021	31
	01-January-2022 - 31-January-2022	31
	01-February-2022- 28-February-2022	28
	01-March-2022 - 31-March-2022	30
	15-July-2020-31-March-2022	**625**
Comments	The daily accumulated meter reading of flowmeters installed in the outlet of anaerobic digesters can be demonstrated that the AWMSs are actually running on a daily basis.	

Data / Parameter	v_f
Data unit	m^3
Description	Biogas flow
Value applied:	(see table below)

period	Vf- at outlet of the anaerobic digestion (m3)	Vf- at the inlet of boiler (m3)	Vf- in inlet of flare system (m3)
15-July-2020-31-July-2020	1,270,966.02	1,253,282.99	0.00
01-August-2020-31-August-2020	2,318,114.08	2,285,862.62	0.00

01-September-2020-30-September-2020	2,243,493.51	2,212,279.96	0.00
01-October-2020 - 31-October-2020	2,318,526.42	2,286,268.05	0.00
01-November-2020 - 30-November-2020	2,243,776.39	2,212,557.76	0.00
01-December-2020 - 31-December-2020	2,318,737.21	2,286,475.89	0.00
01-January-2021 - 31-January-2021	2,319,509.91	2,287,238.34	0.00
01-February-2021- 28-February-2021	2,094,601.45	2,065,458.31	0.00
01-March-2021 - 31-March-2021	2,320,211.18	2,287,931.08	0.00
01-April-2021 - 30-April-2021	2,244,906.85	2,213,671.98	0.00
01-May-2021 - 31-May-2021	2,320,440.21	2,288,156.80	0.00
01-June-2021 - 30-June-2021	2,245,805.20	2,214,560.32	0.00
01-July-2021 - 31-July-2021	2,320,707.22	2,288,418.04	0.00
01-August-2021-31-August-2021	2,320,812.75	2,288,522.77	0.00
01-September-2021-30-September-2021	2,246,848.17	2,215,589.04	0.00
01-October-2021 - 31-October-2021	2,321,438.39	2,289,139.47	0.00
01-November-2021 - 30-November-2021	2,246,844.32	2,215,583.85	0.00
01-December-2021 - 31-December-2021	2,322,197.24	2,289,889.21	0.00
01-January-2022 - 31-January-2022	2,322,711.41	2,290,397.06	0.00
01-February-2022- 28-February-2022	2,097,311.16	2,068,129.91	0.00
01-March-2022 - 31-March-2022	2,322,587.85	2,290,273.88	0.00
15-July-2020-31-March-2022	**46,780,546.94**	**46,129,687.323**	**0.00**

Comments

Monitored continuously by flowmeter 1 installed at the outlet of the anaerobic digestion, flowmeter 2 installed at the inlet of the boiler and flowmeter 3 installed in inlet of flare. Recorded hourly and saved automatically in the Data Collection System (DCS). The data can be obtained from this system and the monthly data was exported by the staff at the beginning of next month and then recorded in monthly operation report.

Flowmeters were calibrated on 12-June-2020 and 07-June-2022 by an officially accredited entity in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China.

For this monitoring period, all the biogas produced is used for heat generation, no surplus biogas for the flaring system.

Swine farm	Type	Accuracy	Series number	Calibration date	Validity

	Wolong 2nd farm	LUGB	1.5 level	Flowmeter1: 20190614358	12-June-2020 07-June-2022	2 years
				Flowmeter2: 20190614362		
				Flowmeter3: 20190614369		
	Junzhang 26th farm			Flowmeter1: 20190120436		
				Flowmeter2: 20190120440		
				Flowmeter3: 20190120447		
	Zhengyang 1st farm			Flowmeter1: 20190614373		
				Flowmeter2: 20190614378		
				Flowmeter3: 20190614382		
	Zhengyang 4th farm			Flowmeter1: 20190210056		
				Flowmeter2: 20190210062		
				Flowmeter3: 20190210067		
	Zhengyang 6th farm			Flowmeter1: 20190120463		
				Flowmeter2: 20190120470		
				Flowmeter3: 20190120485		
	Zhengyang 9th farm			Flowmeter1: 20190713260		
				Flowmeter2: 20190713268		
				Flowmeter3: 20190713279		
	Zhengyang 13th farm			Flowmeter1: 20191208126		
				Flowmeter2: 20191208135		
				Flowmeter3: 20191208149		

Data / Parameter	$EC_{PJ,j,y}$
Data unit	MWh
Description	Quantity of electricity consumed by the proposed project in year y
Value	

