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TEMPLATE

KEY PROJECT INFORMATION & PROJECT DESIGN DOCUMENT (PDD)

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VERSION **v. 1.2**

RELATED SUPPORT

- TEMPLATE GUIDE Key Project Information & Project Design Document v.1.2

This document contains the following Sections

Key Project Information

0 – Description of project

0 – Application of approved Gold Standard Methodology (ies) and/or demonstration of SDG Contributions

0 – Duration and crediting period

0 – Summary of Safeguarding Principles and Gender Sensitive Assessment

0 – Outcome of Stakeholder Consultations

Appendix 1 – Safeguarding Principles Assessment (mandatory)

0 – Contact information of Project participants (mandatory)

0 – LUF Additional Information (project specific)

0 – Summary of Approved Design Changes (project specific)

KEY PROJECT INFORMATION

GS ID of Project	GS11222
Title of Project	Ganzhou Swine Farm Animal Manure Management System GHG Mitigation Project
Time of First Submission Date	21/06/2021
Date of Design Certification	NA
Version number of the PDD	05
Completion date of version	07/02/2022
Project Developer	Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
Project Representative	The official focal point: Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd.
Project Participants and any communities involved	The project owner: Jiangxi Zhengbang Breeding Co. Ltd
Host Country (ies)	People's Republic of China
Activity Requirements applied	☒ Community Services Activities ☐ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Scale of the project activity	☐ Micro scale ☐ Small Scale ☒ Large Scale
Other Requirements applied	<i>GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)</i>
Methodology (ies) applied and version number	<i>ACM0010 GHG emission reductions from manure management systems (Version 08.0)</i>
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A
Project Cycle:	☐ Regular ☒ Retroactive

Table 1 – Estimated Sustainable Development Contributions

Sustainable Development Goals Targeted	SDG Impact (defined in B.6.)	Estimated Annual Average	Units or Products
SDG 13: Climate Action	Emission reductions	498,011	tCO ₂ e
SDG 8: Decent Work and Economic Growth	The number of males and females employed by the project and the Average monthly salary	The number of males and females employed by the project: 20(10 females and 10 males). The Average monthly salary is 5,000 RMB/person with equal salaries for men and women in the same post	
SDG 7: Affordable and Clean Energy	Quantity of electricity generation by capturing biogas	105,690.39	MWh

SECTION A. DESCRIPTION OF PROJECT

A.1 Purpose and general description of project

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Ganzhou Swine Farm Animal Manure Management System GHG Mitigation Project introduce new animal waste management system (AWMS) to a group of 10 existing swine farms in Ganzhou City of Jiangxi Province, which are owned by Jiangxi Zhengbang Breeding Co. Ltd (hereinafter called" Zhengbang"). The purpose of the project activity is to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons.

The project activity will replace the current open anaerobic lagoons with new AWMSs, and Each subsidiary swine farm will install one AWMS. The manure and waster will be collected into the anaerobic digesters and then biogas generated during the anaerobic treatment process will be captured and total $8,632.3824 \times 10^4 \text{m}^3$ biogas are expected to be generated annually. And then the biogas will be sent into the biogas generating system for power generation. Each generator will be installed in each subsidiary swine farm, total installed capacity of the proposed project is 12.55MW. The electricity generated are all used by the AWMSs and the swine farms, and the Residual biogas (if any) will be flared. After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer. Wastewater from the anaerobic digesters will be treated aerobically and then used for agriculture irrigation.

Benefited from the "waste-biogas-fertilizer" pattern, harmlessness and ecological utilization of the swine manure can be realized. The annual average electricity generation is 105,690.39

MWh, all of which will be used by the AWMSs and 10 swine farms. The electricity generated will not be connected to other users or to the regional power grid and the baseline emissions associated with electricity generation will not be claimed.

The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from anaerobic treatment of swine manure and wastewater. 498,011tCO₂e emission reductions will be produced annually and total emission reductions are 2,490,055 tCO₂e in the first crediting period. The project activity can contribute to local sustainable development in the following aspects:

- Capture of methane will significantly reduce the odor nuisance in the vicinity of the facility.
- The project activity can provide 20 job opportunities for local residents.
- The effluent and fermented sludge are ecological organic fertilizers which are partly supplied to the farmers living around for free, which can be used to yield organic products and improve the living conditions of the farmers.
- The project activity can capture methane generated during the swine manure treatment process and the biogas can be used for power generation, which can contribute to the mitigation of global climate change.

A.1.1 Eligibility of the project under Gold Standard

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The proposed project falls under section 3.1.1 of *GS4GG Principles & Requirements* (Version 1.2), section 2,3 of *GS4GG Community Services Activity Requirements* (Version 1.2) and section 2 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements* (Version 2.0) with the following eligibility criteria:

Eligibility Criteria	Justification
(a) Types of Project Section 3.1.1 of <i>GS4GG Principles & Requirements</i> (Version 1.2) Eligible projects shall include physical action/implementation on the ground. Pre-identified eligible project types are identified in the Eligibility Principles and Requirements section. Section 2.1.2 of <i>GS4GG Community Services Activity Requirements</i> (Version 1.2) All CSA Projects shall lead to climate change	The project activity will replace the current open anaerobic lagoons with 10 new closed anaerobic digesters. The biogas generated during the treatment process will be captured for power generation. After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer and partly will be supplied to the farmers living around for free. Wastewater from the new AWMSs will be treated aerobically and then used for agriculture irrigation. Therefore, this project will by providing 10 new closed anaerobic digesters to improve the waste management led

mitigation and/or adaptation by providing or improving access to services/resources at the household or community or institution level. Eligible services include electricity and energy, water and sanitation, waste management, housing, etc. Section 3.1.1 of <i>GS4GG Community Services Activity Requirements</i> (Version 1.2) Pre-identified CSA project types are: a) Renewable energy; b) End-use energy efficiency; c) Waste management and handling; d) Water, sanitation and hygiene (WASH). Section 5.1.1 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements</i> (Version 2.0) The Following Project types are eligible for issuance of GSVERs or GSCERs: a) Renewable Energy Supply; b) End-Use Energy Efficiency Improvement; c) Waste Handling & Disposal; d) Land Use and Forests.	to climate change mitigation, which meets the section 2.1.2 of <i>Community Services Activity Requirements</i> (Version 1.2) and the project falls under the section 3.1.1 (c) "Waste management and handling: All waste management activities that deliver energy or a usable product with sustainable development benefits such as composting, biogas etc." of <i>GS4GG Community Services Activity Requirements</i> (Version 1.2). Besides, the project activity falls under section 5.1.1 (c) "Waste Handling & Disposal: The waste handling and disposal category refers to all waste handling Projects that deliver an energy service (e.g., LFG with some of the recovered methane used for electricity generation) or a usable product with sustainable development benefits (e.g., composting)." of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements</i> (Version 2.0). As per section 4.1.3 of <i>GS4GG Principles & Requirements</i> (Version 1.2), "A Project type is automatically eligible for Gold Standard Certification if there are Gold Standard approved Activity Requirements and/or Impact Quantification Methodologies associated with it or it's referenced in the Gold Standard Product Requirements". The project type is automatically eligible for Gold Standard Certification.
(b) Location of Project: Section 3.1.1 of <i>GS4GG Principles & Requirements</i> (Version 1.2) Projects may be located in any part of the world. Section 3.1.2 of <i>GS4GG Community Services Activity Requirements</i> (Version 1.2) Project Area and Boundary shall be defined in line with the applicable Impact Quantification Methodologies and Product Requirements. Section 3.1.1 of <i>GS4GG GHG Emissions Reduction</i>	The project location is the Republic of China (refer to section A.2 of the PDD for detailed project area and boundary). There is a cap & trade scheme in China. However, the project activity is not included the mandatory emission control scheme since the scheme only cover the high-emission industries, such as power generation. 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

<i>& Sequestration Product Requirements (Version 2.0)</i> Gold Standard VER Projects may be located in any host country or state. However, where host countries or states have mandatory operational schemes to reduce GHG emissions in any form (e.g. cap & trade, carbon tax etc.), Projects shall only be eligible if the Project Developer has either: (a) provided Gold Standard with satisfactory justification that no double counting of emission reductions occur or (b) has committed to retiring eligible units equal to the quantity of Gold Standard VERs. Refer to Annex A of this document.	under any other schemes other than GS. Therefore, the emission reductions will not be double counted. As per section 3.1.1 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)</i>, it is an eligible host country.
(c) Project Area, Project Boundary and Scale: Section 3.1.1 of <i>GS4GG Principles & Requirements (Version 1.2)</i> The Project Area and Project Boundary shall be defined. Projects may be developed at any scale although certain rules, requirements and limitations may apply under specific Activity Requirements, Impact Quantification Methodologies and Products Requirements. In order to avoid double counting the Project shall not be included in any other voluntary or compliance standards programme unless approved by Gold Standard (for example through dual certification). Also, if the Project Area overlaps with that of another Gold Standard or other voluntary or compliance standard programme of a similar nature, the project shall demonstrate that there is no double counting of impacts at design and performance certification (for example use of similar technology or practices through which the potential arises for double counting or misestimation of impacts amongst projects).	The project location is the Republic of China (refer to section A.2 of the PDD for detailed project area and boundary). There is a cap & trade scheme in China. However, the project activity is not included the mandatory emission control scheme since the scheme only cover the high-emission industries, such as power generation. 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 GS. Therefore, the emission reductions will not be double counted. As per section 3.1.1 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)</i>, it is an eligible host country. The project boundary is defined based on <i>ACM0010 GHG emission reductions from manure management systems (Version 08.0)</i>. The spatial extent of the project boundary encompasses the site of AWMSs and the power generation equipment. Refer to section B.3 of the PDD for more details.

Section 3.1.2 of <i>GS4GG Community Services Activity Requirements</i> (Version 1.2) Project Area and Boundary shall be defined in line with the applicable Impact Quantification Methodologies and Product Requirements. The definition of scale is the same for all Projects, except Microscale. Section 3.1.1 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements</i> (Version 2.0) Gold Standard VER Projects may be located in any host country or state. However, where host countries or states have mandatory operational schemes to reduce GHG emissions in any form (e.g. cap & trade, carbon tax etc.), Projects shall only be eligible if the Project Developer has either: (a) provided Gold Standard with satisfactory justification that no double counting of emission reductions occur or (b) has committed to retiring eligible units equal to the quantity of Gold Standard VERs. Refer to Annex A of this document. Section 9.1.1 <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements</i> (Version 2.0) Standard VER Projects may be “large scale”, “small scale” (for the applicability of methodologies and tools only) or “microscale”. Scale is defined in the relevant Gold Standard Activity Requirements or where these do not exist then per following paragraphs. Section 9.1.2 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements</i> (Version 2.0) All Projects exceeding the small-scale thresholds are defined as large scale. Small scale projects are defined in accordance with CDM project standard for project activities, as below;	Annual emission reductions of the project activity are 498,011tCO₂e, which is more than 60,000 tCO₂e. As per section 9.1.1 and 9.1.2 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements</i> (Version 2.0), it's a large-scale GS VER project. Before implementation of the project, no other similar project has been implemented in the project area. Each AWMS can be identified through its GPS coordinates. Therefore, the Project Area do not overlap with that of another Gold Standard or other voluntary or compliance standard programme of a similar nature.
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a. Type 1: Renewable energy Projects: maximum output capacity of 15 MW(e) or 45MW (th). In this context: i. "Output" is the installed/rated capacity as indicated by the manufacturer of the equipment or plant, irrespective of the actual load factor of the plant. The installed/rated capacity of renewable electricity generating units that involve turbine generator systems shall be based on the installed/rated capacity of the generator; ii. Regarding the "appropriate equivalent" of 15 MW, refers to MW, but the project participants may refer to MW(p),³ MW(e) or MW(th). As MW(e) is the most common denomination, MW is defined as MW(e), and otherwise an appropriate conversion factor shall be applied; iii. For biomass, biofuel and biogas project activities, the maximal limit of 15 MW(e) is equivalent to a 45 MW thermal output of the equipment or the plant (e.g. boilers). For thermal applications of biomass, biofuels or biogas (e.g. cookstoves), the limit of 45 MW(th) is the installed/rated capacity of the thermal application equipment or device(s) (e.g. biogas stoves). For electrical or mechanical applications, the limit of a 15 MW installed/rated output shall be used. In the case of co-firing renewable and fossil fuels, the rated capacity of the system when using fossil fuel shall apply; iv. For thermal applications of solar energy project activities, "maximum output" shall be calculated using a conversion factor of 700 W(th)/m² of aperture area of glazed flat plate or evacuated tubular collector, that is, the eligibility limit in terms of aperture area is 64,000 m² of the collector. The project participants may also use other conversion factors determined, but shall then justify why the chosen conversion factor is more appropriate to the project activity; <i>Example of technologies includes but not limited to solar photovoltaic, hydro, wind and renewable biomass that supply electricity to grid,</i>	
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<i>minigrid, individual households/users or groups of households/users.</i> b. Type 2: End-use energy efficiency project improvement: activities that reduce energy consumption, on the supply and/or demand side, with a maximum energy saving of 60 GWh per year (or an appropriate equivalent) in any year of the crediting period. In this context, for project activities that improve thermal energy efficiency, the maximum energy saving of 60 GWh(e) per year is equivalent to 180 GWh(th) per year saving; Examples of technologies and measures include high efficiency biomass fired project devices (cookstoves or ovens or dryers) to replace the existing devices and/or energy efficiency improvements in existing biomass fired cookstoves or ovens or dryers. c. Type 3: Other project activities: project involves technologies such Safe Water Supply, Waste management, etc. not included in Type I or Type II that result in GHG emission reductions not exceeding 60,000-ton CO₂e per year in any year of the crediting period. Examples of technologies and measures include solid waste composting, Water purification technologies including, but are not limited to, water filters (e.g. membrane, activated carbon, ceramic filters), solar energy powered ultraviolet (UV) disinfection devices, solar disinfection techniques, photocatalytic disinfection equipment, pasteurization appliances, chemical disinfection methods (e.g. chlorination), combined treatment approaches (e.g. flocculation plus disinfection), boreholes, wells, water kiosks.	
(d) Host Country Requirements Section 3.1.1 of <i>GS4GG Principles & Requirements</i> (Version 1.2) Projects shall be in compliance with applicable	The project location is the Republic of China (refer to section A.2 of the PDD for detailed project area and boundary). As per <i>Action Plan for Resource Utilization of</i>

Host Country's legal, environmental, ecological and social regulations. Section 3.1.2 of <i>GS4GG Community Services Activity Requirements (Version 1.2)</i> Project Area and Boundary shall be defined in line with the applicable Impact Quantification Methodologies and Product Requirements. Section 3.1.1 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)</i> Gold Standard VER Projects may be located in any host country or state. However, where host countries or states have mandatory operational schemes to reduce GHG emissions in any form (e.g. cap & trade, carbon tax etc.), Projects shall only be eligible if the Project Developer has either: (a) provided Gold Standard with satisfactory justification that no double counting of emission reductions occur or (b) has committed to retiring eligible units equal to the quantity of Gold Standard VERs. Refer to Annex A of this document.	<i>Livestock Manure (2017-2020)</i>¹ and Measures for the Administration of Livestock and Poultry Breeding in Jiangxi Province², the sustainable development of animal husbandry should focus on reduction of livestock waste, and harmless treatment and resource utilization of the manure and wastewater. The project activity will replace the current open anaerobic lagoons with 10 new closed anaerobic digesters. The biogas generated during the treatment process will be captured for power generation. After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer. Wastewater from the new animal waste management systems will be treated aerobically and then used for agriculture irrigation. The project follows China's legal, environmental, ecological and social regulations. There is a cap & trade scheme in China. However, the project activity is not included the mandatory emission control scheme since the scheme only cover the high-emission industries, such as power generation. 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 GS. Therefore, the emission reductions will not be double counted. As per section 3.1.1 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)</i>, it is an eligible host country.
(e) Contact Details Section 3.1.1 of <i>GS4GG Principles & Requirements (Version 1.2)</i> As part of the Project Documentation the Project	The Project Participants' contact details are provided in Appendix 2. Contact information of project participants of this PDD. As the project owner, Jiangxi Zhengbang Breeding

¹ http://www.moa.gov.cn/nybgq/2017/dbq/201801/t20180103_6134011.htm

² http://www.jiangxi.gov.cn/art/2021/12/6/art_64505_3775972.html

Developer shall provide (i) name and (ii) contact details of all Project Participants; AND in case of an organization (iii) the legal registration details and (iv) documentation by the governing jurisdiction that proves that the entity is in good standing (defined as being a legal or other appropriate entity registered in or allowed to operate within the required jurisdiction and with no evidence of insolvency or legal/criminal notices placed against it or any of its Directors). Gold Standard retains the right (at its own discretion) to refuse use of the Standard where reputational concerns are highlighted.	Co. Ltd is in the state of ongoing operation and has no administrative discrimination information, not listed as business abnormal catalog information and serious illegal untrustworthy enterprise list (blacklist) information by querying the national enterprise credit information publicity system³. Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. is a private owned company with limited liability instead of an organization incorporated in the Republic of China. It is in good standing as per credit China⁴. By querying the national enterprise credit information publicity system ⁵ , it shows that Profit Carbon Environmental Energy Technology (Shanghai) Co., Ltd. is in the state of ongoing operation and has no administrative discrimination information, not listed as business abnormal catalog information and serious illegal untrustworthy enterprise list (blacklist) information.
(f) Legal Ownership Section 3.1.1 of <i>GS4GG Principles & Requirements</i> (Version 1.2) Full and uncontested legal ownership of any Products that are generated under Gold Standard Certification, (for example carbon credits) shall be demonstrated. Where such ownership is transferred from project beneficiaries this must be demonstrated transparently and with full, prior and informed consent (FPIC). Note that for certain Project types there is a requirement for full and uncontested legal land title/tenure to be demonstrated. These are contained within specific Activity or Product Requirements. All projects shall immediately	All swine farms with corresponding AWMs were invested and owned by the project owner, who has full and uncontested legal ownership of the credits that will be generated under Gold Standard Certification. In addition, confirmation of the GS VER ownership was discussed during the local stakeholder consultation, which was held on 02/08/2021. The project owner has the legal ownership of the emission reductions generated by the project activity. Refer to section A.1.2 of the PDD for further details.