applied:	<table><tr><td>Period</td><td>Electricity supplied by the grid company (MWh)</td></tr><tr><td>15-July-2020-31-July-2020</td><td>170.3196</td></tr><tr><td>01-August-2020-31-August-2020</td><td>170.3460</td></tr><tr><td>01-September-2020-30-September-2020</td><td>170.3520</td></tr><tr><td>01-October-2020 - 31-October-2020</td><td>170.3616</td></tr><tr><td>01-November-2020 - 30-November-2020</td><td>170.3616</td></tr><tr><td>01-December-2020 - 31-December-2020</td><td>170.3652</td></tr><tr><td>01-January-2021 - 31-January-2021</td><td>170.4144</td></tr><tr><td>01-February-2021- 28-February-2021</td><td>170.3712</td></tr><tr><td>01-March-2021 - 31-March-2021</td><td>170.4516</td></tr><tr><td>01-April-2021 - 30-April-2021</td><td>170.4120</td></tr><tr><td>01-May-2021 - 31-May-2021</td><td>170.4564</td></tr><tr><td>01-June-2021 - 30-June-2021</td><td>170.4648</td></tr><tr><td>01-July-2021 - 31-July-2021</td><td>170.4624</td></tr><tr><td>01-August-2021-31-August-2021</td><td>170.4612</td></tr><tr><td>01-September-2021-30-September-2021</td><td>170.5248</td></tr><tr><td>01-October-2021 - 31-October-2021</td><td>170.4948</td></tr><tr><td>01-November-2021 - 30-November-2021</td><td>170.4948</td></tr><tr><td>01-December-2021 - 31-December-2021</td><td>170.5104</td></tr><tr><td>01-January-2022 - 31-January-2022</td><td>170.5308</td></tr><tr><td>01-February-2022- 28-February-2022</td><td>170.4660</td></tr><tr><td>01-March-2022 - 31-March-2022</td><td>170.5440</td></tr><tr><td>15-July-2020-31-March-2022</td><td>3,579.1656</td></tr></table>
Comments	Monitored continuously by electricity meter 1 installed in the 7 manure treatment plants. The electricity consumption was recorded daily by the staff in electricity daily report and cross-checked with Grid Company Electricity Statement. Electricity meters were calibrated on 08-June-2020 by an officially accredited entity in compliance with JJG596-2012" Verification Regulation of electrical meters" in China. <table><tr><td>Swine farm</td><td>Type</td><td>Accuracy</td><td>Series number</td><td>Calibration date</td><td>Validity</td></tr><tr><td>Wolong 2nd farm</td><td rowspan="7">DTS634</td><td rowspan="7">1.0 level</td><td>20180662422383</td><td rowspan="7">08-June-2020</td><td rowspan="7">5 years</td></tr><tr><td>Junzhang 26th farm</td><td>20180662422396</td></tr><tr><td>Zhengyang 1st farm</td><td>20180662422402</td></tr><tr><td>Zhengyang 4th farm</td><td>20180662422408</td></tr><tr><td>Zhengyang 6th farm</td><td>20180662422411</td></tr><tr><td>Zhengyang 9th farm</td><td>20180662422417</td></tr><tr><td>Zhengyang 13th farm</td><td>20180662422425</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*
Value applied:	20
Comments	The value of this parameter sourced from Tool 05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (version 03.0) and this tool is not updated in this monitoring period.

Data / Parameter	$V_{t,db}$
Data unit	m^3 dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Value applied:	

Period	$V_{t,db}$ (m^3 dry gas/h) monitored by flow meter 1	$V_{t,db}$ (m^3 dry gas/h) monitored by flow meter 3
15-July-2020-31-July-2020	3,115.11	0
01-August-2020-31-August-2020	3,115.74	0
01-September-2020-30-September-2020	3,115.96	0
01-October-2020 - 31-October-2020	3,116.30	0
01-November-2020 - 30-November-2020	3,116.36	0
01-December-2020 - 31-December-2020	3,116.58	0
01-January-2021 - 31-January-2021	3,117.62	0
01-February-2021- 28-February-2021	3,116.97	0
01-March-2021 - 31-March-2021	3,118.56	0
01-April-2021 - 30-April-2021	3,117.93	0
01-May-2021 - 31-May-2021	3,118.87	0
01-June-2021 - 30-June-2021	3,119.17	0
01-July-2021 - 31-July-2021	3,119.23	0
01-August-2021-31-August-2021	3,119.37	0
01-September-2021-30-September-2021	3,120.62	0
01-October-2021 - 31-October-2021	3,120.21	0
01-November-2021 - 30-November-2021	3,120.62	0
01-December-2021 - 31-December-2021	3,121.23	0
01-January-2022 - 31-January-2022	3,121.92	0
01-February-2022- 28-February-2022	3,121.00	0
01-March-2022 - 31-March-2022	3,121.76	0

Comments	Monitored continuously by flowmeter 1 installed at the outlet of the anaerobic digestion and flowmeter 3 installed in inlet of flare. Recorded hourly and saved automatically in the Data Collection System (DCS). The data can be obtained from this system.

	Flowmeters were calibrated on 12-June-2020 and 07-June-2022 by an officially accredited entity in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China. For information about flowmeter, please refer to monitored parameter "v_f" for details.

Data / Parameter	$V_{i,t,db}$
Data unit	m³ gas i/m³ dry gas
Description	Volumetric fraction of greenhouse gas i in a time interval t on a dry basis
Value applied:	(see table below)

Period	Average $V_{i,t,db}$ (m³ gas i/m³ dry gas)
15-July-2020-31-July-2020	58.58
01-August-2020-31-August-2020	61.15
01-September-2020-30-September-2020	58.61
01-October-2020 - 31-October-2020	59.69
01-November-2020 - 30-November-2020	60.53
01-December-2020 - 31-December-2020	57.12
01-January-2021 - 31-January-2021	59.58
01-February-2021- 28-February-2021	61.17
01-March-2021 - 31-March-2021	60.75
01-April-2021 - 30-April-2021	60.84
01-May-2021 - 31-May-2021	58.69
01-June-2021 - 30-June-2021	60.07
01-July-2021 - 31-July-2021	60.35
01-August-2021-31-August-2021	60.78
01-September-2021-30-September-2021	58.72
01-October-2021 - 31-October-2021	60.04
01-November-2021 - 30-November-2021	57.7
01-December-2021 - 31-December-2021	59.22
01-January-2022 - 31-January-2022	61.56
01-February-2022- 28-February-2022	60.11
01-March-2022 - 31-March-2022	59.76

Comments

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 03-June-2020, 28-May-2021 and 23-May-2022 by an officially accredited entity 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 Shanghai Shenkai Gases Technology 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 16-April-2007.

Swine farm	Type	Accuracy	Series number	Calibration date	Validity
Wolong 2nd farm	Gasboard-9060	±1%	2014187	03-June-2020	1 year
Junzhang 26th farm			2014190		

	Zhengyang 1st farm			2014196	28-May-2021 23-May-2022	
	Zhengyang 4th farm			2014205		
	Zhengyang 6th farm			2014213		
	Zhengyang 9th farm			2014219		
	Zhengyang 13th farm			2014228		

Data / Parameter	T_t
Data unit	K
Description	Temperature of the gaseous stream in time interval t
Value applied:	See table below

Period	Average T_t (K)
15-July-2020-31-July-2020	303.35
01-August-2020-31-August-2020	305.95
01-September-2020-30-September-2020	305.45
01-October-2020 - 31-October-2020	304.85
01-November-2020 - 30-November-2020	304.55
01-December-2020 - 31-December-2020	303.75
01-January-2021 - 31-January-2021	303.95
01-February-2021- 28-February-2021	303.65
01-March-2021 - 31-March-2021	304.65
01-April-2021 - 30-April-2021	305.05
01-May-2021 - 31-May-2021	305.45
01-June-2021 - 30-June-2021	305.75
01-July-2021 - 31-July-2021	306.55
01-August-2021-31-August-2021	306.95
01-September-2021-30-September-2021	305.85
01-October-2021 - 31-October-2021	305.15
01-November-2021 - 30-November-2021	304.65
01-December-2021 - 31-December-2021	304.35
01-January-2022 - 31-January-2022	304.05
01-February-2022- 28-February-2022	303.75
01-March-2022 - 31-March-2022	304.45

Comments	Measured continuously by the biogas flowmeters, 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 readout of flowmeter was indicated degrees Celsius (°C). Therefore, the temperature T_t(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. Flowmeters were calibrated on 12-June-2020 and 07-June-2022 by an officially accredited entity in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China. For information about flowmeter, please refer to monitored parameter "v_f" for details.

Data / Parameter	P_t
Data unit	Pa

Description	Pressure of the gaseous stream in time interval t
Value applied:	see table below
Comments	Measured continuously by the biogas flowmeters, since the flowmeters can monitor other parameter such as $V_{t,db}$, T_t and P_t simultaneously. The data can be obtained from DCS system. Daily and Monthly pressure was calculated based on the 24-hour average and daily average pressure. Flowmeters were calibrated on 12-June-2020 and 07-June-2022 by an officially accredited entity in compliance with JJG1029-2007" Verification Regulation of Vortex-shedding Flowmeter" in China. For information about flowmeter, please refer to monitored parameter "v_f" for details.

Period	Average P_t (Pa)
15-July-2020-31-July-2020	101325
01-August-2020-31-August-2020	101325
01-September-2020-30-September-2020	101325
01-October-2020 - 31-October-2020	101325
01-November-2020 - 30-November-2020	101325
01-December-2020 - 31-December-2020	101325
01-January-2021 - 31-January-2021	101325
01-February-2021- 28-February-2021	101325
01-March-2021 - 31-March-2021	101325
01-April-2021 - 30-April-2021	101325
01-May-2021 - 31-May-2021	101325
01-June-2021 - 30-June-2021	101325
01-July-2021 - 31-July-2021	101325
01-August-2021-31-August-2021	101325
01-September-2021-30-September-2021	101325
01-October-2021 - 31-October-2021	101325
01-November-2021 - 30-November-2021	101325
01-December-2021 - 31-December-2021	101325
01-January-2022 - 31-January-2022	101325
01-February-2022- 28-February-2022	101325
01-March-2022 - 31-March-2022	101325

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
Value applied:	see table below

Period	$\rho_{i,t}$ (kg gas i/m³ gas i)
15-July-2020-31-July-2020	0.00064
01-August-2020-31-August-2020	0.00064
01-September-2020-30-September-2020	0.00064
01-October-2020 - 31-October-2020	0.00064
01-November-2020 - 30-November-2020	0.00064
01-December-2020 - 31-December-2020	0.00064
01-January-2021 - 31-January-2021	0.00064
01-February-2021- 28-February-2021	0.00064
01-March-2021 - 31-March-2021	0.00064
01-April-2021 - 30-April-2021	0.00064
01-May-2021 - 31-May-2021	0.00064
01-June-2021 - 30-June-2021	0.00064

	01-July-2021 - 31-July-2021	0.00064
	01-August-2021-31-August-2021	0.00064
	01-September-2021-30-September-2021	0.00064
	01-October-2021 - 31-October-2021	0.00064
	01-November-2021 - 30-November-2021	0.00064
	01-December-2021 - 31-December-2021	0.00064
	01-January-2022 - 31-January-2022	0.00064
	01-February-2022- 28-February-2022	0.00064
	01-March-2022 - 31-March-2022	0.00064
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
Value applied:	100%. As this parameter is not monitored during this monitoring period. so, to be conservative, the value of this parameter in the emission reduction calculation is 100%.
Comments	All the manure flew into AWMSs to be treated; no any 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*
Value applied:	$B_{0,\ LT}$ (Market swine) =0.29 $B_{0,\ LT}$ (Breeding swine) =0.29
Comments	$B_{0,\ LT}$ 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/gVS according to the public literature[33], which is higher. Therefore 0.29 m^3CH_4/kg -dm applied in monitoring period is conservative.

Data / Parameter	$NEX_{LT,y}$

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

Data unit	kg N/animal/year
Description	Annual average nitrogen excretion per head of a defined livestock population estimated as described in Appendix 2
Value applied	(see table below)
Comments	The parameter is calculated as the equation of option 2 in Appendix 2 of methodology ACM0010 Version 08 and the value of other parameter applied in the equation is taken from published sources (2006 IPCC). The value should be updated on latest available public data source. For W_{site}, please refer to the monitoring parameter W_{site}

Period	Market swine	Breeding swine
15-July-2020-31-July-2020	0.39	0.37
01-August-2020-31-August-2020	0.71	0.66
01-September-2020-30-September-2020	0.69	0.65
01-October-2020 - 31-October-2020	0.72	0.68
01-November-2020-30-November-2020	0.70	0.64
01-December-2020-31-December-2020	0.71	0.66
01-January-2021 - 31-January-2021	0.72	0.67
01-February-2021- 28-February-2021	0.65	0.59
01-March-2021 - 31-March-2021	0.71	0.67
01-April-2021 - 30-April-2021	0.70	0.65
01-May-2021 - 31-May-2021	0.72	0.67
01-June-2021 - 30-June-2021	0.70	0.65
01-July-2021 - 31-July-2021	0.72	0.66
01-August-2021-31-August-2021	0.73	0.65
01-September-2021-30-September-2021	0.69	0.65
01-October-2021 - 31-October-2021	0.72	0.67
01-November-2021-30-November-2021	0.70	0.63
01-December-2021-31-December-2021	0.73	0.69
01-January-2022 - 31-January-2022	0.71	0.65
01-February-2022- 28-February-2022	0.64	0.60
01-March-2022 - 31-March-2022	0.72	0.65

Data / Parameter	Type
Data unit	/
Description	Type of barn and AWMS
Value applied:	N/A
Comments	After the first verification, only changes in the type of barn and AWMS will be reported. This monitoring is the first monitoring period and in this monitoring period, the swine barn and AWMS layout and configuration are consistent with the design which is approved by the official government.