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<http://gsxt.amr.jiangxi.gov.cn/stateinfopages/yxgs/warning.jsp?prid=MzYwMTAwNDAAwMDA4MDY4OQ002Cu002C&zchreqno=MzYwMTAwNTIwMDAyNDY4>

4

<https://www.creditchina.gov.cn/xinyongxinxixiangqing/xyDetail.html?searchState=1&entityType=1&keyword=%E4%B8%8A%E6%B5%B7%E7%9B%88%E7%A2%B3%E7%8E%AF%E5%A2%83%E8%83%BD%E6%BA%90%E7%A7%91%E6%8A%80%E6%9C%89%E9%99%90%E5%85%AC%E5%8F%B8&uuid=f314d8d01428b2cab58f6afd8d5f3d69&tyshxydm=91310115301334442X>

⁵ <http://www.gsxt.gov.cn/index.html>

report to Gold Standard any land title/tenure disputes arising. Section 3.1.4 of <i>GS4GG Community Services Activity Requirements</i> (Version 1.2) Projects involving the distribution of a large number of devices for services such as heating, cooking, lighting, electricity generation, water treatment technology such as water filter, etc. shall provide a clear description of the ownership of the Products that are generated under Gold Standard Certification all along the investment chain. In line with the FPIC requirement, the proofs that end-users are aware of and willing to give up their rights on Products shall be provided. The transfer of Product ownership shall be discussed during local stakeholder consultations for projects.	
(g) Other Rights Section 3.1.1 of <i>GS4GG Principles & Requirements</i> (Version 1.2) As well as legal title and ownership, the Project Developer shall also demonstrate where required uncontested legal rights and/or permissions concerning changes in use of other resources required to service the Project (for example, access rights, water rights etc.). Any known disputes or contested rights must be declared immediately to Gold Standard by the Project Developer and resolved prior to further project implementation in affected areas.	The project activity will replace the current open anaerobic lagoons with 10 new closed anaerobic digesters. The biogas generated during the treatment process will be captured for power generation. After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer. Wastewater from the new animal waste management systems will be treated aerobically and then used for agriculture irrigation. Comprehensive utilization and resourceful treatment of the manure waste are encouraged by the local government⁶. All the swine farms of the project have obtained the licenses for production and operation of the breeding livestock and poultry issued by local government. And all the manure from the swine farms will be put into the AWMSs as 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. Therefore,

⁶ http://www.jiangxi.gov.cn/art/2017/7/17/art_4975_212418.html

	the project does not involve any activity that causes alteration of any resource, or contested legal rights and other disputes, therefore the need for acquiring any specific legal right is not applicable.
(h) Official Development Assistance (ODA) Declaration Section 3.1.1 of <i>GS4GG Principles & Requirements</i> (Version 1.2) All Project Developers applying for project activities located in a country named by the OECD Development Assistance Committee's ODA recipient list and seeking Gold Standard Certification for carbon credits shall declare the Official Development Assistance (ODA) support. The Project Developer shall follow the GHG Emissions Reduction & Sequestration Product Requirements and submit the declaration at the time of Design Certification. Section 6.1.1 and 6.1.2 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements</i> (Version 2.0) Projects are ineligible for carbon crediting under Gold Standard if the ODA assistance is provided to the project under the condition that the credits generated by the Project will be transferred, either directly or indirectly, to the donor country providing ODA support. Project Developer submitting a Project located in a country named by the OECD Development Assistance Committee's ODA recipient list shall sign and submit the ODA Declaration.	The project owner has signed the ODA declaration template and confirms that no ODA is provided under the condition that the credits generated by the project will be transferred, either directly or indirectly, to the donor country providing ODA support.
(i) Suppressed Demand Section 3.1.3 of <i>GS4GG Community Services Activity Requirements</i> (Version 1.2) Certain Impact Quantification methodologies allow projects to account Suppressed Demand scenario when establishing a baseline. In such cases, the	Suppressed demand baseline is not applicable to the project. As per Section 3.1.3 of <i>GS4GG Community Services Activity Requirements</i> (Version 1.2), it can be a large-scale GS VER project.

application of Suppressed Demand baseline is limited to Small Scale and Microscale Projects. Where a Suppressed Demand baseline is applied, it is not possible to 'stack' Gold Standard Certified Impact Statements or Products as the definition of the baseline may be contradictory.	
(j) Eligible Greenhouse Gases Section 4.1.1 of <i>GS4GG GHG Emissions Reduction & Sequestration Product Requirements (Version 2.0)</i> Only Carbon Dioxide (CO₂), Methane (CH₄) and/or Nitrous Oxide (N₂O) are eligible for Gold Standard crediting, provided Projects comply with Gold Standard Requirements and eligibility criteria.	The project considers the emission reductions of Carbon Dioxide (CO ₂), methane (CH ₄) and/or Nitrous Oxide (N ₂ O), which are eligible for Gold Standard crediting. Refer to section B.3 of the PDD for further details.

A.1.2 Legal ownership of products generated by the project and legal rights to alter use of resources required to service the project

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All the AWMSs were invested by the project owner, who has full and uncontested legal ownership of the credits that will be generated under Gold Standard Certification. In addition, confirmation of the GS VER ownership had been discussed during the local stakeholder consultation, which was held 02/08/2021. The project owner has the legal ownership of the emission reductions generated by the project activity.

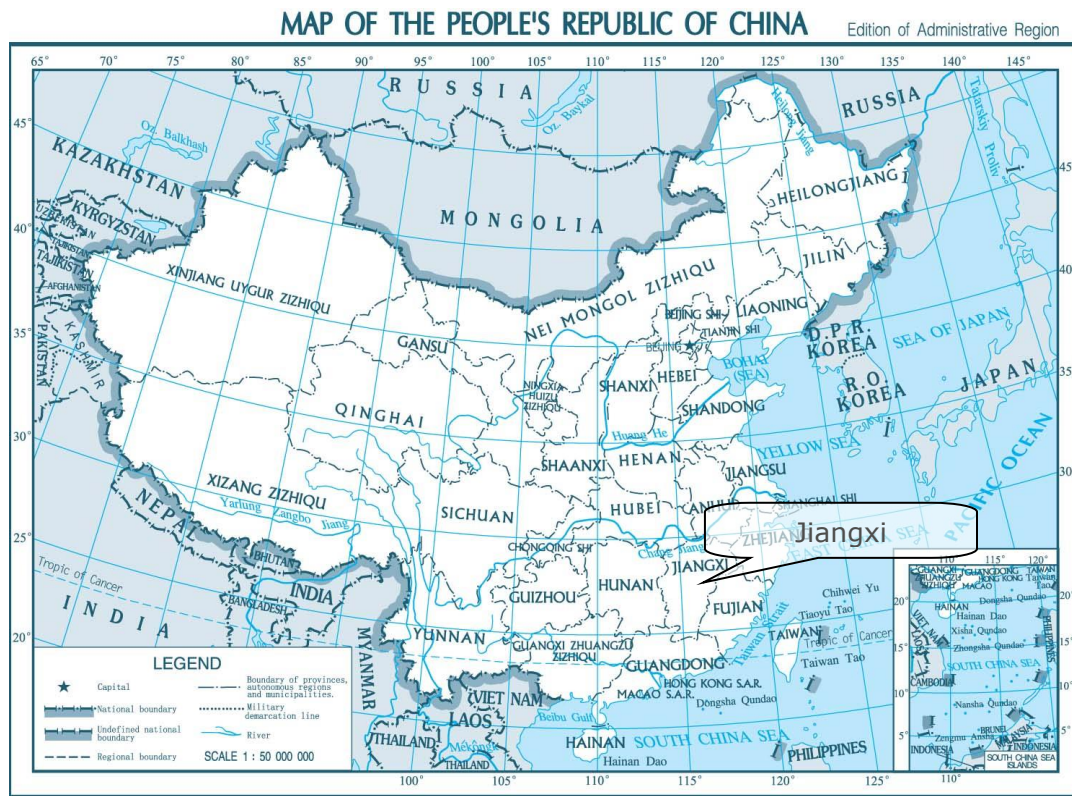
A.2 Location of project

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The proposed project activity is located in Ganzhou City, Jiangxi Province. There are ten subsidiary farms involved in the project, including 8 fattening farms: Guanxi, Jiading, Datang, Baishu, Zhongshi, Babaodong, Tangcun, Taojiang and 2 Breeding farms: Tianxiang, Fuwang. The location of the ten subsidiary farms is shown below:

Swine farm	Address	East longitude	North latitude
Guanxi(关西猪场)	Guanxi Town, Longnan County, Ganzhou City	114°58'3.07"	24°51'43.46"
Jiading(嘉定猪场)	Jiading Town, Xinfeng County, Ganzhou City	115°04'35.20"	25°27'41.57"
Datang(大塘猪场)	Datangbu Town, Xinfeng County, Ganzhou City	114°55'50.6"	25°16'10.87"
Baishu(柏树猪场)	Jiading Town, Xinfeng County, Ganzhou City	115°03'27.19"	25°26'47.21"
Zhongshi(重石猪场)	Banshi Town, Anyuan County, Ganzhou City	115°23'48.06"	25°22'7.24"
Babaodong(八宝洞猪场)	Liren Town, Longnan County, Ganzhou City	114°56'26.09"	24°54'56.01"
Tangcun(塘村猪场)	Tangcun Village, Anyuan County, Ganzhou	115°21'1.36"	25°32'7.28"

	City		
Taojiang(桃江猪场)	Taojiang Village, Longnan County, Ganzhou City	114°40'25.17"	24°56'2.64"
Tianxiang(天香猪场)	Chemen Village, Jinxi County, Fuzhou City	116°42'31.02"	27°58'43.55"
Fuwang(福旺猪场)	Sunfang Town, Chongren County, Fuzhou City	116°09'24.54"	27°51'46.99"



GS(2008) 1416 号

Jun. 2008

Produced by State Bureau of Surveying and Mapping

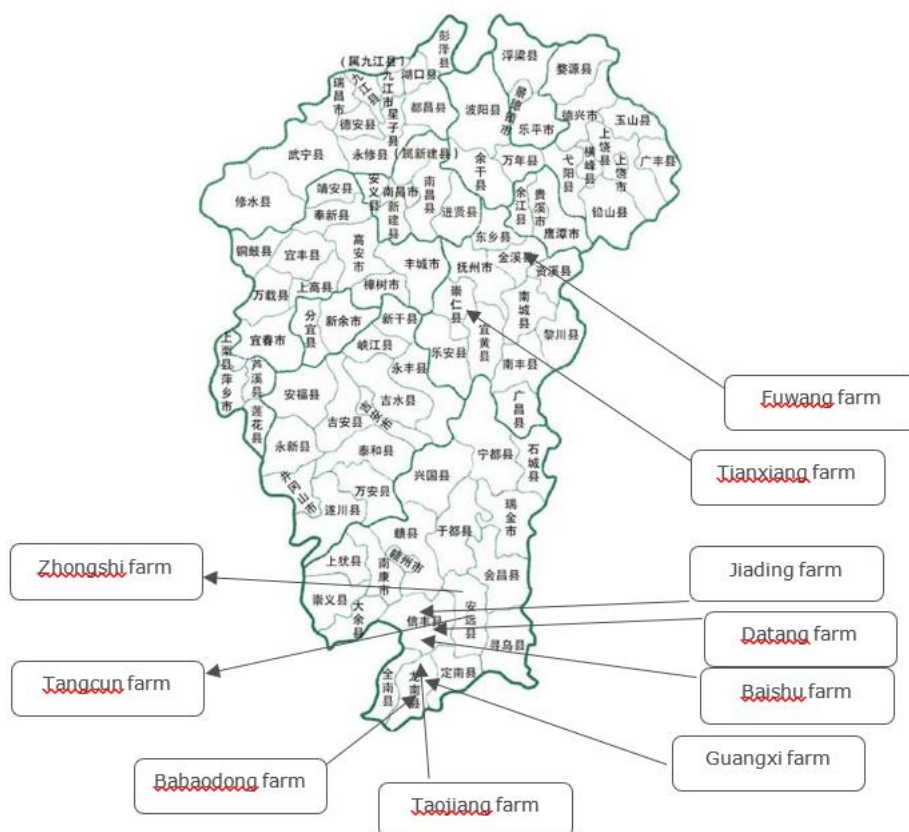


Figure 1 The Geographic Location of the project

A.3 Technologies and/or measures

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The project activity is designed to introduce new AWMSs to a group of 10 swine farms to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. The biogas generated during the treatment process will be captured for power generation, the electricity generated are all used by the swine farms, which is supplied by the grid company in baseline scenario. The grid company is dominated by thermal power generation. Therefore, the project activity will reduce of GHG and provide clean energy, which is in line with SGD 13(Climate Action) and SGD 7(Affordable and Clean Energy).

Temporary and permanent job opportunities are created for locals during the construction and operation period of the project, 20 local residents (10 females and 10 males) are employed permanently during the operation period of the project during project implementation and monitoring activities. Equal pay for work of equal value will be made to both men and women. Therefore, the project activity is in line with SDG 8 (Decent Work and Economic Growth).

The proposed project implemented 10 sets of AWMSs in 10 existing farms involving 573,653 heads of commercial pigs, 140,428 heads of breeding pigs. Live pigs are kept for 180 days in the farms before shipment and are estimated to produce 851,542 tons of manure and

8,632.3824*10⁴m³ of biogas annually. All these 10 existing swine farms were put into operation before the implementation of this project, detailed operation start date can be referred below Table 1.

Table 1 The operation date of swine farms

Swine farm	Operation start date
Guanxi	10/03/2015
Jiading	15/03/2015
Datang	08/04/2015
Baishu	12/04/2015
Zhongshi	24/03/2015
Babaodong	18/04/2015
Tangcun	26/03/2015
Taojiang	23/04/2015
Tianxiang	04/05/2015
Fuwang	14/05/2015

Baseline scenario

Prior to the implementation of the project, all manure waste produced from the existing 10 swine farms was left to decay in 10 uncovered anaerobic lagoons at the livestock farms and methane is emitted to the atmosphere directly without any methane recovery and destruction facility. As per “technical specification for sanitation treatment of livestock and poultry manure⁷”, In China, the uncovered anaerobic lagoons are a manure treatment method recognized by the state. 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.

After the implementation of the project, original 10 uncovered anaerobic lagoons had been removed, the volume for original uncovered anaerobic lagoons is described in below Table 2.

Project technology description

There are 10 existing swine farms for this project, and each AWMS is implemented in each swine farm. The specific process is as follows:

The raw materials such as pig manure, urine and washing water are collected, and then put into the homogenate regulating tank. After further hydrolysis and grit settling, all were put into the anaerobic tank for fermentation.

Anaerobic tanks adopt Upflow Anaerobic Sludge Bed Reactor (UASB) as its anaerobic digester technology, and the biogas generated from the anaerobic digesters will enter the biogas generator set after biological desulfurization and dehydration purification. The generated

⁷ <https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf>

electricity will be used for daily operation of AWMs and the swine farms, and the waste heat of the generator will be recycled for increasing the temperature of the anaerobic reactor. At the same time, and the residual biogas will be flared if there is any surplus biogas. So, this project meets the additional criteria against the methodology stipulated by GS, i.e., Emission reduction associated with methane avoidance (including from the flared biogas fraction) and for substitution of non-renewable shall be eligible if PP demonstrates that the system is designed in a way to at least make use of some of the biogas recovered for energy services (heat & power generation).

After anaerobic digestion, the fermentation liquid is separated by solid and liquid, and the biogas residue is used to produce solid organic fertilizer. The biogas slurry is used as liquid organic fertilizer to irrigate the crops. The sludge produced during the aerobic treatment process is used as high-quality fertilizer. Only a small portion of organic fertilizers will be supplied to the farmers living around for free and the surplus fertilizes will be sold to the end-users at below-market prices. The technical flow of the project activity is shown below:

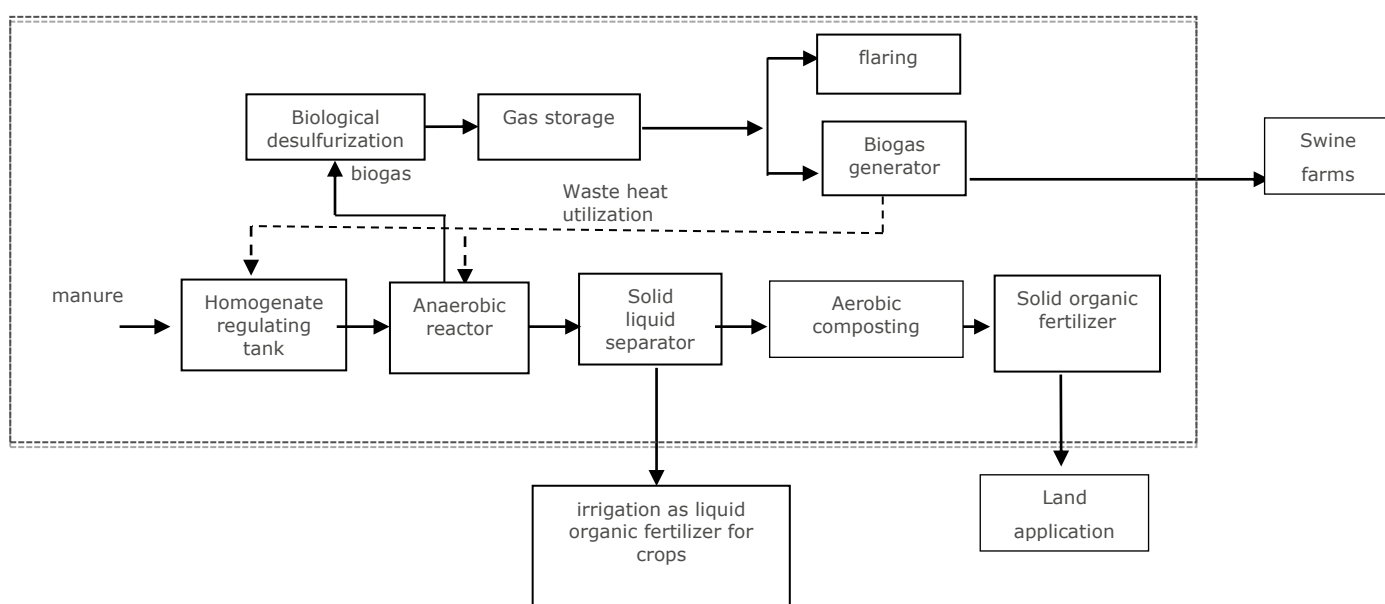


Figure 1 Process flow of biogas project in the swine farms

Pretreatment process

The mixed manure enters the homogenate regulating tank, where the homogenate is further hydrolyzed to remove impurities such as mud and sand. The feed solution is heated to 30 °C in the homogenate hydrolysis tank, and then pumped into the anaerobic tank.

Anaerobic digestion process

Anaerobic digestion process consists of feeding unit, anaerobic digestion unit and biogas storage unit.

- Feeding mode

The manure is pumped into the anaerobic digestion unit by a pump and fed continuously.

- Anaerobic reactor process

The project adopts a completely mixed anaerobic reactor. The fully mixed anaerobic reactor is suitable for the fermentation of livestock manure. It uses stirring and heating technology in anaerobic reactor, which is an important technical breakthrough in biogas fermentation process. Mixing and heating can greatly improve the biogas fermentation rate. The fully mixed anaerobic reactor is also called high-speed biogas fermentation pool. It has a high solid concentration (Total Solid 6 - 12%) and can make all livestock manure sewage biogas fermentation treatment. Its advantages are the large treatment capacity, large biogas production, easy management, easy start-up and low operation cost. It is generally suitable for areas where biogas is the main production and uses liquid organic fertilizer (water and fertilizer). Because this process is suitable for the treatment of livestock manure and organic waste with high suspended solids, it has the incomparable advantages of other efficient biogas fermentation processes and is widely used in Europe and other biogas engineering developed areas. Therefore, it is more appropriate to choose a fully mixed anaerobic reactor, which is conducive to saving investment; The longer Hydraulic Retention Time (HRT) is also conducive to the full decomposition and digestion of pig manure, and the biogas production is relatively stable. At the same time, it is more conducive to the smooth implementation and operation management of the project.