Data / Parameter	T
Data unit	°C
Description	Annual average ambient temperature at project site
Value applied:	Time / T (°C): 15-July-2020-31-December-2020: 15.6[34]; 01-January-2021-31-December-2021: 15.9[35]; 01-March-2022 - 31-March-2022: NA
Comments	The temperature in 2020 and 2021 is sourced respectively from Henan Meteorological Administration and Henan Province Bureau of Statistics. Henan Meteorological Administration and Henan Province Bureau of Statistics is Official institutions. Therefore, the data is creditable. While only three months are included for the period from 01-March-2022 - 31-March-2022 and the monthly average temperature is not available from official public information. Furthermore, the temperature in these 3 months cannot represent the annual average temperature of the whole year. So, the Annual average ambient temperature at project site of 2022 applied the lower ex-ante estimated value i.e.15°C, which is more conservative. MCF value is still 74% with the temperature of 15°C, 15.6°C and 15.9°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.

Value applied (T):

Time	T (°C)
15-July-2020-31-December-2020	15.6[34]
01-January-2021-31-December-2021	15.9[35]
01-March-2022 - 31-March-2022	NA

[34] https://baijiahao.baidu.com/s?id=1690666588700495708&wfr=spider&for=pc

[35] http://www.henan.gov.cn/2022/03-12/2413033.html

6.2 Baseline Emissions

As per paragraph 26 of the applied methodology, Baseline emissions are: $BE_y = BE_{CH4,y} + BE_{N2O,y} + BE_{elec/heat,y}$

As described in section 4.1, the baseline scenario of this project is uncovered anaerobic lagoon, and no heat used in the baseline, only minor electricity will be used, so the emission can be excluded for simplification. In addition, the biogas generated during the treatment process in this project will be captured for heat generation and all the heat generated from this project will be used by the daily operation of AWMS and the 7 swine farms. The heat generated is not connected to another user. So, the baseline CO_2 emission from electricity and/or heat used in the baseline is 0, which is conservative. So, $BE_y = BE_{CH4,y} + BE_{N2O,y}$.

During this monitoring period, the basic monitoring data values used in the calculation of baseline emissions and the calculation results are shown in the Table 6-1 and Table 6-2.

Table 6-1 the basic monitoring data values used in the calculation of baseline emissions

Time	N_{LT}	$N_{AA,LTs}$	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
15-July-2020-31-July-2020	333,770	34,622	54.9	90.7	17	10.00	16.52	0.20	0.11	0.39	0.37
01-August-2020-31-August-2020	333,770	34,658	54.7	88.9	31	18.17	29.53	0.36	0.21	0.71	0.66
01-September-2020-30-September-2020	333,770	34,645	54.9	90.2	30	17.65	28.99	0.35	0.20	0.69	0.65
01-October-2020-31-October-2020	333,770	34,646	55.3	91.4	31	18.37	30.36	0.36	0.21	0.72	0.68
01-November-2020-30-November-2020	333,770	34,614	55.2	88.9	30	17.74	28.58	0.35	0.20	0.70	0.64
01-December-2020-31-December-2020	333,770	34,602	54.8	89.1	31	18.20	29.59	0.36	0.21	0.71	0.66
01-January-	333,770	34,686	55.4	89.6	31	18.40	29.76	0.36	0.21	0.72	0.67

2021-31-January-2021											
01-February-2021-28-February-2021	333,770	34,570	55.3	88.1	28	16.59	26.43	0.33	0.19	0.65	0.59
01-March-2021-31-March-2021	333,770	34,720	54.5	89.4	31	18.10	29.69	0.36	0.21	0.71	0.67
01-April-2021-30-April-2021	333,770	34,606	55.5	90.0	30	17.84	28.93	0.35	0.20	0.70	0.65
01-May-2021-31-May-2021	333,770	34,679	55.3	90.3	31	18.37	29.99	0.36	0.21	0.72	0.67
01-June-2021-30-June-2021	333,770	34,676	55.4	89.8	30	17.81	28.86	0.35	0.20	0.70	0.65
01-July-2021-31-July-2021	333,770	34,644	55.4	88.3	31	18.40	29.33	0.36	0.21	0.72	0.66
01-August-2021-31-August-2021	333,770	34,622	55.7	88.0	31	18.50	29.23	0.36	0.21	0.73	0.65
01-September-2021-30-September-2021	333,770	34,731	54.5	90.6	30	17.52	29.12	0.35	0.20	0.69	0.65
01-	333,770	34,644	55.0	89.6	31	18.27	29.76	0.36	0.21	0.72	0.67

October-2021 - 31-October-2021											
01-November-2021 - 30-November-2021	333,770	34,653	55.2	87.3	30	17.74	28.06	0.35	0.20	0.70	0.63
01-December-2021 - 31-December-2021	333,770	34,687	56.1	92.2	31	18.63	30.62	0.36	0.21	0.73	0.69
01-January-2022 - 31-January-2022	333,770	34,730	54.5	87.8	31	18.10	29.16	0.36	0.21	0.71	0.65
01-February-2022- 28-February-2022	333,770	34,582	54.8	89.1	28	16.44	26.73	0.33	0.19	0.64	0.60
01-March-2022 - 31-March-2022	333,770	34,633	55.2	87.9	31	18.33	29.20	0.36	0.21	0.72	0.65

Table 6-2 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 6-1		
W_{site}	Refer to Table 6-1		
$W_{default}$	28	28	kg
$VS_{default}$	0.3	0.3	Kg-dm/animal/day
$VS_{LT,y}$	Refer to Table 6-1		
$MS\%_{Bl,j}$	100%	100%	%
n_{dy}	Refer to Table 6-1		
$BE_{CH4,y}$ from 15-July-2020-31-December-2020	**147,902**		**tCO_2e**
$BE_{CH4,y}$ from 01-January-2021-31- December -2021	**318,911**		**tCO_2e**
$BE_{CH4,y}$ from 01-January-2022-31-March-2022	**77,943**		**tCO_2e**
$BE_{CH4,y}$ in this monitoring period	**544,756**		**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 6-1		
$NEX_{LT,y}$	Refer to Table 6-1		
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
$BE_{N2O,y}$ from 15-July-2020-31-December-2020	**2,393**		**tCO_2e**
$BE_{N2O,y}$ from 01-January-2021-31-December-2021	**5,163**		**tCO_2e**
$BE_{N2O,y}$ from 01-January-2022-31-March-2022	**1,262**		**tCO_2e**
$BE_{N2O,y}$ in this monitoring period	**8,818**		**tCO_2e**
BE_y from 15-July-2020-31-December-2020	**150,295**		**tCO_2e**
BE_y from 01-January-2021-31-December-2021	**324,074**		**tCO_2e**
BE_y from 01-January-2022-31-March-2022	**79,205**		**tCO_2e**
BE_y in this monitoring period	**553,574**		**tCO_2e**

6.3 Project Emissions

As described in Section 4.2, project emissions can be calculated by Equation 15.

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 $PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y}$

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

All thermal energy used by the project is supplied by the new installed boilers, which is utilizing biogas generated during the treatment process in this project for heat generation. No other thermal energy from outside source is used for the project. And 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

The residual gas is sent to flare system (if any) and project emissions from flaring of biogas ($PE_{flare,y}$) shall be estimated using the tool "Project emissions from flaring". For this monitoring period, there is no residual gas to be flared, so $PE_{flare,y}$=0.

In summary, the Project emissions associated with the anaerobic digester in year y (t CO_2e) is the Project emissions of methane from the anaerobic digester in year y (t CO_2e). i.e., $PE_{AD,y}$= $PE_{CH4,y}$+$PE_{EC,y}$.

The basic monitored parameter used in the and the calculation result of $PE_{EC,y}$,$PE_{CH4,y}$ and $PE_{AD,y}$ are shown in the Table 6-3, Table 6-4 and Table 6-5.

Table 6-3 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)
15-July-2020-31-July-2020	170.3196	0.57205	20%	116.92
01-August-2020-31-August-2020	170.346	0.57205	20%	116.94
01-September-2020-30-September-2020	170.352	0.57205	20%	116.94
01-October-2020-31-October-2020	170.3616	0.57205	20%	116.95
01-November-2020-30-November-2020	170.3616	0.57205	20%	116.95
01-December-2020-31-December-2020	170.3652	0.57205	20%	116.95
01-January-2021-31-January-2021	170.4144	0.57205	20%	116.99
01-February-2021-28-February-2021	170.3712	0.57205	20%	116.96
01-March-2021-31-March-2021	170.4516	0.57205	20%	117.01

01-April-2021-30-April-2021	170.412	0.57205	20%	116.99
01-May-2021-31-May-2021	170.4564	0.57205	20%	117.02
01-June-2021-30-June-2021	170.4648	0.57205	20%	117.02
01-July-2021-31-July-2021	170.4624	0.57205	20%	117.02
01-August-2021-31-August-2021	170.4612	0.57205	20%	117.02
01-September-2021-30-September-2021	170.5248	0.57205	20%	117.06
01-October-2021 - 31-October-2021	170.4948	0.57205	20%	117.04
01-November-2021 - 30-November-2021	170.4948	0.57205	20%	117.04
01-December-2021 - 31-December-2021	170.5104	0.57205	20%	117.05
01-January-2022 - 31-January-2022	170.5308	0.57205	20%	117.07
01-February-2022- 28-February-2022	170.466	0.57205	20%	117.02
01-March-2022 - 31-March-2022	170.544	0.57205	20%	117.08

Table 6-4 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)**
15-July-2020-31-July-2020	28	0.1	476.50	1,334.21
01-August-2020-31-August-2020	28	0.1	907.22	2,540.21
01-September-2020-30-September-2020	28	0.1	841.54	2,356.33
01-October-2020-31-October-2020	28	0.1	885.71	2,480.00
01-November-2020-30-November-2020	28	0.1	869.22	2,433.82
01-December-2020-31-December-2020	28	0.1	847.66	2,373.44
01-January-2021-31-January-2021	28	0.1	884.46	2,476.48
01-February-2021-28-February-2021	28	0.1	820.01	2,296.04
01-March-2021-31-March-2021	28	0.1	902.10	2,525.88
01-April-2021-30-April-2021	28	0.1	874.11	2,447.52

01-May-2021-31-May-2021	28	0.1	871.59	2,440.47
01-June-2021-30-June-2021	28	0.1	863.40	2,417.51
01-July-2021-31-July-2021	28	0.1	896.35	2,509.78
01-August-2021-31-August-2021	28	0.1	902.78	2,527.78
01-September-2021-30-September-2021	28	0.1	844.38	2,364.28
01-October-2021 - 31-October-2021	28	0.1	892.03	2,497.68
01-November-2021 - 30-November-2021	28	0.1	829.71	2,323.21
01-December-2021 - 31-December-2021	28	0.1	880.13	2,464.37
01-January-2022 - 31-January-2022	28	0.1	915.11	2,562.32
01-February-2022- 28-February-2022	28	0.1	806.84	2,259.17
01-March-2022 - 31-March-2022	28	0.1	888.31	2,487.26

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

Period	$PE_{EC,y}$ (tCO_2e)	$PE_{CH4,y}$ (tCO_2e)	$PE_{AD,y}$ (tCO_2e)
15-July-2020-31-December-2020	**702**	**13,519**	**14,221**
01-January-2021-31-December-2021	**1,405**	**29,291**	**30,696**
01-January-2022-31-March-2022	**352**	**7,309**	**7,661**
1st monitoring period	**2,459**	**50,119**	**52,578**

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

The project CH_4 emissions from aerobic AWMS treatment is calculated using Equation 26 described in above Section 4.2. The specific calculation results are shown in Table 6-6.