- Anaerobic tank configuration

The stirring system is set in the anaerobic reactor to make the feed evenly distributed and fully contact with anaerobic microorganisms and make the temperature of the feed liquid in the anaerobic system uniform, which is conducive to improving the gas production rate. Moreover, it can also break scum and prevent crusting.

A discharge system is set at the upper part of the reactor to overflow into the next treatment unit.

- Heat preservation and warming

Anaerobic digestion reaction process is greatly affected by temperature. The temperature of the anaerobic treatment unit of this project is designed as medium temperature, and the optimal temperature range is 35 ~ 38 °C. To ensure the normal operation of anaerobic reaction in winter, it is necessary to implement warming and overall insulation measures for the system.

- a. Heat preservation

The whole system insulation includes pipeline and valve insulation; Heat preservation system of anaerobic digestion tank.

b. Temperature increase

The temperature increase is mainly carried out in the pretreatment homogenate regulating tank and anaerobic reactor at the same time.

The heat source comes from the waste heat generated by the cogeneration unit; A heating tube is arranged in the pool body, and the heat of the generator is exchanged through the exchange tube to realize the temperature increase of the pool body. After the waste heat of the generator is heated to the anaerobic digestion system, the water after heat exchange returns to the generator system.

Solid liquid separation and biogas residue treatment process

There are a lot of solid substances in the effluent after anaerobic fermentation, so the solid-liquid separation must be carried out. Solid liquid separation chooses compound spiral extrusion solid-liquid separator. The effluent from solid-liquid separation (biogas slurry) overflows into the biogas slurry storage tank. The solid-liquid separator can reduce the moisture content of biogas residue to less than 70% and transport it to the organic fertilizer storage yard for use in farmland and feed fields.

Biogas slurry treatment process

Biogas slurry tank, sewage treatment system and oxidation pond are designed for the project.

Application of biogas slurry: the biogas slurry is used as liquid organic fertilizer through the pipe network to silage corn feed field, orchard, nursery and other fertilization land. At the same time, it is equipped with oxidation pond to purify biogas slurry in non-fertilizer season and meet the discharge standard of livestock wastewater.

Biogas purification process

Biogas was desulfurized by biological desulfurization method. Biological desulfurization method uses colorless sulfur bacteria, such as *Thiobacillus thiooxidans* and *Thiobacillus ferrooxidans*, to oxidize H_2S to elemental sulfur or sulfite under micro- oxygen conditions. This desulfurization method has been widely used in Europe and has been used in some domestic projects. Its advantages are no catalyst, no chemical sludge treatment, little biological sludge, low energy consumption, 90% H_2S removal rate and high removal efficiency. The cost of desulfurization is 0.04 yuan per cubic meter of biogas, which is 70% lower than that of chemical desulfurization.

Biogas storage technology

Double-Membrane Constant Pressure Gas Storage tank is selected to store biogas in this project. The gas storage tank is equipped with an explosion-proof fan, which automatically adjusts the gas delivery volume to the biogas generator according to the requirements, so as to maintain the stability of the air pressure in the gas storage tank. It is equipped with ultrasonic range finder to automatically adjust and control the storage capacity of biogas.

Aerobic composting process

The biogas residue after solid-liquid separation is transported to the aerobic composting workshop to be mixed with high-efficiency microbial fermentation bacteria. The bottom of the organic fertilizer workshop is embedded with a blast aeration device, which can forcefully ventilate and oxygenate the pile, so that the microorganisms can grow and multiply quickly, so that the temperature of the stack increases rapidly. After 7-8 days of composting, turn the pile will be turned through Turnover machines. The compost fermentation process is divided into 4 stages: heating stage (45 °C), high temperature stage (60-70 °C), cooling stage, and decomposing stage. After 15 days of fermentation in the composting workshop, the manure can form coarse fertilizer.

The proposed project was implemented in 10 swine farms 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 volume for original uncovered anaerobic lagoons and the equipment parameters used of each swine farm are shown in the following Table 2:

TEMPLATE

Table 2 technical parameters of main equipment and uncovered anaerobic lagoons

Farm name	Guanxi	Jiading	Datang	Baishu	Zhongshi	Babaodong	Tangcun	Taojiang	Tianxiang	Fuwang
Treatment capacities of AWMS(t/d)	65	300	450	240	500	630	320	200	320	320
Baseline anaerobic lagoon										
Size of baseline anaerobic lagoon(length*width*depth) (m³)	60*40*3	80*80*4.5	100*100*4.5	80*80*3.5	100*100*4.5	120*100*5	80*80*4.5	80*80*3.5	80*80*4.5	80*80*4.5
technical life	No Less than 15 years									
Biogas Generator										
Type	KDGH-250G	KDGH-1200G	KDGH-1600G	KDGH-800G	KDGH-1800G	KDGH-2500G	KDGH-1200G	KDGH-800G	KDGH-1200G	KDGH-1200G
Unit power(kw/kvA)	250	1200	1600	800	1800	2500	1200	800	1200	1200
Frequency (Hz)	50	50	50	50	50	50	50	50	50	50
Rated speed (rpm)	1500	1500	1500	1500	1500	1500	1500	1500	1500	1500
Equipment Quantity	1	1	1	1	1	1	1	1	1	1
Equipment technical life	No Less than 30 years									
Anaerobic tank										
Design capacity (m³)	1000	2500*2	3000*1+2000*2	1500+2000	3000*2+2000*1	3000*1+2500*3	2000+3000	2500+1000	2500+3000	2500+3000

Anaerobic technology	UASB	UASB	UASB	UASB	UASB	UASB	UASB	UASB	UASB	UASB
Stay time(day)	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8	15.8
Fermentation temperature(℃)	38	38	38	38	38	38	38	38	38	38
Equipment Quantity	1	2	3	2	3	4	2	2	2	2
Equipment technical life	No Less than 30 years									
Turnover machine										
Type	FJL 6000*10 50	FJL 6000*10 50	FJL6000*135 0	FJL 6000*10 50	FJL6000*135 0	FJL6000*135 0	FJL 6000*10 50	FJL 6000*10 50	FJL 6000*10 50	FJL 6000*10 50
Supporting power(kw)	25.74	25.74	41.5	25.74	41.5	41.5	25.74	25.74	25.74	25.74
Speed of work(m/h)	50	50	50	50	50	50	50	50	50	50
No-load speed(m/h)	100	100	100	100	100	100	100	100	100	100
Height of mixing rod(mm)	3400	3400	4500	3400	4500	4500	3400	3400	3400	3400
Turning depth(mm)	1500-1800	1500-1800	1500-1800	1500-1800	1500-1800	1500-1800	1500-1800	1500-1800	1500-1800	1500-1800
Equipment Quantity	1	1	1	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	Open flare	Open flare	Open flare
Treatment capacities (m³/h)	0-90	0-90	0-90	0-90	0-90	0-90	0-90	0-90	0-90	0-90

Material	304 stainless steel	304 stainless steel	304 stainless steel	304 stainless steel	304 stainless steel	304 stainless steel	304 stainless steel	304 stainless steel	304 stainless steel	304 stainless steel
Height (m)	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5
Main wall thickness (mm)	3	3	3	3	3	3	3	3	3	3
Equipment technical life	No Less than 15 years									

A.4 Scale of the project

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The proposed project introduces new AWMSs to treat the manure and wastewater. As per section 9.1.2 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements* (Version 2.0), it belongs to the Type 3: other project activities. The annual emission reductions of the project activity are 498,011tCO₂e, which is more than 60,000 tCO₂e. Thus, the project does not meet the definition of small-scale projects in section 9.1.2 of *GS4GG GHG Emissions Reduction & Sequestration Product Requirements* (Version 2.0), Therefore, the project is a large-scale GS VER project.

A.5 Funding sources of project

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The project will be financed by the project owner only during the entire operational lifetime. No public funding will be involved. On the long run, the project will be financially sustainable through income from organic fertilizer and carbon credits.

Project financing for this project activity will not use Official Development Assistance (ODA) Funds. The signed ODA declaration template will be provided as evidence.

SECTION B. APPLICATION OF APPROVED GOLD STANDARD METHODOLOGY (IES) AND/OR DEMONSTRATION OF SDG CONTRIBUTIONS

B.1. Reference of approved methodology (ies)

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The approved methodology applied by this project is referenced as ACM0010" GHG emission reductions from manure management systems (Version 08.0)".

The project also applies the following Tools,

Tool 02: "Combined tool to identify the baseline scenario and demonstrate additionality(version07.0)"⁸

Tool 05:" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" (Version 3.0)⁹

Tool 06:" Project emissions from flaring" (Version 3.0)¹⁰

Tool 08: "Tool to determine the mass flow of a greenhouse gas in a gaseous stream (version03.0)"¹¹

Tool 14: "Project and leakage emissions from anaerobic digesters (Version 02.0)"¹²

Tool 24: "Common practice (Version 03.1)"¹³

B.2. Applicability of methodology (ies)

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The following table summarize the justification of the applicability conditions:

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	For this project, 10 sets of new AWMS are installed in 10 existing swine farms in order to treat the manure and wastewater from these swine farms, which avoids methane emissions generated in the baseline uncovered anaerobic lagoons. The biogas generated during the treatment process will be captured for power

⁸ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-02-7.0.pdf/history_view

⁹ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-05-3.0.pdf/history_view

¹⁰ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-06-3.0.pdf/history_view

¹¹ https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-08-3.0.pdf/history_view

¹² https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-14-v2.pdf/history_view

¹³ <https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf>

emissions.	generation and all the electricity will be used by the 10 swine farms and will not be connected to another user or to the regional power grid.
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.	For this project, 10 identical sets of new AWMS are installed in 10 existing swine farms in order to treat the manure and wastewater from these swine farms, which was treated in the baseline uncovered anaerobic lagoons prior to the implementation of the project. The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from anaerobic treatment of swine manure and wastewater.
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 layer at the lagoon	(a) This project introduces new animal waste management systems to a group of 10 swine farms in Ganzhou City of Jiangxi Province, which are owned by Zhengbang. Zhengbang¹⁴ is one of the leading national leading agricultural enterprise with the largest scale of swine farming in China. So, the farms in the project boundary contain swine populations. All swine is managed under confined conditions, which can be confirmed during site visit. (b) All 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)". (d) The annual average ambient temperature at the site is 19.8°C¹⁵, which is higher than 5°C. (e) The minimum retention time of manure waste in the open anaerobic lagoons is not less than 45

¹⁴ 正邦集团 (zhengbang.com)

¹⁵ <https://baike.baidu.com/item/%E8%B5%A3%E5%B7%9E/142839?fr=aladdin>

bottom.	days, i.e., at least 60 days in the baseline scenario¹⁶. (f) The anaerobic tanks are made of carbon steel and is a fully enclosed environment. The inside of anaerobic tanks is painted 3 times with epoxy bituminous paint and the outside of anaerobic tanks is painted 2 times with anti-rust paint. Therefore, the anaerobic tanks are impermeable and will not cause leakage of manure waste into ground water.
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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 introduce new 10 AWMSs to a group of 10 swine farms to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. Alternative scenarios, barrier analysis, investment analysis and common practice analysis will be carried out based on Tool 02. Refer to section B.4 and B.5 of the PDD 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	The electricity generated by the project will be used firstly for the operation of AWMSs normally, then the excess electricity will be supplied to the swine farms. Unless no electricity generation for this project, the electricity consumption of the project will be supplied by the grid company¹⁷, 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.

¹⁶

https://mbd.baidu.com/newspage/data/landingsuper?context=%7B%22nid%22%3A%22news_9639404512015689726%22%7D&n_type=-1&p_from=-1

¹⁷ https://www.mee.gov.cn/ywgz/xdqhbh/wsqtz/202012/t20201229_815386.shtml

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 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 CO₂ emissions.	Tool 05 is only used to calculate project emissions of electricity consumption supplied by CCPG (Central China Power Grid). For conservativeness, baseline emissions of captive biogas power generation system are ignored. Only CO₂ emissions will be accounted.

Tool 06: "Project emissions from flaring (version03.0)"	
This tool provides procedures to calculate project emissions from flaring of a residual gas. The tool is applicable to enclosed or open flares and	The biogas generated during the treatment process will be captured for power generation and the residual biogas will be flared if there is any

project participants should document in the CDM-PDD the type of flare used in the project activity.	surplus biogas. One opened flare will be constructed in each swine farm; total 10 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 per Project Evaluation Report of the project, 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 will be 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. Operating specifications were provided by the manufacturer of the flare.

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 collected at the digester will be collected and monitored. Refer to section B.7 of the PDD 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 ₂ S, O ₂ , CO, CO ₂ , N ₂ and H ₂ , of which CH ₄ is the main component. 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 N₂).	a) Methodological tool" Tool to determine the mass flow of a greenhouse gas in a gaseous stream" is applied in the PDD. b) The mass flow is determined in the monitoring plan of the PDD. c) The flow of the gaseous stream will be measured continuously. d) The gaseous stream is dry, equation (5) and (6) 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) CO₂ emissions from consumption of electricity associated with the operation of the anaerobic digester; (b) CO₂ emissions from consumption of fossil fuels associated with the operation of the anaerobic digester; (c) CH₄ 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) CH₄ emissions from flaring of biogas.	Electricity will be used during the operation of the anaerobic digester, and the anaerobic digestion process of this project does not involve the use of fossil fuels, meanwhile the project activity will replace the current open anaerobic lagoons with 10 new closed anaerobic digesters in 10 swine farms. In addition, 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) CH₄ and N₂O emission from composting of digestate; (b) CH₄ emissions from the anaerobic decay of digestate disposed in a SWDS or subjected to anaerobic storage, such as in a stabilization pond.	The project activity will replace the current open anaerobic lagoons with 10 new closed anaerobic digesters. The biogas generated during the treatment process will be captured for power generation. After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer. So, the proposed project meets this criterial.
Emission sources associated with N₂O 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 N₂O 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: Methodological tool: "common practice (version03.1)"	
This methodological tool is applicable to project activities that apply the methodological tool "Tool for the demonstration and assessment of additionality", the methodological tool "Combined tool to identify the baseline scenario and	Combined tool to identify the baseline scenario and demonstrate additionality (Version07.0) is applied to identify the baseline scenario by the project.

demonstrate additionality”, or baseline and monitoring methodologies that use the common practice test for the demonstration of additionality.	
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.

B.3. Project boundary

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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 proposed project boundary considers the GHG emissions that come from AWMSs, including the GHGs emissions from the anaerobic digestion, GHG emissions from sludge treatment by aerobic composting and GHG emissions from flaring system in 10 swine farms. The current situation is shown as follows.

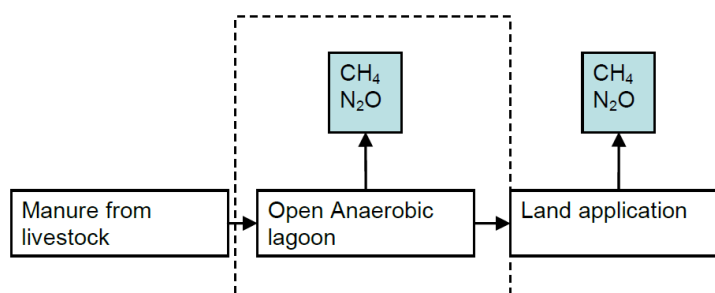


Figure 2 The current situation in the swine farms

The project activity boundary is defined as follows.

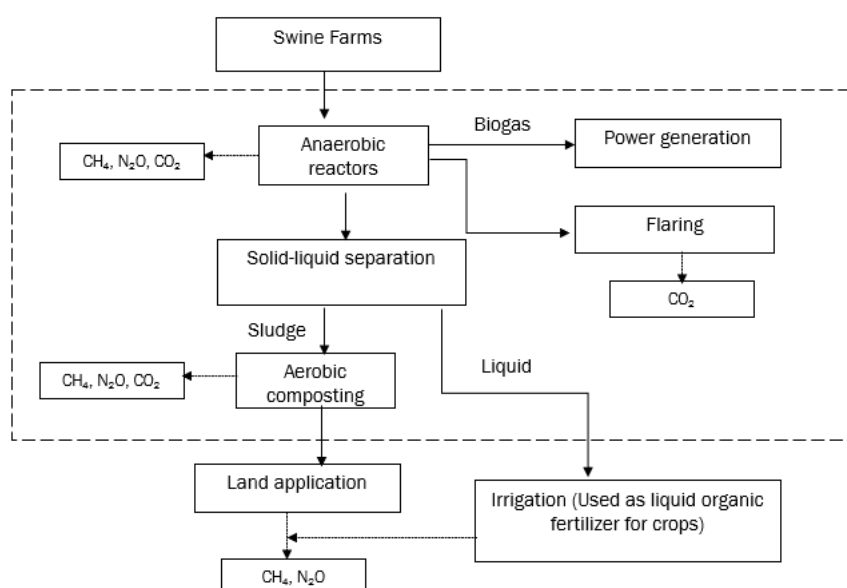


Figure 3 The project boundary of the project

The greenhouse gases included or excluded from the project boundary are summarized in following table.

Emission Sources Included in or Excluded from the Project Boundary

Source	GHGs	Included?	Justification/Explanation
Baseline scenario	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 ₂ O	Yes	Direct and indirect N ₂ O emissions are accounted
	CO ₂	No	Excluded for simplification. This is conservative.
	CH ₄	No	Excluded for simplification. This is conservative
	N ₂ O	No	Excluded for simplification. This is conservative
	CO ₂	No	The anaerobic lagoon does not consume thermal energy.
	CH ₄	No	Excluded for simplification. This is conservative
	N ₂ O	No	Excluded for simplification. This is conservative

Project scenario	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 ₂ O	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 ₂ O	No	Excluded for simplification.
		N ₂ O	Yes	Direct and indirect N ₂ O emissions are accounted
	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 emission from anaerobic digesters and aerobic treatment

B.4. Establishment and description of baseline scenario

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Baseline scenario has been identified using the methodological tool 02 "Combined tool to identify the baseline scenario and demonstrate additionality (Version07.0)".

Step1: Identification of alternative to the project activity consistent with current laws and regulations

Step 1a: Define alternative scenarios to the project activity

Prior to the implementation of the project, all manure waste produced from the existing 10 swine farms was left to decay in 10 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 10 sets of AWMSs in these 10 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 10 farms in the project. The proposed project is Non-free captive mode. 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, usually for periods less than one year. 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 ¹⁸ ", the uncovered anaerobic lagoon is a kind of harmless treatment of manure. After being treated in the uncovered anaerobic pond, the manure can be used for agricultural irrigation, Prior to the implementation of the project, the animal manure waste was left to decay in uncovered anaerobic lagoons. Therefore, animal waste that has been treated by uncovered anaerobic lagoon can satisfy the above regulations. 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. 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 pigs will be quickly killed by the accumulation of toxic fumes.
8	Anaerobic digester (Anaerobic Digester-	Applicable	A single Anaerobic digester is suitable for treating manure, but to implement such technology need

¹⁸ <https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf>

	Aerobic Treatment system)		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 GS VER 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	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 GS 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 proposed project activity not being registered as a GS project activity

Step 1b: Consistency with mandatory 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 Farming¹⁹ issued by the State Council in Nov.2013.

According to "Technical specification for sanitation treatment of livestock and poultry manure²⁰", 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 the "Specifications for the construction of manure resource utilization facilities for large-scale livestock and poultry farms (for trial implementation)²¹", anaerobic digester, aerobic 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 cost and economic benefits attributable to the waste management scenario should be illustrated in a transparent and complete manner. Table 3 shows the investment analysis results of the uncovered anaerobic lagoon.

¹⁹ <http://politics.people.com.cn/n/2013/1126/c1001-23662445.html>

²⁰ <https://oss.baigongbao.com/2020/12/14/MRyhTKQcWC.pdf>

²¹ http://www.moa.gov.cn/gk/tzgg_1/tfw/201801/t20180111_6134801.htm

Table 3 Investment analysis of the uncovered anaerobic lagoon (10⁴ RMB)

Costs and benefits	1	2	3-4	5	6-15	16
Cash inflow	0.00	0.00	0.00	0.00	0.00	0.00
Revenues from organic fertilizers sales	0.00	0.00	0.00	0.00	0.00	0.00
Subsidy income	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
Recovered current capital	0.00	0.00	0.00	0.00	0.00	0.00
Cash outflow	12.40	2.40	2.40	2.40	2.40	2.40
Construction investment	0.00	0.00	0.00	0.00	0.00	0.00
Current capital	0.00	0.00	0.00	0.00	0.00	0.00
O&M cost	2.40	2.40	2.40	2.40	2.40	2.40
Sales tax and associate charge	0.00	0.00	0.00	0.00	0.00	0.00
Net cash flow	-12.40	-2.40	-2.40	-2.40	-2.40	-2.40
NPV (discount rate=9%²²)	-29.12					
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 4 summarize the results of financial analysis of Anaerobic Digester-Aerobic Treatment without GS VER revenues.

Table 4 Investment analysis of the Anaerobic Digester-Aerobic Treatment without GS VER revenues (10⁴ RMB)

Costs and benefits	1	2	3-4	5	6-15	16
Cash inflow	0.00	2,945.48	2,945.48	2,561.91	2,517.50	3,511.03
Revenues from organic fertilizers sales	0.00	2,517.50	2,517.50	2,517.50	2,517.50	2,517.50
Subsidy income	0.00	427.98	427.98	44.41	0.00	0.00
Fixed assets residue	0.00	0.00	0.00	0.00	0.00	663.52

²² The cumulative method is the most common method used in NPV discount rate recognition and discount rate is equal to the sum of the risk-free rate of profit, the risk rate of profit and the inflation rate (<https://wiki.mbalib.com/wiki/%E6%8A%98%E7%8E%B0%E7%8E%87>) and the risk-free rate of profit is typically 3%, the risk rate of profit is generally taken as 3-5% and inflation rate for the last ten years is 2.29%. the discount rate is usually no more than 15%. Therefore 9% of NPV discount rate for this project is reasonable.

value						
Recovered current capital	0.00	0.00	0.00	0.00	0.00	330.11
Cash outflow	13,060.11	1,519.41	1,189.30	1,189.30	1,189.30	1,189.30
Construction investment	13,060.11	0.00	0.00	0.00	0.00	0.00
Current capital	0.00	330.11	0.00	0.00	0.00	0.00
O&M cost	0.00	1,137.94	1,137.94	1,137.94	1,137.94	1,137.94
Sales tax and associate charge	0.00	51.36	51.36	51.36	51.36	51.36
Net cash flow	-13,060.11	1,305.03	1,620.84	1,372.62	1,328.21	2,202.64
NPV (discount rate=9%)	-1,855.04					
IRR (%)	6.24					

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 GS VER revenues is far more negative than that of the uncovered anaerobic lagoon which means the cost of the project activity without GS VER revenues is much higher than the uncovered anaerobic lagoon.

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. Additionally, the investment required to generate electricity from biogas is still too high and the cost is much higher than electricity prices in the market, so 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 Gold Standard certification, 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 proposed project will use benchmark analysis method (option III) based on the consideration that benchmark, Project IRR is available.

For the proposed project, the applied benchmark in the investment analysis is animal industry Project IRR (after tax) of 9.5%, which is sourced from the "notice on adjusting financial benchmark rate of return of construction projects in some industries" issued by NDRC and the ministry of housing and urban-rural development of PRC. So, the applied benchmark in the investment analysis meets the "Benchmarks supplied by relevant national authorities are also appropriate".

(a) Basic parameters

item	value	source
Annual organic fertilizers sales ²³	114,432t	Project evaluation report, 18/10/2019
Total static investment	13,060.11*10 ⁴ RMB	Project evaluation report, 18/10/2019
O&M cost	1,137.94*10 ⁴ RMB	Project evaluation report, 18/10/2019
Operation period	15 years	Project evaluation report, 18/10/2019
Emission reduction	498,011tCO ₂ e	Calculated
GS VER Price	1US dollar/ton	Expected

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

Without income from selling GS VERs, the IRR of the proposed project is 6.24%, lower than the benchmark IRR 9.5% and the proposed project is financially unacceptable because of its low profitability. While considering such income, the IRR of the proposed project is 9.71%, higher than the benchmark, and the proposed project is financially acceptable.

Item	Without income from GS VERs	Benchmark IRR	With income from GS VERs
The Project IRR	6.24%	9.5%	9.71%

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

²³ Only a small portion of the solid organic fertilizers generated by the project will be supplied to the farmers living around for free due to few villagers live in the surrounding area and the effluent through anaerobic process will also be used for irrigation the surrounding crops. The extra organic fertilizer will be sold into the market, which is the most direct revenue for PP for this project.

organic fertilizers sales

O&M cost

As per paragraph 19 the applied methodology, the following parameter is identified to analyze IRR of the project.

Parameter	Clarification
Land cost	The project site is in the swine farm, and the land cost is not included since the land cost was paid during the construction of the swine farms.
Engineering, procurement and construction cost	Included. Engineering, procurement and construction cost are included in investment analysis according to the project evaluation report.
Labour cost	Included. Labour cost is included in investment analysis according to the project evaluation report.
Operation and maintenance cost;	Included. operation and maintenance cost are included in investment analysis according to the project evaluation report.
Administration cost	Included, the insurance cost included in investment analysis according to the project evaluation report can be considered as administration cost.
Fuel cost	Not included. According to the agreement signed by the Farming Department and Environmental Department of the company, the swine farms hand over their manure i.e. fuel to the project free of charge and the electricity generated by the project is also used by the swine farms free of charge. Therefore, the fuel cost and the revenue from electricity saving is not included in investment analysis.
Capital cost and interest	This is included in investment analysis.
Revenue from electricity sales	Not included. After the implementation of the project, the electricity generated through biogas are all used by the AWMSs and the swine farms, not connected to the grid company. Therefore, there is no revenue from electricity sales.
All other costs of implementing the technology of each lagoon design option	Not included. the project does not involve the implementing the technology of each lagoon design option since the project belongs to existing facilities.
All revenues generated by the implementation of the proposed technology (including energy savings due to captive use of biogas as fuel for either electricity or heat generation at the project site, revenue on account of	Included. The operation of AWMSs does need the electricity, therefore only the electricity used by the swine farms can be saved. however, according to the agreement signed by the Farming Department and Environmental Department of the company, the swine farms

avoided water consumption, fossil fuel replacement, sale of concentrated solids as fertilizers, subsidies/fiscal incentives etc.).	therefore hand over their manure to the project free of charge and the electricity generated by the project is also used by the swine farms free of charge. the sales of organic fertilizers are included in investment analysis.
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The variation range of -10%~10% which was employed in the Project evaluation report and prevailing in China was used. The results of sensitivity analysis of the three parameters of the proposed project are shown in the following table and figure:

item	-10%	-5%	0	5%	10%
Total static investment	7.94%	7.06%	6.24%	5.49%	4.80%
O&M cost	7.27%	6.76%	6.24%	5.72%	5.20%
organic fertilizers sales	3.96%	5.12%	6.24%	7.35%	8.43%

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 17.9%;

Organic fertilizers sales: increase 15.0%;

O&M cost: decrease 32.6%

Since all the data used for the investment analysis was sourced from the project evaluation report, which was completed by an authorized entity i.e., Jiangxi Huisen Environmental Science and Technology Engineering Co., LTD., which belongs to Zhengbang Group. It is a high-tech environmental protection enterprise integrating the development, application and comprehensive utilization of environmental management technology. The company has been committed to promoting the development and progress of environmental protection technology for a long time, with excellent engineering design, construction, installation, commissioning, equipment manufacturing and other comprehensive service capabilities. In the biomass energy comprehensive utilization, organic waste gas treatment and recovery, livestock and poultry breeding, heavy metals, urban sewage treatment and water reuse, ecological planning and restoration and other fields formed its own unique advantages and technical characteristics. 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 17.9%: But the change of this extent is unlikely to happen. 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.

There were five similar CDM projects registered²⁴, and the investment costs were compared with each other. The investment per installed capacity (10^4 RMB/MW) of the 5 registered CDM projects ranges from $1,651.38 \times 10^4$ RMB/MW to $2,759.26 \times 10^4$ RMB/MW, which is higher than that of the project activity ($1,040.65 \times 10^4$ RMB/MW). There is no space to reduce the investment costs of the project. Besides, as per general contract and purchase agreement of the main equipment (power generator, anaerobic tanks and flaring system), the actual investment costs of the project have reached to $1,151.80 \times 10^4$ RMB/MW, which is higher than that of the estimated value calculated based on the project evaluation report ($1,040.65 \times 10^4$ RMB/MW). As a result, the IRR cannot increase through the change of investment costs.

Annual organic fertilizers sales 15.0%: 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, therefore the increase of annual organic fertilizers generation to threshold is impossible to achieve, 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 agricultural company and local organic fertilizer plant with the fixed price i.e. 220RMB/ton.

O&M cost decreasing 32.6%: However, the decrease of it is not likely to occur. Based on Chinese Statistic Yearbook, the fluctuations of indices of purchasing price of raw material, power and fuel are insignificant over last ten years and the annual average wages in Jiangxi Province have been constantly growing during over last ten years. Moreover, the equipment will be getting more and more with the abrasion, which means the maintenance cost will be increasing in the coming years. As a result, the drastic decreasing of 32.6% 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

²⁴ Reference number of the five projects are 1301, 1891, 3716, 3488 and 7595 separately.

uncertain factors which could make the proposed project financially feasible is unlikely to occur. Therefore, the conclusion regarding the infeasibility of the proposed project is robust to reasonable variations of the critical assumptions.

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

B.5. Demonstration of 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 B.4 of this PDD.

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 proposed 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 power generation. Therefore, according to the "Combined tool to identify the baseline scenario and demonstrate additionality" (version 07.0) and the methodological tool "Common Practice" (Version 03.1), the measure of the proposed 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 proposed project is belonged to type (D) measure listed in the latest version of the methodology 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 methodology tool 24, the "common practice (Version 03.1)" 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, 10 swine farms involving 573,653 heads of marketing pigs, 140,428 heads of breeding pigs in stock are included, and are estimated to produce 851,542 tons of manure every year, therefore. the Swine Farm Animal Manure Management System GHG Mitigation projects that can handle manure annually from 425,771 tons to 1,277,313 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, Jiangxi 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 measure of the proposed project belongs to “Methane formation avoidance”

(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 10 swine farms avoid methane emissions generated in the baseline uncovered anaerobic lagoons through new 10 set of AWMSs. The biogas captured for power 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;

There are 105,690.39MWh will be generated and used by the swine farms and handle 851,542 tons of animal manure waste annually. If the similar projects can treat the manure waste 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 Step 1, the output/capacity ranges of similar project are that can handle manure from 425,771 tons to 1,277,313 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 started commercial operation before the start date of proposed project at 01/07/2020, which is earlier date.

Based on above analysis, it can conclude the Swine Farm Animal Manure Management System GHG Mitigation project with delivery electricity operated before 01/07/2020, that can handle manure from 425,771 tons to 1,277,313 tons annually in Jiangxi province is the similar project as the proposed 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 UNFCCC website, China CDM website, China CER exchange info-platform, GS website, VCS, local DRC of Jiangxi province website²⁵ and Department of Agriculture and rural affairs of Jiangxi Province²⁶, there are five CDM projects that were registered as below. However, these CDM projects are not located in Jiangxi Province, therefore $N_{all}=0$ since the Swine Farm Animal Manure Management System GHG Mitigation project with delivery electricity operated before 01/07/2020 that can handle manure from 371,056 tons to 1,113,168 tons annually in Jiangxi province is the similar project.

Project name	Reference number
Methane Recovery and Utilization CDM Project at Muyuan Swine Farm in Henan Province	1301
Animal Manure Management System (AMMS) GHG Mitigation Project, Shandong Minhe Livestock Co. Ltd., Penglai, Shandong Province, P.R. of China	1891
Beijing Deqingyuan Chicken Farm 2.4MW Biogas Power Project	3716
Inner-Mongolian Mengniu Aoya Biogas Power Project (1.36MW)	3488
Rural Eco-energy Project of Henan Hengyou Husbandry Development Co., Ltd	7595

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

²⁵ <http://drc.jiangxi.gov.cn/>

²⁶ <http://nync.jiangxi.gov.cn/>

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 proposed activity is not a common practice in the region.

B.5.1 Prior Consideration

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As per “principles & requirements (version 1.2)”, the Retroactive project is defined as “the Stakeholder Consultation (1st round) is conducted after the Project Start Date”. For this project, the Stakeholder Consultation (1st round) is conducted on 02/08/2021 and the project start date is 01/07/2020, so this project is a Retroactive project. According to clause 4.1.49 of *GS4GG Principles & Requirements (Version 1.2)*, Retroactive projects shall submit the required documents for preliminary review (time of first submission) within one year of the project start date. Retroactive Project submitted at a date later than one year from the project start date will not be eligible for Gold Standard certification.

For this project, the project start date is 01/07/2020, and PP have submitted the required documents for preliminary review on 21/06/2021 which within one year of the project start date. Therefore, the project is eligible for Gold Standard certification.

The project proponent has completed an investment analysis in the *Project Evaluation Report*, which considered the expected carbon revenue. During the online board meeting conducted on 24/03/2020, the project proponent determined to apply for Gold Standard certification of this project. Key events of the project are shown in the following table.

Time	Milestone
18/10/2019	Completion of <i>Project Evaluation Report</i> (Including prior consideration of carbon revenue).
24/03/2020	Online board meeting regarding to the project implementation with Gold Standard.
01/07/2020	Start date of the project (the date on signing the equipment purchase contract).
01/09/2020	Training for the employees
01/10/2020	The project was put into operation
21/06/2021	The date of the first submission for preliminary review to GS
02/08/2021	Local stakeholder consulting physical meeting

B.5.2 Ongoing Financial Need

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According to the results of investment analysis described in section B.4, IRR without carbon revenue of the project is 6.24%, which is lower than 9.5% benchmark of construction project for animal industry. The project can apply for carbon credits under GS project, the IRR can reach to 9.71% with carbon revenue. Therefore, the revenue from Gold Standard certification is material to the ongoing sustainability of the project.

Conclusion of the assessment and demonstration of additionality

To summarize, “the Project is undertaken without being registered as a GS project activity” is not financially attractive to investors, thus it is not feasible. Being registered as a GS project, the VERs revenues can alleviate the identified barriers, therefore the proposed project is additional.

B.6. Sustainable Development Goals (SDG) outcomes

Relevant Target/Indicator for each of the three SDGs

Sustainable Development Goals Targeted	Most relevant SDG Target	SDG Impact
		Indicator (Proposed or SDG Indicator)
13 Climate Action	Target 13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	13.3.2 Number of countries that have communicated the strengthening of institutional, systemic and individual capacity-building to implement adaptation, mitigation and technology transfer, and development actions
	The project activity is designed to introduce new animal waste management systems to a group of 10 swine farms to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. Besides, the project will provide an opportunity for local residents to learn and raise awareness on climate change and mitigation measures on the stakeholder consultation fiscal meeting.	Project Monitoring Indicator: <i>GHG emission reductions</i>
8 Decent Work and Economic Growth	Target 8.5 By 2030, achieve full and productive employment and decent work for all women and	8.5.2 Unemployment rate, by sex, age and persons

	men, including for young people and persons with disabilities, and equal pay for work of equal value	with disabilities	
	The project activity will provide job opportunities for all locals during project implementation and monitoring activities irrespective of gender or any other status. Equal pay for work of equal value will be made to both men and women.	Project Indicator: 1) <i>Number of males and females employed by the project;</i> 2) <i>Average monthly salary.</i>	Monitoring
7 Affordable and Clean Energy	Target 7.2 By 2030, increase substantially the share of renewable energy in the global energy mix. The project activity is designed to introduce new animal waste management systems to treat the manure and wastewater from the 10 swine farms. The biogas generated during the treatment process will be captured for power generation, the electricity generated are all used by the swine farms, which is supplied by the grid company in baseline scenario. The grid company is dominated by thermal power generation.	7.2.1 Renewable energy share in the total final energy consumption Project Indicator: Quantity of electricity generation by capturing biogas (MWh)	Monitoring

B.6.1 Explanation of methodological choices/approaches for estimating the SDG Impact

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SDG contribution and project monitoring indicator	Project monitoring indicator	Baseline outcome	Project outcome
SDG 8 Decent Work and Economic Growth	1) <i>Number of males and females employed by the project.</i>	In baseline situation, no new job created. Therefore, the baseline outcome is 0.	In project situation, the number of jobs created for males and females will be recorded. Source of data is record keeping book and it will be cross checked by the labor contracts. Net benefit of SDG8=Project outcome of SDG8 – Baseline outcome of SDG8
	2) <i>Average monthly</i>	In baseline situation, no new job created.	The average monthly salary will be determined by the record keeping book

	salary.	Therefore, the baseline outcome is 0.	and cross checked by the salary slips. Net benefit of SDG8=Project outcome of SDG8 – Baseline outcome of SDG8
SDG 7 Affordable and Clean Energy	Affordable and Clean Energy	In baseline situation, the electricity consumption of the swine farm is supplied by the grid company, which is dominated by thermal power generation.no clean energy can be generated in baseline situation; Therefore, the baseline outcome is 0.	For ex ante calculation, in project situation, Annual electricity generation by capturing biogas can be estimated through the amount of biogas and the assumed electricity to methane ratio of 1.6 kWh/m ³ of biogas as per Project evaluation report. During the monitoring period, Annual electricity generation can be monitored by the electricity meters. Net benefit of SDG7=Project outcome of SDG7 – Baseline outcome of SDG7
SDG 13 Climate Action	GHG emission reductions	ACM0010" GHG emission reductions from manure management systems (Version 08.0)" provides specific calculation methods for baseline, project and leakage emissions as well as monitoring plan. The GHG emission reductions can be calculated as follows.	