Table 6-6 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 6-1		
$VS_{LT,y}$	Refer to Table 6-1		
$MS\%_j$	100%	100%	
$PE_{Aer,y}$ from 15-July-2020-31-December-2020	**43**		**tCO_2e**
$PE_{Aer,y}$ from 01-January-2021-31-December-2021	**92**		**tCO_2e**
$PE_{Aer,y}$ from 01-January-2022-31-March-2022	**22**		**tCO_2e**
$PE_{Aer,y}$ in this monitoring period	**157**		**tCO_2e**

iii) Project N_2O emissions in year y ($PE_{N20,y}$)

The project N_2O emissions in year y can be calculated using Equation 27-29 described in above Section 4.2. The specific calculation result is shown in Table 6-7.

Table 6-7 the calculation result of $PE_{N20,y}$

Parameter	**Value**		**Unit**
species	**Market Swine**	**Breeding Swine**	
$EF_{N20,D,j}$	0	0	kg N_2O-N/kg N
$NEX_{LT,y}$	Refer to Table 6-1		
N_{LT}	Refer to Table 6-1		
$MS\%_j$	100%	100%	/
$E_{N20,D,y}$ from 15-July-2020-31-December-2020	**0**		**kg N_2O-N/year**
$E_{N20,D,y}$ from 01-January-2021-31-December-2021	**0**		**kg N_2O-N/year**
$E_{N20,D,y}$ from 01-January-2022-31-March-2022	**0**		**kg N_2O-N/year**
$E_{N20,D,y}$ in this monitoring period	**0**		**kg N_2O-N/year**
$EF_{N20,D,j}$	0.006	0.006	kg N_2O-N/kg N
$NEX_{LT,y}$	Refer to Table 6-1		
N_{LT}	Refer to Table 6-1		
$MS\%_j$	100%	100%	/
$E_{N20,D,y}$ from 15-July-2020-31-December-2020	**8,625**		**kg N_2O-N/year**
$E_{N20,D,y}$ from 01-January-2021-31-December-2021	**18,610**		**kg N_2O-N/year**
$E_{N20,D,y}$ from 01-January-2022-31-March-2022	**4,551**		**kg N_2O-N/year**
$E_{N20,D,y}$ in this monitoring period	**31,786**		**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 6-1		
N_{LT}	Refer to Table 6-1		
$MS\%_j$	100%	100%	%
GWP_{N20}	265	265	tCO_2/tN_2O
$E_{N20,ID,y}$ from 15-July-2020-31-December-2020	**5,753**		**kg N_2O-N/year**
$E_{N20,ID,y}$ from 01-January-2021-31-December-2021	**12,414**		**kg N_2O-N/year**
$E_{N20,ID,y}$ from 01-January-2022-31-March-2022	**3,034**		**kg N_2O-N/year**
$E_{N20,ID,y}$ in this monitoring period	**21,201**		**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 6-1		
N_{LT}	Refer to Table 6-1		
$MS\%_j$	100%	100%	%

GWP_{N2O}	265	265	$tCO_2/t\ N_2O$
$E_{N2O,ID,y}$ from 15-July-2020-31-December-2020	**6,472**		**kg N_2O-N/year**
$E_{N2O,ID,y}$ from 01-January-2021-31-December-2021	**13,962**		**kg N_2O-N/year**
$E_{N2O,ID,y}$ from 01-January-2022-31-March-2022	**3,413**		**kg N_2O-N/year**
$E_{N2O,ID,y}$ in this monitoring period	**23,847**		**kg N_2O-N/year**
$PE_{N2O,y}$ from 15-July-2020-31-December-2020	**8,683**		**tCO_2e**
$PE_{N2O,y}$ from 01-January-2021-31-July-2021	**18,733**		**tCO_2e**
$PE_{N2O,y}$ from 01-January-2022-31-March-2022	**4,580**		**tCO_2e**
$PE_{N2O,y}$ in this monitoring period	**31,996**		**tCO_2e**

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

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 proposed project in this monitoring period are summarized in Table 6-8.

Table 6-8 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)
15-July-2020-31-December-2020	14,221	43	8,683	**22,947**
01-January-2021-31-December-2021	30,696	92	18,733	**49,522**
01-January-2022-31-March-2022	7,661	22	4,580	**12,264**
1st monitoring period	52,578	157	31,996	**84,733**

6.4 Leakage

As described in section 4.3, Leakage emissions can be calculated by Equation 33: $LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y}) + LE_{AD,y}$.

Also, as described in Section 4.3, The leakage emissions associated with the anaerobic digester ($LE_{AD,y}$) depend on how the digestate is managed. For this project, the anaerobic digestion process of this project is carried out in a fully enclosed system. The biogas generated during the treatment process is captured for heat generation or flared (if any). The Emissions from combustion is calculated in project emissions (if any). After anaerobic digestion, the fermented sludge is treated in aerobic composting system, which is used as fertilizer. Wastewater from the new animal waste management systems is 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. Therefore, the $LE_y = \left(LE_{PJ,N2O,y} - LE_{BL,N2O,y}\right) + \left(LE_{PJ,CH4,y} - LE_{BL,CH4,y}\right)$.

The $LE_{BL,N2O,y}$, $LE_{PJ,N2O,y}$, $LE_{BL,CH4,y}$ and $LE_{PJ,CH4,y}$ can be calculated by Equation 34-43 described in Section 4.3 and the specific calculation and the result are shown in Table 6-9. The calculation result of leakage emission is shown in Table 6-10.