Baseline emissions

The baseline is the AWMSs identified through the baseline selection procedure in Section B.4 of this PDD. As per paragraph 26 of the applied methodology,

Baseline emissions are:

$$BE_y = BE_{CH_4,y} + BE_{N_2O,y} + BE_{elec/heat,y} \quad (\text{Equation 1})$$

where:

BE_y	Baseline emissions in year y (t CO ₂ /yr)
$BE_{CH_4,y}$	Baseline CH ₄ emissions in year y (t CO ₂ /yr)
$BE_{N_2O,y}$	Baseline N ₂ O 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 CH₄ emissions ($BE_{CH_4,y}$)

$$BE_{CH_4,y} = GWP_{CH_4} * D_{CH_4} * \sum_{j,LT} (MCF_j * B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_{BI,j}) \quad (\text{Equation 2})$$

where:

$BE_{CH_4,y}$	Baseline CH ₄ emissions in year y (t CO ₂ /yr)
GWP_{CH_4}	Global Warming Potential (GWP) of CH ₄ (t CO ₂ e/t CH ₄)
D_{CH_4}	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 AWMS _j . IPCC 2006, table 10.17, chapter 10, volume 4.
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT

	(m ³ CH 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% _{0Bl,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% _{0Bl,j} = 100%
LT	Type of livestock
j	Type of treatment system

Estimation of various variables and parameters for above equations:

(A) VS_{LT,y} shall be determined in one of the following ways, presented in the order of preference.

Option 1:

Using published country specific data. If the data is expressed in kilogram volatile solid excretion per day on a dry-matter basis (kg -dm per day), multiply the value with n_{dy} (number of days treatment plant was operational in year y).

Option 2:

Estimation of VS_{LT,y} based on dietary intake of livestock:

$$VS_{LT,y} = \left[GE_{LT} * \left(1 - \frac{DE_{LT}}{100} \right) + (UE * GE_{LT}) \right] * \left[\frac{(1-ASH)}{ED_{LT}} \right] * nd_y \quad (\text{Equation 3})$$

where:

VS _{LT,y}	Annual volatile solid excretions for livestock LT entering all AWMS on a dry matter weight basis (kg -dm/animal/yr)
GE _{LT}	Daily average gross energy intake (MJ/animal/day)
DE _{LT}	Digestible energy of the feed (per cent)
UE	Urinary energy (fraction of GELT)
ASH	Ash content of manure (fraction of the dry matter feed intake)
ED _{LT}	Energy density of the feed fed to livestock type LT (MJ/kg -dm)
nd _y	Number of days treatment plant was operational in year y

Option 3:

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

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}} \right) * VS_{default} * nd_y \quad (\text{Equation 4})$$

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

Option 4:

Utilizing published IPCC defaults for $VS_{LT,y}$ (IPCC 2006 guidelines, volume 4, chapter 10), multiply the value by nd_y (number of days in year y).

Developed countries $VS_{LT,y}$ values may be used provided the following conditions are satisfied:

- (a) The genetic source of the production operations livestock originates from an Appendix I Party;
- (b) The farm use formulated feed rations (FFR) which are optimized for the various animal(s), stage of growth, category, weight gain/productivity and/or genetics;
- (c) The use of FFR can be validated (through on-farm record keeping, feed supplier, etc.); and
- (d) The project specific animal weights are more similar to developed country IPCC default values.

There is no published country specific data available, so we could not use Option 1. The energy intake of the swine is not available, so we could not use Option 2. Option 3 utilizes the average weight of the swine, this data is available and therefore Option 3 is adopted to calculate $VS_{LT,y}$.

(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:

$$N_{LT} = N_{da,LT} * \left(\frac{N_{p,LT}}{365} \right) \quad (\text{Equation 5})$$

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:

$$N_{LT} = \frac{\sum_1^{365} N_{A,LT}}{365} \quad (\text{Equation 6})$$

where:

N_{LT}	Annual average number of animals of type LT for the year y (number)
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$N_{AA,LT}$ 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 proposed project is located in Ganzhou city, Jiangxi 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 $0.29 \text{ m}^3 \text{ CH}_4/\text{kg VS}$.

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

(a)The MCF_j values given in table 10.17, chapter 10, volume 4, IPCC 2006 Guidelines should be used. MCF_j 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 19.8°C^{27} and the value of 77% is applied.

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

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

$$BE_{N2O,y} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (E_{N2O,D,y} + E_{N2O,ID,y}) \quad (\text{Equation 7})$$

where:

$BE_{N2O,y}$	Annual baseline N_2O emissions in (t $\text{CO}_2\text{e}/\text{yr}$)
GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t $\text{CO}_2\text{e}/\text{tN}_2\text{O}$)
$CF_{N2O-N,N}$	Conversion factor $\text{N}_2\text{O-N}$ to N_2O (44/28)
$E_{N2O,D,y}$	Direct N_2O emission in year y (kg $\text{N}_2\text{O-N}/\text{year}$)
$E_{N2O,ID,y}$	Indirect N_2O emission in year y (kg $\text{N}_2\text{O-N}/\text{year}$)

²⁷ <https://baike.baidu.com/item/%E8%B5%A3%E5%B7%9E/142839?fr=aladdin>

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

where:

$E_{N2O,D,y}$	Direct N ₂ O emission in year y (kg N ₂ O-N/yr)
$EF_{N2O,D,j}$	Direct N ₂ O emission factor for the treatment system j of the manure management system (kg N ₂ O-N/kg N). (Estimated with site-specific, regional or national data if such data is available, otherwise use default EF ₃ from table 10.21, chapter 10, volume 4, in the IPCC 2006 Guidelines for National Greenhouse Gas Inventories). The site-specific, regional or national data are not available, so this project activity adopts default EF ₃ .
$NEX_{LT,y}$	Annual average nitrogen excretion per head of a defined livestock population (kg N/animal/yr) estimated as described in Appendix 2
$MS\%_{Bl,j}$	Fraction of manure handled in system j (fraction)
N_{LT}	Annual Average number of animals of type LT for the year y estimated as per equation (5) or (6) (number)

$$E_{N2O,ID,y} = \sum_{j,LT} EF_{N2O,ID} * F_{gasMS,j,LT} * NEX_{LT,y} * N_{LT} * MS\%_{Bl,j} \quad (\text{Equation 9})$$

where:

$E_{N2O,ID,y}$	Indirect N ₂ O emission in year y (kg N ₂ O-N/year)
$EF_{N2O,ID}$	Indirect N ₂ O emission factor for N ₂ O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN ₂ O-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 (5) or (6) (number)

Estimation of various variables and parameters for above equations:

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

Option 1:

$$NEX_{LT,y} = N_{intake} * (1 - N_{retention}) * nd_y \quad (\text{Equation 10})$$

where:

N_{intake}	Daily N intake per animal (kg N/animal/yr)
$N_{retention}$	Portion of that N intake that is retained in the animal (kg N retained/animal/yr)

nd_y Number of days treatment plant was operational in year y

N_{intake} may be calculated using:

$$N_{intake} = \left(\frac{GE}{18.45} \right) * \left(\frac{CP/100}{6.25} \right) \quad (\text{Equation 11})$$

where:

CP	Crude per cent of protein (per cent)
GE	Gross energy intake of the animal (MJ/animal/day-)
18.45	Conversion factor for dietary GE per kg of dry matter (MJ/kg). This value is relatively constant across a wide range of forage and grain-based feeds commonly consumed by livestock
6.25	Conversion from kg of dietary protein to kg of dietary N, kg feed protein (kg N) ⁻¹

Option 2:

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

$$NEX_{LT,y} = \frac{W_{site}}{W_{default}} * NEX_{IPCC\ default} \quad (\text{Equation 12})$$

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)

$$NEX_{IPCC\ default} = N_{rate(T)} * \frac{TAM}{1000} * 365^{28} \quad (\text{Equation 13})$$

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

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}.

iii) Baseline CO₂ emission from electricity and/or heat used in the baseline

$$BE_{elec/heat,y} = BE_{EC,y} + BE_{HG,y} \quad (\text{Equation 14})$$

where:

²⁸ This formula refers to the formula 10.30 in chapter 10 volume IPCC2006.

$BE_{elec/heat,y}$	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 will be captured for power generation and all the electricity generated from this project will be used by the 10 swine farms. The electricity generated will not be connected to another user or to the regional power grid. So, the baseline CO₂ emission from electricity and/or heat used in the baseline is 0, which is conservative.

Project Emissions

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

Project emissions are estimated as follows:

$$PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y} + PE_{EC/FC,y} \quad (\text{Equation 15})$$

where:

PE_y	Project emissions in year y
$PE_{AD,y}$	Project emissions associated with the anaerobic digester in year y (t CO ₂ e/yr)
$PE_{Aer,y}$	Project CH ₄ emissions from aerobic AWMS treatment (t CO ₂ e/yr)
$PE_{N2O,y}$	Project N ₂ O emissions in year y (t CO ₂ /yr)
$PE_{EC/FC,y}$	Project emissions from electricity consumption and fossil fuel combustion (t CO ₂ e/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 "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:

$$PE_{AD,y} = PE_{EC,y} + PE_{FC,y} + PE_{CH4,y} + PE_{flare,y} \quad (\text{Equation 16})$$

where:

$PE_{AD,y}$	Project emissions associated with the anaerobic digester in year y (t CO ₂ e)
$PE_{EC,y}$	Project emissions from electricity consumption associated with the anaerobic digester in year y (t CO ₂ e)
$PE_{FC,y}$	Project emissions from fossil fuel consumption associated with the anaerobic digester in year y (t CO ₂ e)
$PE_{CH4,y}$	Project emissions of methane from the anaerobic digester in year y (t CO ₂ e)

$PE_{flare,y}$ Project emissions from flaring of biogas in year y (t CO₂e)

The biogas generated during the treatment process in this project will be captured for power generation and all the electricity generated from this project will be used by the 10 swine farms. The electricity generated will not be connected to another user or to the regional power grid. As 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 Tool 05 "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation (Version 03.0)",

$$PE_{EC,y} = \sum_{j,LT} EC_{PJ,j,y} * EF_{EF,j,y} * (1 + TDL_{j,y}) \quad (\text{Equation 17})$$

Where

$PE_{EC,y}$ Project emissions from electricity consumption in year y (t CO₂e)
 $EC_{PJ,j,y}$ 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 CO₂/MWh)
 $TDL_{j,y}$ Average technical transmission and distribution losses for providing electricity to source j in year y

As the electricity generated by this project will be used firstly for the operation of AWMS, and then surplus electricity will be supplied to the swine farms, if the generator set is in a shutdown state or the electricity is insufficient for the operation of AWMSs, the electricity consumed by the project will provided from the regional power grid. So, in the ex-calculation, it can be assumed that all the electricity consumed of the project activities comes from the electricity generated by the biogas generated during the anaerobic fermentation process of the project, which is belongs to self-generated and self-consumed. So, the Quantity of electricity consumed by the project electricity is 0, i.e., $PE_{EC,y} = 0$.

During the monitoring period, the project emissions from electricity consumption will be calculated as Tool 05 in the case of the electricity consumed from the regional power grid. And the electricity consumption sourced from the grid company will be determined through the electricity meters measurement and cross-check with the grid statement.

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 will be flared by flaring and the project emissions from flaring of biogas ($PE_{\text{flare},y}$) shall be estimated using the tool 06 "Project emissions from flaring"(version 03.0).

The calculation procedure in this tool determines the project emissions from flaring the residual gas ($PE_{\text{flare},y}$) based on the flare efficiency ($\eta_{\text{flare},m}$) and the mass flow of methane to the flare ($F_{\text{CH}_4,\text{RG},m}$). 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 $F_{\text{CH}_4,m}$:

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 .

$F_{\text{CH}_4,m}$, 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 ($F_{\text{CH}_4,\text{RG},m}$). $F_{\text{CH}_4,m}$ 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 (T_t) is less than 60°C (333.15 K) at the flow measurement point. For this project, the flowmeters installed in the outlet of the anaerobic tanks and the temperature of the anaerobic treatment unit of this project is designed as medium temperature, and the optimal temperature range is $35 \sim 38^\circ\text{C}$. Therefore, the gas temperature measured by the flowmeter does not exceed 60°C , it can be demonstrated that the gaseous stream is dry.

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

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad (\text{Equation 18})$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad (\text{Equation 19})$$

where:

$F_{i,t}$	Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (m^3 dry gas/h)
$v_{i,t,db}$	Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m^3 gas i / m^3 dry gas)
$\rho_{i,t}$	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i / m^3 gas i)
P_t	Absolute pressure of the gaseous stream in time interval t (Pa)
MM_i	Molecular mass of greenhouse gas i (kg/kmol)
R_u	Universal ideal gases constant ($\text{Pa} \cdot \text{m}^3 / \text{kmol} \cdot \text{K}$)
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 ($\eta_{\text{flare},m}$) is 50% when the flame is detected in the minute m (Flame_m), otherwise $\eta_{\text{flare},m}$ 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 ($F_{\text{CH}_4,\text{RG},m}$) and the flare efficiency ($\eta_{\text{flare},m}$), as follows:

$$PE_{\text{flare},y} = GWP_{\text{CH}_4,y} * \sum_{m=1}^{525600} F_{\text{CH}_4,\text{GR},m} * (1 - \eta_{\text{flare},m}) * 10^{-3} \quad (\text{Equation 20})$$

Where:

$PE_{\text{flare},y}$	Project emissions from flaring of the residual gas in year y (tCO_2e)
GWP_{CH_4}	Global warming potential of methane valid for the commitment period ($\text{tCO}_2\text{e}/\text{tCH}_4$)
$F_{\text{CH}_4,\text{RG},m}$	Mass flow of methane in the residual gas in the minute m (kg)

$\eta_{flare,m}$ Flare efficiency in minute m

As described above, $F_{CH_4, RG, m}$ will be determined according to equation 18 and 19, so the Project emissions from flaring can be calculated by:

$$PE_{flare,y} = GWP_{CH_4,y} * V_{t,db} * v_{i,t,db} * \rho_{i,t} * (1 - \eta_{flare,m}) * 10^{-3} \quad (\text{Equation 21})$$

Where:

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

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

According to Project evaluation report, nearly all the biogas generated in the AWMS will be collected for power generation, only a small fraction of biogas will be flared in pre-calculation. In the monitoring period, the project emissions from flaring of biogas will be calculated according to the actual situation.

Determination of project emissions of methane from the anaerobic digester ($PE_{CH_4,y}$)

$PE_{CH_4,y}$ 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 ($EF_{CH_4, default}$), as follows:

$$PE_{CH_4,y} = Q_{CH_4,y} * EF_{CH_4, default} * GWP_{CH_4} \quad (\text{Equation 22})$$

where:

- $PE_{CH_4, y}$ Project emissions of methane from the anaerobic digester in year y (t CO_2e)
- $Q_{CH_4,y}$ Quantity of methane produced in the anaerobic digester in year y (t CH_4)
- $EF_{CH_4, default}$ Default emission factor for the fraction of CH_4 produced that leaks from the anaerobic digester (fraction)
- GWP_{CH_4} 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 $Q_{CH_4,y}$

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 ($Q_{CH_4,y}$). For large scale projects only Option 1 shall be used. For small scale projects, project participants may choose between Option 1 or Option 2. The proposed project belongs to large scale projects, so $Q_{CH_4,y}$ was determined following step 1 and Option 1 of the applied tool. Below is the formula used for the calculation of $Q_{CH_4,y}$.

Option1: Procedure using monitored data

$Q_{CH_4,y}$ shall be measured using the "Tool to determine the mass flow of a greenhouse gas in a gaseous stream(version03.0)". 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 ($Q_{CH_4,y}$) is the accumulation of the mass flow of methane in the gaseous stream in an hourly basis time interval. i.e., $Q_{CH_4,y} = \sum_{i=1}^{8760} F_{i,t}$.

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

$$F_{i,t} = V_{t,db} * v_{i,t,db} * \rho_{i,t} \quad (\text{Equation 23})$$

$$\rho_{i,t} = \frac{P_t * MM_i}{R_u * T_t} \quad (\text{Equation 24})$$

where:

$F_{i,t}$	Mass flow of greenhouse gas i in the gaseous stream in time interval t (kg gas/h)
$V_{t,db}$	Volumetric flow of the gaseous stream in time interval t on a dry basis (m ³ dry gas/h)
$v_{i,t,db}$	Volumetric fraction of greenhouse gas i in the gaseous stream in a time interval t on a dry basis (m ³ gas i /m ³ dry gas)
$\rho_{i,t}$	Density of greenhouse gas i in the gaseous stream in time interval t (kg gas i /m ³ gas i)
P_t	Absolute pressure of the gaseous stream in time interval t (Pa)
MM_i	Molecular mass of greenhouse gas i (kg/kmol)
R_u	Universal ideal gases constant (Pa.m ³ /kmol.K)
T_t	Temperature of the gaseous stream in time interval t (K)

In summary, the Project emissions associated with the anaerobic digester in year y (t CO₂e) is the sum of Project emissions from electricity consumption, project emissions from flaring of biogas (if any), and Project emissions of methane from the anaerobic digester in year y (t CO₂e). i.e., $PE_{AD,y} = PE_{EC,y} + PE_{flare,y} + PE_{CH_4,y}$.

ii) Project CH₄ 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.

$$PE_{Aer, y} = GWP_{CH_4} * D_{CH_4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^N (1 - R_{VS, n}) \right] * \sum_{j, LT} (B_{0, LT} * N_{LT} * VS_{LT, y} * MS\%_j) + PE_{sl, y}$$

(Equation 25)

where:

GWP_{CH_4}	Global Warming Potential (GWP) of CH ₄ (t CO ₂ e/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_{CH_4}	Density of CH ₄ (t/m ³)
F_{Aer}	Fraction of volatile solid directed to aerobic system (fraction)
LT	Type of livestock
$B_{0, LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m ³ CH 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 (5) or (6)
$PE_{sl, y}$	Project CH ₄ emissions from sludge disposed of in storage pit prior to disposal during the year y (t CO ₂ e/yr)
$MS\%_j$	Fraction of manure handled in system j in the project activity (fraction)

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

$$\text{So, } PE_{Aer, y} = GWP_{CH_4} * D_{CH_4} * 0.001 * F_{Aer} * \left[\prod_{n=1}^N (1 - R_{VS, n}) \right] * \sum_{j, LT} (B_{0, LT} * N_{LT} * VS_{LT, y} * MS\%_j)$$

(Equation 26)

where:

GWP_{CH_4}	Global Warming Potential (GWP) of CH ₄ (t CO ₂ e/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_{CH_4}	Density of CH ₄ (t/m ³)
F_{Aer}	Fraction of volatile solid directed to aerobic system (fraction)
LT	Type of livestock
$B_{0, LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m ³ CH 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 (5) or (6)

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

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

$$PE_{N_2O,y} = GWP_{N_2O} * CF_{N_2O-N,N} * \frac{1}{1000} * (E_{N_2O,D,y} + E_{N_2O,ID,y}) \quad (\text{Equation 27})$$

where:

PE_{N₂O,y} Project N₂O emissions in year y (t CO₂/yr)
 GWP_{N₂O} Global Warming Potential (GWP) for N₂O (t CO₂e/tN₂O)
 CF_{N₂O-N,N} Conversion factor N₂O-N to N₂O (44/28)
 E_{N₂O,D,y} Direct N₂O emission in year y (kg N₂O-N/year)
 E_{N₂O,ID,y} Indirect N₂O emission in year y (kg N₂O-N/year)

Option1:

$$E_{N_2O,D,y} = \sum_{j,LT} EF_{N_2O,D,j} * NEX_{LT,y} * N_{LT} * MS\%_j \quad (\text{Equation 28})$$

where:

E_{N₂O,D,y} Direct N₂O emission in year y (kg N₂O-N/yr)
 EF_{N₂O,D,j} Direct N₂O emission factor for the treatment system j of the manure management system (kg N₂O-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 (5(a)) or (5(b)) (number)

$$E_{N_2O,ID,y} = \sum_{j,LT} EF_{N_2O,ID} * F_{gasMS,j,LT} * NEX_{LT,y} * N_{LT} * MS\%_j \quad (\text{Equation 29})$$

where:

E_{N₂O,ID,y} Indirect N₂O emission in year y (kg N₂O-N/year)
 EF_{N₂O,ID} Indirect N₂O emission factor for N₂O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kgN₂O-N/kg NH₃-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 NH₃ and NO_x from manure management (fraction)
 N_{LT} Annual Average number of animals of type LT for the year y estimated as per equation (5) or (6) (number)

Option2:

$$E_{N_2O,D,y} = \sum_j EF_{N_2O,D,j} * \sum_{m=1}^{12} (Q_{EM,m} * [N]_{EM,m}) \quad (\text{Equation 30})$$

$$E_{N_2O,ID,y} = EF_{N_2O,ID} * \sum_{j,LT} F_{gasMS,j,LT} * \sum_{m=1}^{12} (Q_{EM,m} * [N]_{EM,m}) \quad (\text{Equation 31})$$

where:

$E_{N_2O,D,y}$	Direct N_2O emission in year y (kg N_2O -N/yr)
$E_{N_2O,ID,y}$	Indirect N_2O emission in year y (kg N_2O -N/year)
$EF_{N_2O,D,j}$	Direct N_2O emission factor for the treatment system j of the manure management system (kg N_2O -N/kg N)
$Q_{EM,m}$	Monthly volume of the effluent mix entering the manure management system (m ³ /month)
$[N]_{EM,m}$	Monthly total nitrogen concentration in the effluent mix entering the manure management system (kg N/m ³)
$EF_{N_2O,ID}$	Indirect N_2O emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces (kg N_2O -N/kg NH_3 -N and NO_x -N)
$F_{gasMS,j,LT}$	Default values for nitrogen loss due to volatilisation of NH_3 and NO_x from manure management (fraction)

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 to calculate the Project N_2O emissions $PE_{N_2O,y}$.

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

$$PE_{EC/FC,y} = PE_{EC,y} + \sum_j PE_{FC,j,y} \quad (\text{Equation 32})$$

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 $EC_{PI,y} = \sum_i CP_{i,y} * 8760$, where $CP_{i,y}$ is the rated capacity (in MW) of electrical equipment i used for the project activity.
$PE_{FC,y}$	Project emissions from fossil fuel combustion in process j during the year y . The project emissions from fossil fuel combustion will be calculated following the latest version of the "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion". For this purpose, the processes j in the tool corresponds to all fossil fuel combustion in the AWMS (not including fossil fuels consumed for transportation of feed material and sludge or any other on-site transportation).

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

The same for the $PE_{EC,y}$, please refer to $PE_{EC,y}$ calculation.

Therefore, $PE_{elec/heat}=0$

Leakage

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

$$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y}) + LE_{AD,y} \quad (\text{Equation 33})$$

Where:

$LE_{PJ, N2O, y}$	Leakage N_2O emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)
$LE_{BL, N2O, y}$	Leakage N_2O emissions released during baseline scenario from land application of the treated manure in year y (t CO_2e/yr)
$LE_{PJ, CH4, y}$	Leakage CH_4 emissions released during project activity from land application of the treated manure in year y (t CO_2e/yr)
$LE_{BL, CH4, y}$	Leakage CH_4 emissions released during baseline scenario from land application of the treated manure in year y (t CO_2e/yr)
$LE_{AD, y}$	Leakage emissions associated with the anaerobic digester in year y (t CO_2e)

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

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

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

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

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

where:

GWP_{N2O}	Global Warming Potential (GWP) for N_2O (t CO_2e/tN_2O)
$CF_{N2O-N,N}$	Conversion factor N_2O-N to N_2O (44/28)
$LE_{N2O,land,y}$	Leakage N_2O emissions from application of manure waste in year y (kg $N_2O-N/year$)
$LE_{N2O,runoff,y}$	Leakage N_2O emissions due to leaching and run-off in year y (kg $N_2O-N/year$)
$LE_{N2O,vol,y}$	Leakage N_2O emissions due to 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 (5(a)) or (5(b)) (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 ₂ O/ (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 N₂O emissions released during project activity from land application of the treated manure in year y, LE_{PJ, N2O}

$$LE_{PJ,N2O} = GWP_{N2O} * CF_{N2O-N,N} * \frac{1}{1000} * (LE_{N2O,land,y} + LE_{N2O,runoff,y} + LE_{N2O,vol,y}) \quad (\text{Equation 38})$$

$$LE_{N2O,land,y} = EF_1 * \prod_{n=1}^N (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (\text{Equation 39})$$

$$LE_{N2O,runoff,y} = EF_5 * F_{leach} * \prod_{n=1}^N (1 - R_{N,n}) * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (\text{Equation 40})$$

$$LE_{N2O,vol,y} = EF_4 * \prod_{n=1}^N (1 - R_{N,n}) * F_{gasm} * \sum_{LT} NEX_{LT,y} * N_{LT} \quad (\text{Equation 41})$$

where:

GWP _{N2O}	Global Warming Potential (GWP) for N ₂ O (t CO ₂ e/tN ₂ O)
CF _{N2O-N,N}	Conversion factor N ₂ O-N to N ₂ O (44/28)
LE _{N2O,land,y}	Leakage N ₂ O emissions from application of manure waste in year y (kg N ₂ O-N/year)
LE _{N2O,runoff,y}	Leakage N ₂ O emissions due to leaching and run-off in year y (kg N ₂ O-N/year)
LE _{N2O,vol,y}	Leakage N ₂ O emissions due to volatilisation in year y (kg N ₂ O-N/year)
F _{gasm}	Fraction of N lost due to volatilization (fraction)
N _{LT}	Annual average number of animals of type LT estimated as per equation (5(a)) or (5(b)) (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 ₂ O emissions from N inputs (kg N ₂ O-N/kg N input)
EF ₅	Emission factor for N ₂ O emissions from N leaching and runoff in (kg N ₂ O-N/kg N leached and runoff)
EF ₄	Emission factor for N ₂ O emissions from atmospheric deposition of N on soils and water surfaces, [kg N- N ₂ O/ (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)

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

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

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

$$LE_{BL,CH_4,y} = GWP_{CH_4} * D_{CH_4} * MCF_d * \left[\prod_{n=1}^N (1 - R_{VS,n}) \right] * \sum_{j,LT} (B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad (\text{Equation 42})$$

$$LE_{PJ,CH_4,y} = GWP_{CH_4} * D_{CH_4} * MCF_d * \left[\prod_{n=1}^N (1 - R_{VS,n}) \right] * \sum_{j,LT} (B_{0,LT} * N_{LT} * VS_{LT,y} * MS\%_j) \quad (\text{Equation 43})$$

where:

$LE_{BL,CH_4,y}$	Leakage CH ₄ emissions released during baseline scenario from land application of the treated manure in year y (t CO ₂ e/yr)
$LE_{PJ,CH_4,y}$	Leakage CH ₄ emissions released during project activity from land application of the treated manure in year y (t CO ₂ e/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_{CH_4}	Global Warming Potential (GWP) of CH ₄ (t CO ₂ e/tCH ₄)
D_{CH_4}	Density of CH ₄ (t/m ³)
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated by animal type LT (m ³ CH 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_d) assumed to be equal to 1

iv) Estimation of leakage emissions associated with the anaerobic digester

$LE_{AD,y}$ is determined using the methodological tool "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:

$$LE_{AD,y} = LE_{storage,y} + LE_{comp,y} \quad (\text{Equation 44})$$

where:

$LE_{AD,y}$	Leakage emissions associated with the anaerobic digester in year y (t CO ₂ e)
$LE_{storage,y}$	Leakage emissions associated with storage of digestate in year y (t CO ₂ e)
$LE_{comp,y}$	Leakage emissions associated with composting digestate in year y (t CO ₂ e)

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 TN).

The anaerobic digestion process of this project is carried out in a fully enclosed system, the flaring will be not taken into account as the equipment will only be used when there will be surplus biogas, normally there will be no surplus biogas during the operational period of the project. After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer. Wastewater from the new animal waste management systems will be treated aerobically and then used for agriculture irrigation. so, the Estimation of leakage emissions associated with the anaerobic digester is 0. i.e., $LE_{AD,y} = 0$.

Emission reduction

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:

$$ER_y = BE_y - PE_y - LE_y \quad (\text{Equation 45})$$

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 ($Q_{CH_4,y}$ 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 ($BE_{CH_4,y} - PE_{AD,y}$ in the tool "Project and leakage emissions from anaerobic digesters") and if found lower, then ($BE_{CH_4,y} - PE_{AD,y}$) (which is a component of $BE_y - PE_y$) in Equation (44) is replaced by $Q_{CH_4,y}$.

B.6.2 Data and parameters fixed ex ante

SDG13

Data/parameter	GWP_{CH_4}
Unit	tCO_2e/tCH_4
Description	Global Warming Potential of CH_4
Source of data	IPCC Fifth Assessment Report
Value(s) applied	28

Choice of data or Measurement methods and procedures	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014 ²⁹
Purpose of data	Used in project emission/baseline calculations
Additional comment	N/A

Data/parameter	GWP _{N2O}
Unit	tCO ₂ e/tN ₂ O
Description	Global Warming Potential of N2O
Source of data	IPCC Fifth Assessment Report
Value(s) applied	265
Choice of data or Measurement methods and procedures	100-year values are adopted from Box 3.2, table 1, IPCC Fifth Assessment Report, 2014 ³⁰
Purpose of data	Used in project emission/baseline calculations
Additional comment	N/A

Data/parameter	D _{CH4}
Unit	t/m ³
Description	Density of CH ₄
Source of data	ACM0010 Version 08.0
Value(s) applied	0.00067
Choice of data or Measurement methods and procedures	0.00067 t/m ³ at room temperature 20°C and 1 atm pressure.
Purpose of data	Used in project emission/baseline calculations
Additional comment	N/A

²⁹ https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

³⁰ https://www.ipcc.ch/site/assets/uploads/2018/02/SYR_AR5_FINAL_full.pdf

Data/parameter	MCF _j
Unit	-
Description	Methane conversion factor for the baseline AWMS _j
Source of data	IPCC 2006 table 10.17, chapter 10, volume 4
Value(s) applied	72.38%
Choice of data or Measurement methods and procedures	MCF_j value for uncovered anaerobic lagoon (baseline AWMS) is chosen. A conservativeness factor has been applied by multiplying MCF_j value (i.e., 77%) with a value of 0.94, to account for the 20 per cent uncertainty in the MCF_j values as reported by IPCC 2006. For this project, the annual average temperature is 19.8°C and the value of 77 % is applied. Therefore, MCF_j value of 72.38% will be applied.
Purpose of data	project/baseline emission calculations
Additional comment	N/A

Data/parameter	MS% _{BI,j}
Unit	Fraction
Description	Fraction of manure handled in system j in the baseline.
Source of data	Project proponents
Value(s) applied	100%
Choice of data or Measurement methods and procedures	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
Additional comment	N/A

Data/parameter	W _{default}
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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(s) applied	$W_{\text{default}}(\text{Market swine})=28\text{kg}$ $W_{\text{default}}(\text{Breeding swine})=28\text{kg}$
Choice of data or Measurement methods and procedures	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
Additional comment	N/A

Data/parameter	VS_{default}
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(s) applied	$VS_{\text{default}}(\text{Market swine})=0.3$ $VS_{\text{default}}(\text{Breeding swine})=0.3$
Choice of data or Measurement methods and procedures	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
Additional comment	N/A

Data/parameter	$NEX_{\text{IPCC default}}$
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(s) applied	$NEX_{IPCC\ default} (Market\ swine) = 4.29$ $NEX_{IPCC\ default} (Breeding\ swine) = 2.45$
Choice of data or Measurement methods and procedures	$NEX_{IPCC\ default}$ is calculated as equation 10.30 in IPCC2006, $N_{rate(T)}$ and TAM are default value from IPCC 2006
Purpose of data	Baseline, Project and leakage emissions calculations
Additional comment	N/A

Data/parameter	$N_{rate(T)}$
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(s) applied	$N_{rate(T)} (Market\ swine) = 0.42$ $N_{rate(T)} (Breeding\ swine) = 0.24$
Choice of data or Measurement methods and procedures	Default value from IPCC 2006 is applied.
Purpose of data	$NEX_{IPCC\ default}$ calculations
Additional comment	N/A

Data/parameter	TAM
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(s) applied	TAM (Market swine) =28 TAM (Breeding swine) =28
Choice of data or Measurement methods and procedures	Default value from IPCC 2006 is applied.

procedures	
Purpose of data	NEX _{IPCC default} calculations
Additional comment	N/A

Data/parameter	$F_{\text{gas MS},j,LT}$
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(s) applied	$F_{\text{gas MS},j,LT}$, (anaerobic lagoon) : 40% $F_{\text{gas MS},j,LT}$, (solid storage) : 45%
Choice of data or Measurement methods and procedures	Site specific data is unavailable therefore default values are opted for.
Purpose of data	Used in project/baseline emission calculations
Additional comment	N/A

Data/parameter	$EF_{\text{N}_2\text{O},D,j}$
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(s) applied	$EF_{\text{N}_2\text{O},D}=0$ for anaerobic lagoon and digester, $EF_{\text{N}_2\text{O},D}=0.01$ for aerobic lagoon
Choice of data or Measurement methods and procedures	Site specific data is unavailable therefore default values are opted for.
Purpose of data	Used in project/baseline emission calculations
Additional comment	N/A

Data/parameter	EF _{N2O,ID}
Unit	kgN ₂ O-N/kg NH ₃ -N and NO _x -N
Description	Indirect N ₂ O 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(s) applied	0.01
Choice of data or Measurement methods and procedures	Site specific data is unavailable therefore default values are opted for.
Purpose of data	Used in project/baseline emission calculations
Additional comment	N/A

Data/parameter	EF _{CH4,default}
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(s) applied	0.05
Choice of data or Measurement methods and procedures	UASB (Upflow Anaerobic Sludge Blanket) type digesters ³¹ , floating gas holders with no external water seal
Purpose of data	Calculation of project emissions
Additional comment	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 B.7 of PDD.

Data/parameter	R _{VS,n}
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³¹ As per tool 14: "project and leakage emission from anaerobic digesters (version 02.0)", the value this parameter should be determined according to the type of digester used in the project activity and the digester type shall be identified by manufacturer information. For this project, as per the 5purchasing contract of Anaerobic digester, the type of digester used in the project activity belongs to UASB type digester, so the Default emission factor for the fraction of CH₄ produced that leaks from the anaerobic digester (fraction) is 0.05 t CH₄ leaked / t CH₄ produced.

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 and Project evaluation report		
Value(s) applied	R _{VS,n} , aerobic treatment anaerobic digester ³² : 2%,45% and 35% for leakage N ₂ O emission released during project activity		
	R _{VS,n} , one cell lagoon ³³ :85% for leakage N ₂ O emission released during baseline scenario		
	R _{VS,n}	ACM0010	Project evluation
	Project Activity (aerobic treatment-anaerobic digester)	80% (cover first cell of two lagoon)	2%, 45% and 35%
	baseline	85%(one cell lagoon)	/
Choice of data or Measurement methods and procedures	For this project, values from Table provided in Appendix 1 of ACM0010 and Project evaluation report are compared in order to adopt the most conservative value for the given technology.		
Purpose of data	project emission/ leakage calculation		
Additional comment	N/A		

Data/parameter	$R_{N,n}$
Unit	Fraction
Description	Nitrogen reduction factor
Source of data	Refer to Appendix 1 of methodology ACM0010
Value(s) applied	$R_{N,n}$, project activity(anaerobic digester) : 0.25³⁴ $R_{N,n}$, baseline (uncovered anaerobic lagoon) : 0.80³⁵

³² For proposed project, Before the treated manure is applied to the land, it undergoes three stages of homogenization pretreatment, anaerobic fermentation, and aerobic composting. The corresponding R_{VS} of each stage is 2%, 45%, and 35%, respectively. In addition, the leakage calculated based on this value is more conservative than the 80% of the cover first cell of two lagoon in Annex 1 of the methodology.

³³ For proposed 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.

³⁴The treatment process of this project is an anaerobic-aerobic combined treatment technology. The anaerobic process is carried out in a closed anaerobic fermentation tank, so the treatment process of this project is similar to the covered first cell of two cell lagoon in the applied methodology appendix 1. so, the $R_{N,n}$ is 25% which is the most conservative value.

³⁵For proposed 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.

Choice of data or Measurement methods and procedures	Anaerobic digester has been assumed as a covered first cell of two cell lagoon. Uncovered anaerobic lagoon has been assumed as one cell lagoon. The most conservative value for the given technology has been used.
Purpose of data	Calculation of leakage emission
Additional comment	N/A

Data/parameter	EF ₁ , EF ₄ , EF ₅
Unit	kg N ₂ O-N/kg N for EF ₁ , EF ₅ and [kg N ₂ O-N/(kg NH ₃ -N and NO _x -N) for EF ₄
Description	Emission factor for N ₂ O 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(s) applied	EF ₁ = 0.010 EF ₄ =0.010 EF ₅ = 0.0075
Choice of data or Measurement methods and procedures	Site specific data is unavailable therefore default values are opted for.
Purpose of data	Calculation of leakage emission
Additional comment	N/A

Data/parameter	F _{gas} m
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(s) applied	0.2
Choice of data or Measurement methods and procedures	Site specific data is unavailable therefore default values are opted for.
Purpose of data	Used in project/baseline emission calculations

Additional comment	N/A
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Data/parameter	F_{leach}
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(s) applied	0.3
Choice of data or Measurement methods and procedures	Site specific data is unavailable therefore default values are opted for.
Purpose of data	Calculation of leakage emission
Additional comment	N/A

Data/parameter	MCF_d
Unit	-
Description	Methane conversion factor for leakage calculation
Source of data	Methodology ACM0010(version 08.0)
Value(s) applied	1
Choice of data or Measurement methods and procedures	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
Additional comment	N/A

Data/parameter	$EF_{EF,j,y}$
Unit	tCO ₂ /MWh

Description	Emission factor for electricity generation
Source of data	Published by Ministry of Ecology and Environment of the People's Republic of China, which is the DNA of China ³⁶ .
Value(s) applied	0.57205 ³⁷
Choice of data or Measurement methods and procedures	According to tool "Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Purpose of data	Calculation of project emission
Additional comment	N/A

Data/parameter	R_u
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(s) applied	8,314
Choice of data or Measurement methods and procedures	Value is fixed as Tool 08
Purpose of data	Calculation of project emission
Additional comment	/

Data/parameter	MM_i
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(s) applied	16.04 kg/mol for methane
Choice of data or	Value is fixed as Tool 08

³⁶ <https://cdm.unfccc.int/DNA/bak/index.html>

³⁷ https://www.mee.gov.cn/ywgz/xdqhbh/wsqtzkz/202012/t20201229_815386.shtml

Measurement methods and procedures	
Purpose of data	Calculation of project emission
Additional comment	/

Data/parameter	$\eta_{\text{flare},m}$
Unit	%
Description	Flare efficiency in minute m
Source of data	Tool 06" Project emissions from flaring (Version 03.0)"
Value(s) applied	0%
Choice of data or Measurement methods and procedures	0% is the conservative value.
Purpose of data	Calculation of project emission
Additional comment	/

B.6.3 Ex ante estimation of SDG Impact

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SDG7

Quantity of Electricity generation by the project can be estimated through the amount of biogas and the assumed electricity to methane ratio of 1.6 kWh/m³ of biogas which sourced from project evaluation report. For ex ante estimation, electricity generation of 105,690.39 MWh can be generated by the project annually.