Table 6-9 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 6-1		
$NEX_{LT,y}$	Refer to Table 6-1		
$R_{N,n}$	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
$LE_{N2O,land,y}$ from 15-July-2020-31-December-2020	2,867		kg N_2O-N/year
$LE_{N2O,land,y}$ from 01-January-2021-31-December-2021	6,188		kg N_2O-N/year
$LE_{N2O,land,y}$ from 01-January-2022-31-March-2022	1,513		kg N_2O-N/year
$LE_{N2O,land,y}$ in the 1st monitoring period	10,568		kg N_2O-N/year
$LE_{N2O,runoff,y}$ from 15-July-2020-31-December-2020	640		kg N_2O-N/year
$LE_{N2O,runoff,y}$ from 01-January-2021-31-December-2021	1,385		kg N_2O-N/year
$LE_{N2O,runoff,y}$ from 01-January-2022-31-March-2022	338		kg N_2O-N/year
$LE_{N2O,runoff,y}$ in the 1st monitoring period	2,363		kg N_2O-N/year
$LE_{N2O,vol,y}$ from 15-July-2020-31-December-2020	570		kg N_2O-N/year
$LE_{N2O,vol,y}$ from 01-January-2021-31-December-2021	1,229		kg N_2O-N/year
$LE_{N2O,vol,y}$ from 01-January-2022-31-March-2022	301		kg N_2O-N/year
$LE_{N2O,vol,y}$ in the 1st monitoring period	2,100		kg N_2O-N/year
$LE_{BJ,N2O,y}$ from 15-July-2020-31-December-2020	**1,697**		**tCO_2e**
$LE_{BJ,N2O,y}$ from 01-January-2021-31-July-2021	**3,665**		**tCO_2e**
$LE_{BJ,N2O,y}$ from 01-January-2022-31-March-2022	**896**		**tCO_2e**
$LE_{BJ,N2O,y}$ in the 1st monitoring period	**6,258**		**tCO_2e**
N_{LT}	Refer to Table 6-1		
NEX_{LT}	Refer to Table 6-1		
R_N	25%	25%	/
R_N	5%	5%	
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	/
$LE_{N2O,land,y}$ from 15-July-2020-31-December-2020	10,245		kg N_2O-N/year
$LE_{N2O,land,y}$ from 01-January-2021-31-December-2021	22,101		kg N_2O-N/year
$LE_{N2O,land,y}$ from 01-January-2022-31-March-2022	5,403		kg N_2O-N/year
$LE_{N2O,land,y}$ in the 1st monitoring period	37,749		kg N_2O-N/year
$LE_{N2O,runoff,y}$ from 15-July-2020-31-December-2020	2,310		kg N_2O-N/year
$LE_{N2O,runoff,y}$ from 01-January-2021-31-December-2021	4,982		kg N_2O-N/year
$LE_{N2O,runoff,y}$ from 01-January-2022-31-March-2022	1,218		kg N_2O-N/year
$LE_{N2O,runoff,y}$ in the 1st monitoring period	8,510		kg N_2O-N/year
$LE_{N2O,vol,y}$ from 15-July-2020-31-December-2020	2,054		kg N_2O-N/year
$LE_{N2O,vol,y}$ from 01-January-2021-31-December-2021	4,429		kg N_2O-N/year
$LE_{N2O,vol,y}$ from 01-January-2022-31-March-2022	1,083		kg N_2O-N/year
$LE_{N2O,vol,y}$ in the 1st monitoring period	7,566		kg N_2O-N/year
$LE_{PJ,N2O,y}$ from 15-July-2020-31-December-2020	**6,084**		**tCO_2e**
$LE_{PJ,N2O,y}$ from 01-January-2021-31-December-2021	**13,123**		**tCO_2e**
$LE_{PJ,N2O,y}$ from 01-January-2022-31-March-2022	**3,209**		**tCO_2e**
$LE_{PJ,N2O,y}$ in the 1st monitoring period	**22,416**		**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 6-1		
N_{LT}	Refer to Table 6-1		
$B_{0,LT}$	0.29	0.29	$m^3\ CH_4$/kg-VS
R_{VS}	85%	85%	/
$MS\%_j$	100%	100%	/
$LE_{BL,CH4,y}$ from 15-July-2020-31-December-2020	**31,888**		**tCO_2e**
$LE_{BL,CH4,y}$ from 01-January-2021-31-December-2021	**68,759**		**tCO_2e**
$LE_{BL,CH4,y}$ from 01-January-2022-31-March-2022	**16,805**		
$LE_{BL,CH4,y}$ in this monitoring period	**117,452**		**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 6-1		
NLT	Refer to Table 6-1		
$B_{0,LT}$	0.29	0.29	$m^3\ CH_4$/kg-VS
R_{VS}	80%	80%	/
R_{VS}	20%	20%	/

MS%$_j$	100%	100%	/
LE $_{PJ,CH4}$ from 15-July-2020-31-December-2020	**34,026**		**tCO_2e**
LE $_{PJ,CH4}$ from 01-January-2021-31-December-2021	**73,370**		**tCO_2e**
LE $_{PJ,CH4}$ from 01-January-2022-31-March-2022	**17,932**		**tCO_2e**
LE $_{PJ,CH4}$ in this monitoring period	**125,328**		**tCO_2e**

Table 6-10 The calculation result of leakage emission

Period	**$LE_{PJ,CH4,y}$** (tCO_2e)	**$LE_{BL,CH4,y}$** (tCO_2e)	**$LE_{BL,N2O,y}$** (tCO_2e)	**$LE_{PJ,N2O,y}$** (tCO_2e)	**LE_y** (tCO_2e/yr)
15-July-2020-31-December-2020	34,026	31,888	1,697	6,084	**6,525**
01-January-2021-31-December-2021	73,370	68,759	3,665	13,123	**14,069**
01-January-2022-31-March-2022	17,932	16,805	896	3,209	**3,440**
1st monitoring period	125,328	117,452	6,258	22,416	**24,034**

6.5 Net GHG Emission Reductions and Removals

As per paragraph 54 in applied methodology ACM0010 (Version08.0): Furthermore, if the actual methane captured from anaerobic digesters in project activity is lower than ($BE_{CH4,y}$ - $PE_{AD,y}$), then($BE_{CH4,y}$ - $PE_{AD,y}$) is replaced by actual methane captured $Q_{CH4,y}$.

Biogas captured during monitoring period is 46,780,546.98m^3, which equals to 501,176 tCO_2e that emission from methane production [36]. Baseline methane emission ($BE_{CH4,y}$) in this monitoring period is 544,756tCO_2e. project emissions associated with anaerobic digester in this monitoring period is ($PE_{AD,y}$) is 52,578 tCO_2e. Actual methane captured from anaerobic digesters is higher than the difference of $BE_{CH4,y}$ and $PE_{AD,y}$. 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 45 in Section 4.4. 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)

[36] Biogas captured during this monitoring period is 46,780,546.98m^3. The quality of methane is 17,899.17tCH_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 CH4 i.e. 28tCO_2/tCH_4 is the result of 501,176 tCO_{2e}. Please refer ER sheet, tab "monitoring results" for detail calculation process and final results.