SDG 8

Number of males and females employed by the project will be reported for each monitoring period based on keeping book and be cross checked by the labor contracts and training records of employees. For ex ante estimation, 20 jobs are created including 10 males and 10 females.

For ex ante estimation, average monthly salary is 5,000 RMB/person with equal salaries for men and women in the same post. The actual average monthly salary will be determined by the record keeping book and cross checked by the salary slips.

SDG 13

The project activity is designed to introduce new animal waste management systems to a group of 10 swine farms to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. The annual emission reductions of the project for ex-ante emission are 498,011tCO₂e.

B.6.4 Summary of ex ante estimates of each SDG Impact

As described in B.6.1 of the PDD, emission reductions of the project are as below:

Calculation of the baseline emission:

$$BE_y = BE_{CH_4,y} + BE_{N_2O,y}$$

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
GWP_{CH_4}	28	28	tCO ₂ /tCH ₄
D_{CH_4}	0.00067	0.00067	t/m ³
MCF_j	77%	77%	%
Conservative Factor	0.94	0.94	/
MCF_j with cons. Factor	0.7238	0.7238	/
$B_{o,LT}$	0.29	0.29	m ³ CH ₄ /kg_dm
N_{LT}	573,653	140,428	No of heads
W_{site}	79.98	57.60	kg
$W_{default}$	28	28	kg
$VS_{default}$	0.3	0.3	Kg-dm/animal/day
$VS_{LT,y}$	312.78	225.26	kg-dm/animal/yr
$MS\%_{BI,j}$	100%	100%	%
nd_y	365	365	days
Sub total	706,539	124,561	tCO ₂ e
BE_{CH₄}	831,100		tCO ₂ e

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
$EF_{N_2O,D,j}$	0	0	kg N ₂ O-N/kg N
$EF_{N_2O,ID}$	0.01	0.01	kg N ₂ O-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}	79.98	57.60	kg
TAM	28.00	28.00	kg
$W_{default}$	28	28	kg
$NEX_{LT,y}$	12.26	5.05	kg N/animal/yr

N_{LT}	573,653	140,428	No of heads
$MS\%_{0Bl,j}$	100%	100%	/
$F_{gasMS,j,LT}$	40%	40%	/
GWP_{N2O}	265	265	tCO ₂ /tN ₂ O
$CF_{N2O,N-N}$	1.57	1.57	Conversion Factor N ₂ O-N to N ₂ O
$BE_{N2O,y}$	12,896		tCO ₂ e

Baseline Emissions: $BE_{CH_4,y} + BE_{N2O,y} = 831,100 \text{ tCO}_2\text{e} + 12,896 \text{ tCO}_2\text{e} = 843,996 \text{ tCO}_2\text{e}$

Calculation of the project emission

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

Parameter	Value	Unit
$EC_{PJ,j,y}$	0	MWh/yr
$EF_{EF,j,y}$	0.57205	tCO ₂ /MWh
$TDL_{j,y}$	20%	/
$PE_{EC,y}$	0	tCO ₂ e

Parameter	Value	Unit
GWP_{CH_4}	28	tCO ₂ /tCH ₄
$EF_{CH_4,default}$	0.05	/
$Q_{CH_4,y}$	34,702.18	t CH ₄
$PE_{CH_4,y}$	48,583	tCO ₂ e

Parameter	Value	Unit
GWP_{CH_4}	28	tCO ₂ /tCH ₄
$\eta_{flare,m}$	0	/
$Q_{CH_4,y}$	627.42	t CH ₄
$PE_{flare,y}$	17,568	tCO ₂ e

$$PE_{AD,y} = PE_{EC,y} + PE_{CH_4,y} + PE_{flare,y} = 0 \text{ tCO}_2\text{e} + 48,583 \text{ tCO}_2\text{e} + 17,568 \text{ tCO}_2\text{e} = 66,151 \text{ tCO}_2\text{e}$$

Parameter	Value		Unit
	Market Swine	Breeding Swine	
GWP_{CH_4}	28	28	tCO ₂ /tCH ₄
D_{CH_4}	0.00067	0.00067	t/m ³
	0.001	0.001	/
F_{Aer}	54%	54%	/
$1-R_{VS,1}$	54%	54%	/
$B_{0,LT}$	0.29	0.29	m ³ CH ₄ /kg VS

N_{LT}	573,653	140,428	No of heads
$VS_{LT,y}$	312.78	225.26	kg-dm/animal/yr
$MS\%_j$	100%	100%	/
Sub total	284	50	tCO ₂ e
PE_{Aer,y}	334		tCO ₂ e

Parameter	Value		Unit
	Market Swine	Breeding Swine	
$EF_{N2O,D,j}$	0	0	kg N ₂ O-N/kg N
$NEX_{LT,y}$	12.26	5.05	kg N/animal/yr
N_{LT}	573,653	140,428	No of heads
$MS\%_j$	46%	46%	/
Sub total	0.00	0.00	kg N ₂ O-N/year
E_{N2O,D,y}	0		kg N ₂ O-N/year

Parameter	Value		Unit
	Market Swine	Breeding Swine	
$EF_{N2O,D,j}$	0.006	0.006	kg N ₂ O-N/kg N
$NEX_{LT,y}$	12.26	5.05	kg N/animal/yr
N_{LT}	573,654	140,428	No of heads
$MS\%_j$	54%	54%	/
Sub total	22,723.69	2,289.21	kg N ₂ O-N/year
E_{N2O,D,y}	25,012.90		kg N ₂ O-N/year

Parameter	Value		Unit
	Market Swine	Breeding Swine	
$EF_{N2O,iD}$	0.01	0.01	kg N ₂ O-N/kg NH ₃ and NO _x -N
$F_{gasMS,j,LT}$	0.4	0.4	/
$NEX_{LT,y}$	12.26	5.05	kg N/animal/yr
N_{LT}	573,653	140,428	No of heads
$MS\%_j$	46%	46%	%
GWP_{N2O}	265	265	tCO ₂ /tN ₂ O
Sub total	12,984.96	1,308.12	kg N ₂ O-N/year
E_{N2O,ID,y}	14,293		kg N ₂ O-N/year

Parameter	Value		Unit
	Market Swine	Breeding Swine	
$EF_{N2O,iD}$	0.01	0.01	kg N ₂ O-N/kg NH ₃ and NO _x -N
$F_{gasMS,j,LT}$	0.45	0.45	/
$NEX_{LT,y}$	12.26	5.05	kg N/animal/year

N_{LT}	573,653	140,428	No of heads
$MS\%_j$	54%	54%	%
GWP_{N2O}	265	265	tCO ₂ /tN ₂ O
Sub total	17,042.76	1,716.91	kg N ₂ O-N/year
$E_{N2O,ID,y}$	18,760		kg N ₂ O-N/year
$PE_{N2O,y}$	24,180		tCO ₂ e

Project emission: $PE_y = PE_{AD,y} + PE_{Aer,y} + PE_{N2O,y} = 66,151 \text{ tCO}_2\text{e} + 334 \text{ tCO}_2\text{e} + 24,180 \text{ tCO}_2\text{e} = 90,665 \text{ tCO}_2\text{e}$

Calculation of leakage

$$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH4,y} - LE_{BL,CH4,y})$$

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
N_{LT}	573,653	140,428	No of heads
$NEX_{LT,y}$	12.26	5.05	kg N/animal/yr
$R_{N,n}$	80%	80%	/
EF_1	0.01	0.01	kg N ₂ O-N/kg N
EF_5	0.0075	0.0075	kg N ₂ O-N/kg N
EF_4	0.01	0.01	KgN-N ₂ O-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 /tN ₂ O
$LE_{N2O,land,y}$	14,067.04	1,417.13	kg N ₂ O-N/year
	15,484.18		kg N ₂ O-N/year
$LE_{N2O,runoff,y}$	3,165.80	318.85	kg N ₂ O-N/year
	3,483.94		kg N ₂ O-N/year
$LE_{N2O,vol,y}$	2,813.41	283.43	kg N ₂ O-N/year
	3,096.84		kg N ₂ O-N/year
$LE_{BL,N2O,y}$	9,188		tCO ₂ e

Parameter	Value		Unit
species	Market Swine	Breeding Swine	
N_{LT}	573,653	140,428	No of heads
NEX_{LT}	12.26	5.05	kg N/animal/yr
R_N	25%	25%	-
EF_1	0.01	0.01	kg N ₂ O-N/kg N
EF_5	0.0075	0.0075	kg N ₂ O-N/kg N
EF_4	0.01	0.01	KgN-N ₂ O-N/kg NH ₃ -N+NO _x -N

F_{leach}	0.3	0.3	/
F_{gas}	0.2	0.2	/
$LE_{N2O,land,y}$	52,751.44	5,314.24	kg N ₂ O-N/year
	58,065.66		kg N ₂ O-N/year
$LE_{N2O,runoff,y}$	11,869.07	1,195.71	kg N ₂ O-N/year
	13,064.77		kg N ₂ O-N/year
$LE_{N2O,vol}$	10,550.28	1,062.85	kg N ₂ O-N/year
	11,613.13		kg N ₂ O-N/year
$LE_{PJ,N2O}$	34,457		tCO ₂ e

Parameter species	Value		Unit
	Market Swine	Breeding Swine	
GWP_{CH_4}	28	28	tCO ₂ /tCH ₄
D_{CH_4}	0.00067	0.00067	t/m ³
MCF_d	1	1	/
$VS_{LT,y}$	312.78	225.26	kg-dm/animal/yr
N_{LT}	573,653	140,428	No of heads
$B_{0,LT}$	0.29	0.29	m ³ CH ₄ /kg-VS
R_{VS}	85%	85%	/
$MS\%_j$	100%	100%	/
$LE_{BL,CH_4,y}$	146,422.85	25,813.94	tCO ₂ e
Total	172,237		tCO ₂ e

Parameter species	Value		Unit
	Market Swine	Breeding Swine	
GWP_{CH_4}	28	28	tCO ₂ /tCH ₄
D_{CH_4}	0.00067	0.00067	t/m ³
MCF_d	1	1	/
$VS_{LT,y}$	312.78	225.26	kg-dm/animal/yr
N_{LT}	573,653	140,428	No of heads
$B_{0,LT}$	0.29	0.29	m ³ CH ₄ /kg-VS
R_{VS}	2%	2%	/
R_{VS}	45%	45%	/
R_{VS}	35%	35%	/
$MS\%_j$	100%	100%	/
$LE_{PJ,CH_4,y}$	341,994.96	60,292.77	tCO ₂ e
Total	402,288		tCO ₂ e

$$LE_y = (LE_{PJ,N2O,y} - LE_{BL,N2O,y}) + (LE_{PJ,CH_4,y} - LE_{BL,CH_4,y}) = (34,457 \text{ tCO}_2\text{e} - 9,188 \text{ tCO}_2\text{e}) + (402,288 \text{ tCO}_2\text{e} - 172,237 \text{ tCO}_2\text{e}) = 255,320 \text{ tCO}_2\text{e}$$

Emission Reduction: $ER_y = BE_y - PE_y - LE_y = 843,996tCO_2e - 90,665tCO_2e - 255,320tCO_2e = 498,011tCO_2e$

Ex-ante estimation of SDG 8 Outcome

Year	Baseline estimate	Project estimate	Net benefit
01/10/2020-30/09/2021	0 jobs for local people created and 0 income.	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)
01/10/2021-30/09/2022	0 jobs for local people created and 0 income.	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)
01/10/2022-30/09/2023	0 jobs for local people created and 0 income.	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)
01/10/2023-30/09/2024	0 jobs for local people created and 0 income.	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)
01/10/2024-30/09/2025	0 jobs for local people created and 0 income.	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)
Total	0 jobs for local people created and 0 income.	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)
Total number of crediting years	5		
Annual average over the crediting period	0 jobs for local people created and 0 income.	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)	20 jobs for local people created including 10 female and 10 male; 5,000 RMB/person (with equal salaries for men and women)

Ex-ante estimation of SDG 7 Outcome

Year	Baseline estimate	Project estimate	Net benefit
01/10/2020-	0 MWh electricity	electricity generation of	electricity generation of

30/09/2021	generated in baseline situation	105,690.39 MWh can be generated by the project annually	105,690.39 MWh can be generated by the project annually
01/10/2021-30/09/2022	0 MWh electricity generated in baseline situation	electricity generation of 105,690.39 MWh can be generated by the project annually	electricity generation of 105,690.39 MWh can be generated by the project annually
01/10/2022-30/09/2023	0 MWh electricity generated in baseline situation	electricity generation of 105,690.39 MWh can be generated by the project annually	electricity generation of 105,690.39 MWh can be generated by the project annually
01/10/2023-30/09/2024	0 MWh electricity generated in baseline situation	electricity generation of 105,690.39 MWh can be generated by the project annually	electricity generation of 105,690.39 MWh can be generated by the project annually
01/10/2024-30/09/2025	0 MWh electricity generated in baseline situation	electricity generation of 105,690.39 MWh can be generated by the project annually	electricity generation of 105,690.39 MWh can be generated by the project annually
Total	0 MWh electricity generated in baseline situation	528,451.95 MWh can be generated by the project	528,451.95 MWh can be generated by the project
Total number of crediting years	5		
Annual average over the crediting period	0 MWh electricity generated in baseline situation	electricity generation of 105,690.39 MWh can be generated by the project annually	electricity generation of 105,690.39 MWh can be generated by the project annually

Ex-ante estimation of SDG 13 Outcome

Year	Baseline estimate	Project estimate	Leakage	Net benefit
01/10/2020-30/09/2021	843,996	90,665	255,320	498,011
01/10/2021-30/09/2022	843,996	90,665	255,320	498,011
01/10/2022-30/09/2023	843,996	90,665	255,320	498,011
01/10/2023-30/09/2024	843,996	90,665	255,320	498,011
01/10/2024-30/09/2025	843,996	90,665	255,320	498,011

Total	4,219,980	453,325	1,276,600	2,490,055
Total number of crediting years		5		
Annual average over the crediting period	843,996	90,665	255,320	498,011

B.7. Monitoring plan

B.7.1 Data and parameters to be monitored

SDG 13

Data / Parameter	$N_{p,LT}$
Unit	Number
Description	Number of animals of type LT produced annually for the year y
Source of data	Project proponents
Value(s) applied	573,653 heads of commercial pigs for ex-estimated which is the annual average number of swine (N_{LT}) and this value sourced from Project evaluation report and it is the average value of the past three years (2016-2018) ³⁸ in the evaluation report. 1,163,241head of commercial pigs is produced annually ($N_{p,LT}$).
Measurement methods and procedures	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.
Monitoring frequency	Monitored monthly.
QA/QC procedures	The sale records will be crosschecked during the monitoring period and archive electronically during project plus 5 years.
Purpose of data	Use for the calculation of N_{LT}
Additional comment	Indirect information (sale records) will be crosschecked.

³⁸ The project evaluation report was prepared in October 2019, so compared to the project appraisal report, the past three years are 2016-2018

Data / Parameter	$N_{da,LT}$
Unit	Number
Description	Number of days animal of type LT is alive in the farm in the year y
Source of data	Project proponents
Value(s) 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 ³⁹ .
Measurement methods and procedures	The days of swine alive in the farm will be recorded manually by the responsible staff.
Monitoring frequency	Monitored monthly.
QA/QC procedures	The sale records will be crosschecked during the monitoring period and Archive electronically during project plus 5 years.
Purpose of data	Use for the calculation of N_{LT}
Additional comment	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. Indirect information (sale records) will be crosschecked.

Data / Parameter	$N_{AA,LT}$
Unit	Number
Description	Daily stock of animals in the farm, discounting dead and discarded animals
Source of data	Project proponents
Value(s) applied	140,428 heads of breeding pigs were used to ex-estimated, and this value sourced from Project evaluation report and it is the average value of the past three years (2016-2018) in the evaluation report.
Measurement methods and procedures	Monitored daily. Archive electronically during project plus 5 years
Monitoring frequency	Monitored daily
QA/QC procedures	Each pig involved in this project has a unique electronic ear tag when was born, which is an electronic device dedicated to the identification

³⁹ <https://zhuanlan.zhihu.com/p/38676811>
<http://finance.people.com.cn/n1/2017/1121/c1004-29658996.html>

	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.
Purpose of data	Use for the calculation of N_{LT}
Additional comment	The project proponents monitor the population of breeding pigs 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}
Unit	kg
Description	Average animal weight of a defined livestock population at the project site
Source of data	Project proponents
Value(s) applied	79.98kg for commercial pigs and 57.6kg for breeding pigs which sourced from Project evaluation report.
Measurement methods and procedures	Measured by the weight measurer
Monitoring frequency	monthly
QA/QC procedures	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.
Purpose of data	Used for estimating $VS_{LT,y}$
Additional comment	Sampling procedures and method is described in Section B7.2 of PDD.

Data/parameter	n_{dy}
Unit	number
Description	Number of days treatment plant was operational in year y.
Source of data	Project proponents
Value(s) applied	365 days for ex ante estimation. The actual number of days treatment plant was operational used in the monitoring periods will be monitored by Project proponents
Measurement methods and procedures	The days of treatment plant was operational will be recorded by the responsible staff.
Monitoring frequency	Daily
QA/QC procedures	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
Additional comment	N/A

Data / Parameter	F_{Aer}
Unit	Fraction
Description	Fraction of volatile solids directed to aerobic treatment
Source of data	Project evaluation report
Value(s) applied	54% was used in the pre-calculation, 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%.
Measurement methods and procedures	The maximum value is applied due to not monitored in operation period.
Monitoring frequency	Annually
QA/QC procedures	The value of this parameter in the emission reduction calculation is 100%, which is conservative.
Purpose of data	Calculation of project emission
Additional comment	

Data/parameter	V_f^{40}
Unit	m^3
Description	Biogas flow
Source of data	Project proponents
Value(s) applied	In pre-calculation, $8,632.38 \times 10^4 m^3$ of biogas can be generated by the project annually, which sourced from Project evaluation report.
Measurement methods and procedures	Measured by flow meter
Monitoring frequency	Continuously monitored by flow meters and reported cumulatively on weekly basis
QA/QC procedures	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 calculate CH_4 generated in the anaerobic digester in the project situation $Q_{CH_4,y}$
Additional comment	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, all the biogas generated will be used for electricity generation and the residual gas will be sent to flare system (if any), therefore the biogas generated from the anaerobic digestion, the amount of biogas used for electricity generation and the amount of biogas burned will be monitored through the flow meters.