15-July-2020-31-December-2020	150,295	22,947	6,525	120,823
01-January-2021-31-December-2021	324,074	49,522	14,069	260,483
01-January-2022-31-March-2022	79,205	12,264	3,440	63,501
Total	553,574	84,733	24,034	444,807

APPENDIX 1: <EVIDENCE OF ACHIEVED SDGS>

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

The project design document has estimated that 319,227 tCO_2e emission reductions will be produced annually. This is the 1st monitoring period, which is covering from 15-July-2020 to 31-March-2022 and the emission reductions of first monitoring period is 444,807 tCO_2e. please see Section 6 of JPM for details.

Table showing the emission reductions during the first 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)
15-July-2020 to 31-March-2022	553,574	84,733	24,034	444,807

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

The project design document has estimated that 3,287.1575*10^4m^3 of biogas are expected to be generated annually. This is the 1st monitoring period, which is covering from 15-July-2020 to 31-March-2022 and during this monitoring period 4, 678.05*10^4m^3 of biogas is generated by the project.

牧原食品股份有限公司卧龙、均张和正阳养殖场环保项目生产运行月报表							
沼气产生量（m^3）							
	卧龙二场	均张26场	正阳1场	正阳4场	正阳6场	正阳9场	正阳13场
2020年7月	227,923.20	222,941.44	37,239.61	302,740.82	336,033.68	23,197.95	120,889.32
2020年8月	415,806.76	406,583.03	67,927.22	552,114.83	612,831.74	42,382.08	220,468.42
2020年9月	402,332.62	393,508.81	65,627.43	534,360.86	593,125.33	41,159.49	213,378.97
2020年10月	415,560.76	406,668.52	68,042.50	552,230.93	612,960.60	42,548.33	220,514.78
2020年11月	402,106.58	393,591.55	65,683.86	534,473.21	593,250.04	41,247.32	213,423.83
2020年12月	415,616.65	406,754.02	67,723.30	552,347.03	613,089.47	42,645.60	220,561.14
2021年1月	415,824.31	406,796.77	68,202.56	552,405.08	613,153.91	42,542.96	220,584.32
2021年2月	375,457.62	367,467.95	61,255.83	498,998.96	553,874.63	38,288.07	199,258.39
2021年3月	416,207.24	406,882.27	68,078.27	552,521.18	613,282.77	42,608.77	220,630.68
2021年4月	402,220.40	393,798.40	65,889.02	534,754.10	593,561.81	41,147.12	213,536.00
2021年5月	416,320.09	406,967.76	68,054.48	552,637.29	613,411.64	42,371.91	220,677.04
2021年6月	402,975.40	393,881.14	65,817.53	534,866.45	593,686.53	40,997.29	213,580.86
2021年7月	415,853.32	407,053.26	68,257.75	552,753.39	613,540.51	42,525.59	220,723.40
2021年8月	416,085.99	407,096.01	68,044.43	552,811.44	613,604.94	42,423.36	220,746.58
2021年9月	403,138.95	394,005.25	65,996.79	535,034.99	593,873.59	41,150.44	213,648.16
2021年10月	416,103.76	407,181.51	68,210.15	552,927.54	613,733.81	42,488.68	220,792.94
2021年11月	402,869.90	394,087.99	65,906.98	535,147.34	593,998.30	41,140.79	213,693.02
2021年12月	416,518.96	407,267.01	68,003.88	553,043.64	613,862.68	42,661.77	220,839.30
2022年1月	416,770.58	407,309.75	68,048.64	553,101.69	613,927.11	42,691.15	220,862.49
2022年2月	375,834.45	367,931.29	61,515.57	499,628.15	554,573.01	38,319.06	199,509.63
2022年3月	416,524.03	407,395.25	67,842.27	553,217.79	614,055.98	42,643.68	220,908.85
小计	8,388,051.57	8,205,168.98	1,371,368.07	11,142,116.71	12,367,432.08	857,181.41	4,449,228.12
合计							**46,780,546.94**

Supporting evidence for contribution to SDG 8.3 Proportion of informal employment in non-agriculture employment by sex

The project activity generates permanent job opportunities for 14 persons including 7 females and 7 males during the operation period. During this monitoring period, total 14 jobs for local people were created (including 7 females and 7 males) by the project.

牧原卧龙、均张和正阳养殖场环保项目员工花名册

序号	职位名称	姓名	性别	入职日期	所属养殖场	家庭住址	身份证号
1	环保项目专员	王雪凡	女	2020.4.1	卧龙二场	南阳市卧龙区	411303198609172356
2	环保项目专员	龚海洋	男	2020.4.1	卧龙二场	南阳市卧龙区	411330198405214180
3	环保项目专员	朱元阳	男	2020.4.1	均张26场	南阳市内乡县	411325198908122031
4	环保项目专员	吴芸	女	2020.4.1	均张26场	南阳市内乡县	411325198812056793
5	环保项目专员	邹贵平	男	2020.4.1	正阳1场	驻马店市正阳县	411724199202184976
6	环保项目专员	许细仙	女	2020.4.1	正阳1场	驻马店市正阳县	411724198505192659
7	环保项目专员	赵明华	男	2020.4.1	正阳4场	驻马店市正阳县	411724198303161890
8	环保项目专员	王欣英	女	2020.4.1	正阳4场	驻马店市正阳县	411724198603245637
9	环保项目专员	孙金航	男	2020.4.1	正阳6场	驻马店市正阳县	411724199006146431
10	环保项目专员	陈丽霞	女	2020.4.1	正阳6场	驻马店市正阳县	41172419910620353X
11	环保项目专员	杨国真	男	2020.4.1	正阳9场	驻马店市正阳县	411724199311154973
12	环保项目专员	李婷婷	女	2020.4.1	正阳9场	驻马店市正阳县	411724198504172836
13	环保项目专员	魏青辉	男	2020.4.1	正阳13场	驻马店市正阳县	411724198810172412
14	环保项目专员	黄晓媛	女	2020.4.1	正阳13场	驻马店市正阳县	411724198606152449