Data/parameter	$EC_{PJ,j,y}$
Unit	MWh
Description	Quantity of electricity consumed by the proposed project in year y
Source of data	Direct measurement or calculated based on measurements from more than one electricity meters
Value(s) applied	0 MWh for ex ante estimation. During the monitoring period, if the electricity consumption sourced from the grid company, then the value

⁴⁰ this parameter is not used in the calculation of emission reductions, but according to applied methodology ACM0010 (version08.0), this parameter needs to be monitored.

	will be determined as per the electricity meters monitoring and Cross-check with the grid statement.
Measurement methods and procedures	Monitored by the electricity meters installed at the electricity consumption sources.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	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
Additional comment	Should be cross-check with the grid statement

Data/parameter	$TDL_{j,y}$
Unit	/
Description	Average technical transmission and distribution losses for providing electricity to source j in year y
Source of data	tool" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Value(s) applied	20%
Measurement methods and procedures	Default value of 20% will be applied, which is conservative according to tool" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation"
Monitoring frequency	This value will change once the tool is updated
Purpose of data	Calculation of project emission
Additional comment	N/A

Data/parameter	$V_{t,db}$
Unit	m ³ dry gas/h
Description	Volumetric flow of the gaseous stream in time interval t on a dry basis
Source of data	Flowmeters
Value(s) applied	Biogas were estimated according to the amount of manure for Ex ante estimation.
Measurement methods and procedures	Monitored by flowmeter and Volumetric flow measurement should always refer to the actual pressure and temperature.
Monitoring frequency	Continuous measurement
QA/QC procedures	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
Additional comment	N/A

Data/parameter	$V_{i,t,db}$
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	gas analyzers
Value(s) applied	60% for pre-calculation which sourced from Project evaluation report. In monitoring period. This value will be monitored by the gas analyzers.
Measurement methods and procedures	Continuous gas analysers operating in dry basis. Volumetric flow measurement should always refer to the actual pressure and temperature
Monitoring frequency	Continuous measurement
QA/QC procedures	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
Additional comment	N/A

Data/parameter	T_t
Unit	K
Description	Temperature of the gaseous stream in time interval t
Source of data	Measured by instrument
Value(s) applied	293.15 K was used in the pre-calculation for the density of CH ₄ as the applied methodology ACM0010 (Version 08.0), 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 $T(K) = t(^{\circ}C) + 273.15$
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include thermocouples, thermo resistance, etc
Monitoring frequency	Continuous
QA/QC procedures	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
Additional comment	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
Unit	Pa
Description	Pressure of the gaseous stream in time interval t
Source of data	Measured by instrument
Value(s) applied	101.325 kPa for the pre-calculation for the density of CH ₄ as the applied methodology ACM0010 (Version 08.0), in actual monitoring period, the temperature of the gaseous stream will be monitored by the recordable electronic signal.
Measurement methods and procedures	Instruments with recordable electronic signal (analogical or digital) are required. Examples include pressure transducers, etc
Monitoring frequency	Continuous
QA/QC procedures	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
Additional comment	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	$\rho_{i,t}$
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
Value(s) applied	0.00067 t/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

Measurement methods and procedures	Calculated based on temperature of the gaseous stream in time interval t and pressure of the gaseous stream in time interval t .
Monitoring frequency	Pressure and temperature are measured continuously by the biogas flow meters
QA/QC procedures	Calculated value according to the pressure and temperature
Purpose of data	Calculation of project emissions
Additional comment	NA

Data/parameter	MS% _j
Unit	Fraction
Description	Fraction of manure handled in system j in project activity
Source of data	Project proponents
Value(s) applied	100% for ex-estimated. 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% or total MS% _j in different treatment system is 100% since the treatment process of this project is an anaerobic-aerobic combined treatment technology, main including anaerobic fermentation, and aerobic composting.
Measurement methods and procedures	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%.
Monitoring frequency	Annually
QA/QC procedures	100% is the maximum value and conservative.
Purpose of data	Calculation of project emissions
Additional comment	NA

Data/parameter	B _{0, LT}
Unit	m ³ CH 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

Value(s) applied	$B_{0,LT}$ (Market swine) =0.29 ⁴¹ $B_{0,LT}$ (Breeding swine) =0.29
Measurement methods and procedures	$B_{0,LT}$ 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 ³ CH 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 ⁴² , which is higher. Therefore 0.29 m ³ CH ₄ /kg -dm applied in monitoring period is conservative.
Monitoring frequency	Annually
QA/QC procedures	The value is taken from published sources. The parameter value should be updated on latest available public data source.
Purpose of data	Used in project emission/baseline calculations
Additional comment	N/A

Data/parameter	Type
Unit	/
Description	Type of barn and AWMS
Source of data	Project proponent
Value(s) applied	NA
Measurement methods and procedures	The swine barn and AWMS layout and configuration are collected. Archive electronically during project plus 5 years.
Monitoring frequency	Once for each monitoring period
QA/QC procedures	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
Additional comment	Swine barn and AWMS layout and configuration.

Data/parameter	T
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⁴¹ The proposed project is located in Ji'an, Jiangxi 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 m³ CH₄/kg VS.

⁴² <http://www.doc88.com/p-9902182440715.html>

Unit	°C
Description	Annual average ambient temperature at project site
Source of data	Ganzhou Meteorological Bureau
Value(s) applied	19.8 for ex-ante estimation
Measurement methods and procedures	Data sourced from Ganzhou Meteorological Bureau
Monitoring frequency	Monthly
QA/QC procedures	Cross-Check with the Annual average ambient temperature at project site from public website monthly (https://www.tianqi24.com/ganzhou/history202109.html)
Purpose of data	Used to select the annual MCF from IPCC 2006 Guidelines
Additional comment	NA

SDG 8

Data / Parameter	<i>Number of males and females employed by the project</i>
Unit	Number
Description	Jobs created for both men and women.
Source of data	Record keeping book and labor contract
Value(s) applied	Will be reported for each monitoring period. For ex ante estimation, 20 jobs are created including 10 males and 10 females during the operation period of the project.
Measurement methods and procedures	The number of jobs created for males and females will be recorded. Source of data is record keeping book and it will be cross checked by the labor contracts.
Monitoring frequency	Once for each monitoring period.
QA/QC procedures	After the first verification, only changes in employees will be reported. The results will also be cross checked with training records of employees.
Purpose of data	To demonstrate contribution to SDG 8.
Additional comment	N/A

Data / Parameter	<i>Average monthly salary</i>
Unit	RMB/person

Description	This parameter states the payment conditions of the people employed within the project. Equal pay for work of equal value regardless of gender.
Source of data	Pay roll
Value(s) applied	To be monitored and for ex ante estimation, the average monthly salary is 5,000 RMB/person with equal salaries for men and women in the same post. The actual number of the data used in the monitoring periods will be monitored by Project proponents
Measurement methods and procedures	The average monthly salary will be determined by Pay roll and cross checked by the labor contract.
Monitoring frequency	monthly
QA/QC procedures	The results will also be cross checked with labor contracts.
Purpose of data	To demonstrate contribution to SDG 8.
Additional comment	N/A

SDG 7

Data / Parameter	EGd,y
Unit	MWh
Description	Quantity of electricity generation by capturing biogas
Source of data	Direct measurement
Value(s) applied	To be monitored and the annual electricity generation by capturing biogas can be estimated through the amount of biogas and the assumed electricity to methane ratio of 1.6 kWh/m ³ of biogas according to Project evaluation report. Quantity of electricity generation of 105,690.39 MWh can be generated annually for ex ante estimation.
Measurement methods and procedures	Monitored by electricity meters installed at the generator outlet. Archive electronically during project plus five years.
Monitoring frequency	Continuous measurement and at least monthly recording
QA/QC procedures	The calibration of electricity meters, including the frequency of calibration, should be done in accordance with national standards or requirements.
Purpose of data	To demonstrate contribution to SDG 7.
Additional comment	N/A

Mitigation Measure for Safeguarding Principles

Data / Parameter	Employee Training of biogas safety operation
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Unit	/
Description	Employees will be trained on the safety operation of the biogas
Source of data	Training record
Value(s) applied	/
Measurement methods and procedures	Training once a year
Monitoring frequency	Annually
QA/QC procedures	Meeting attendance record will be cross-checked
Purpose of data	To demonstrate Mitigation Measure for Safeguarding Principles
Additional comment	N/A

B.7.2 Sampling plan

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The sampling objective: determining the Average animal weight of a defined livestock population at the project site W_{site} during the crediting period with a 95/10 confidence/precision.

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

Parameter	W_{site}
Objectives and reliability requirements	Determining the Average animal weight of a defined livestock population at the project site during the crediting period. According to 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 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 714,081 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. During the monitoring periods, the target population will be changed as the actual situation.
Sampling method	For this project, Guanxi, Jiading, Datang, Zhongshi, Babaodong, Tangcun and Taojiang belong to Fattening farm, which only has market swine in stock. Tianxiang and Fuwang belong to breeding farm, which only has breeding swine in stock. As this project involved 10 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 10 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 10 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 size:

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 follows⁴³:

⁴³ <https://www.doc88.com/p-73947158230.html>

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

$$n_2 = n_1 N / (N + n_1)$$

$$n_3 = B n_2$$

$$n_4 = n_3 / r$$

$$n = n_4 (110\%)$$

Where:

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

σ the standard deviation;

d the maximum error of estimate;

X the mean value of samples;

V the coefficient of variation, $V = \sigma / X \leq 1$ 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 714,081;

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, n_4 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 714,081, N in the calculation of sample size is 714,081, and the calculation result is as follows:

Z	V	e	N	B	r
1.96	1	10%	714,081	1	100%
n_1	$Z^2 V^2 / e^2$	384			
n_2	$n_1 N / (N + n_1)$	384			
n_3	$B n_2$	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.

During the monitoring period, the overall sample size should be calculated based on the actual inventory and the actual sample size of each age groups of Market swine and Breeding swine

in each farm should be determined based on the proportional distribution described in sample method. As the larger the sample size, the lower the sampling risk and the more accurate the estimate, the sample size calculated according to the proportional distribution will be rounded up.

Implementation

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 GS monitoring team.

The one monthly monitoring activity of the samples will be completed in the 10 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 10 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 normal growth state.

B.7.3 Other elements of monitoring plan

>>

1. Monitoring framework

The project owner will be responsible for the whole monitoring work. The GS Monitoring Team will be established to collect and record monitoring data within the project boundary. The GS 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 GS monitoring team will be trained by the

project owner at least once a year. The overall monitoring system structure of the project shows as below:

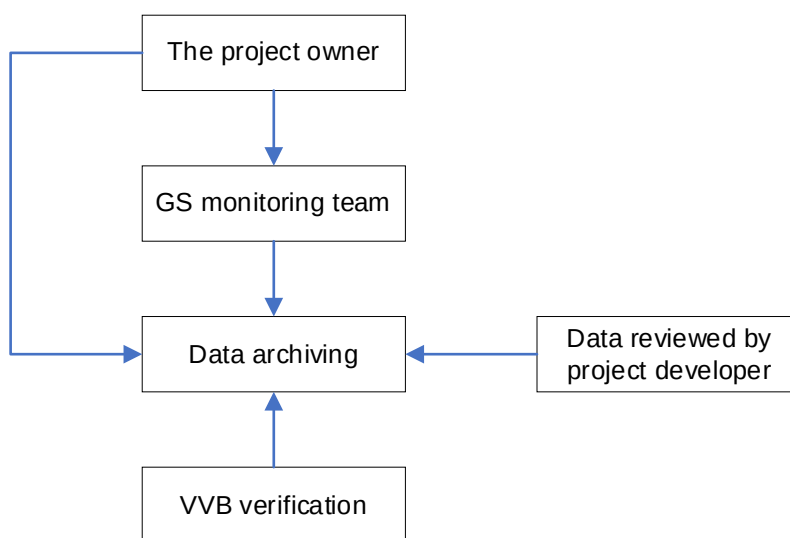


Figure 4 The Organization Structure of the Monitoring Team

2.Principle of Monitoring

Every swine farm should monitor all the data mentioned description in section B.7.1 in this PDD.

The installation of relevant monitoring instruments and meters 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.

3.Parameters to be monitored

The monitoring requirements for this methodology include the monitoring of parameters for both baseline and project emissions calculations. All provisions in the methodology and relevant tools shall apply, as described for each parameter in section B.7.1 of this PDD.

For Mitigation Measure for Safeguarding Principles, Employee Training of biogas safety operation will be monitored through the training record.

For the parameters of SDG 8, number of males and females employed by the project and average monthly salary will be determined based on record keeping book.

For the parameters of SDG 7, quantity of electricity generation by capturing biogas ($EG_{d,y}$) will be monitored.

For the parameter of SDG13, the parameters that need to be monitored as the description of section B.7.1 are as follows:

- a) Number of animals of type LT produced annually for the year y , $N_{p,LT}$;
- b) Number of days animal of type LT is alive in the farm in the year y , $N_{da,LT}$;
- c) Daily stock of animals in the farm, discounting dead and discarded animals, $N_{AA,LT}$;
- d) Average animal weight of a defined livestock population at the project site, W_{site} ;
- e) Number of days treatment plant was operational in year y , n_{dy} ;
- f) Quantity of electricity consumed by the proposed project in year y , $EC_{PJ,j,y}$;
- g) Average technical transmission and distribution losses for providing electricity to source j in year y , $TDL_{j,y}$;
- h) Biogas flow, V_f ;
- i) Volumetric flow of the gaseous stream in time interval t on a dry basis, $V_{t,db}$;
- j) Volumetric fraction of greenhouse gas i in a time interval t on a dry basis, m^3 gas i/m^3 dry gas, $V_{i,t,db}$;
- k) Temperature of the gaseous stream in time interval t , T_t ;
- l) Pressure of the gaseous stream in time interval t , P_t .
- m) Density of greenhouse gas i in the gaseous stream in time interval t , $\rho_{i,t}$;
- n) Fraction of volatile solids directed to aerobic treatment, F_{Aer} ;
- o) Fraction of manure handled in system j in project activity, $MS\%_j$;
- p) Maximum methane producing potential of the volatile solid generated by animal type LT , $B_{0,LT}$;
- q) Type of barn and AWMS, Type
- r) Annual average ambient temperature at project site, T .

For the number of animals of type LT produced annually for the year y and the daily stock of animals in the farm, discounting dead and discarded animals is sourced from the data logged in the manure treatment plant.

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

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

The number of days treatment plant was operational is determined according to the actual operating days of the manure treatment system during the monitoring period. The data is sourced from data logged in the manure treatment plant.

The quantity of electricity consumed from the grid company by the proposed project is sourced from the data logged in the manure treatment plant and the grid statement issued by the power company can be cross-checked.

Average technical transmission and distribution losses for providing electricity to source *j* is sourced from the tool" Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation" and will be updated once the tool is updated.

Biogas flow, Volumetric flow of the gaseous stream in time interval *t* on a dry basis and the volumetric fraction of greenhouse gas *i* in a time interval *t* on a dry basis can be monitored by the flowmeters and gas analysers, the data are sourced from the the data logged in the manure treatment plant.

The temperature and pressure of the gaseous stream in time interval *t* is measured by the instruments with recordable electronic signal, the monitoring is continuous, and the change is very small. so, the data can be obtained from the data logged in the manure treatment plant. And the Density of greenhouse gas *i* in the gaseous stream in time interval *t* should be calculated based on the temperature and pressure of the gaseous stream in time interval *t*.

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

For B_0 , LT , a default value from IPCC 2006 is applied, therefore it is not monitored during the operation period.

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

For annual average ambient temperature at project site, the monthly data can be sourced from local Ji'an Meteorological Bureau.

4. Data collection and management, QA/QC and Emergency procedure

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Data collection and management

The monitoring activities will be conducted by GS monitoring team. Then the survey result should be summarized by monitoring team member. The data will be reviewed by the project developer and VVB.

If the recorded raw data on the summary table of each parameter are reasonable and basically consistent with the actual state, the raw data will be archived. In addition, the original record file also should be preservation.

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

- 1) The general principle is that conservative values 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 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 conservative 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 conservative value for the missing or damaged data.
- 4) If some data recorded are significantly higher or lower than the normal range and inconsistent with actual situation, the monitoring personnel should ask for the reason. If the measurement is high or low due to the damage of measurement equipment, conservative value will be used. And need to calibrate or replace the measuring equipment immediately and avoid this situation in the future.

The PP shall perform statistical analysis on the data collated using Microsoft excel in an automated tool that will use standard deviation and mean values to determine outliers. 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. The project proponent commits itself to accurate and transparent record keeping, monitoring and evaluation. All supporting documentation and records for the project must be easily accessible for spot checking and cross referencing by a third party; these records will be kept by Jiangxi Zhengbang Breeding Co. Ltd. An auditor must also be able to cross reference pertinent project documentation, including but not limited to on-site operation diary, weight record sheet, sales record, etc.

Emergency procedure

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

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

TEMPLATE

SECTION C. DURATION AND CREDITING PERIOD

C.1. Duration of project

C.1.1 Start date of project

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01/07/2020⁴⁴, the date of signing the equipment purchases contract.

C.1.2 Expected operational lifetime of project

>>

15years⁴⁵

C.2. Crediting period of project

C.2.1 Start date of crediting period

>>

01/10/2020⁴⁶ or two years prior to the date of Project Design Certification⁴⁷, whichever is later.

C.2.2 Total length of crediting period

>>

15years. As per section 4.1.5 of *GS4GG Community Services Activity Requirements* (Version 1.2), the crediting period is 5 years for each Design Certification Renewal Cycle and in total two Design Certification Renewal Cycles.

⁴⁴ According to "Principles & Requirements (version 1.2)", the project start date is defined as: Examples of the start date may include the date on which contracts have been signed for equipment or construction/operation services required for the Project. Minor pre-project expenses, such as the contracting of services/payment of fees for feasibility studies or preliminary surveys, shall not be considered in the determination of the start date as they do not necessarily indicate the commencement of implementation of the Project. For distributed technology projects, the start date is the date of implementation of the first unit under the project.

This project is not a distributed technology project, so the start date of this project is the date on which contracts have been signed for equipment or construction/operation services required for the Project. The purchase date of the equipment (power generators) of the project is 01/07/2020, so the Start date of project is 01/07/2020.

⁴⁵ As per manufacturer specifications of the anaerobic fermentation equipment, the technical lifetime is more than 15 years.

⁴⁶ The date of all the Animal Manure Management System put into operation.

⁴⁷ The date of project design certification is expected 07/01/2022, and the actual date of project design certification will be updated according to the actual date of project design certification

SECTION D. SUMMARY OF SAFEGUARDING PRINCIPLES AND GENDER SENSITIVE ASSESSMENT

D.1 Safeguarding Principles that will be monitored

A completed Safeguarding Principles Assessment is in [Appendix 1](#), ongoing monitoring is summarised below.

Principles	Mitigation Measures added to the Monitoring Plan
Principle 1 Human Rights	Not required
Principle 2 Gender Equality and Women's Rights	Not required
Principle 3 Community Health, Safety and Working Conditions	Not required
Principle 4 Cultural Heritage, Indigenous Peoples, Displacement and Resettlement	Not required
Principle 5 Corruption	Not required
Principle 6 Economic Impacts	Not required
Principle 7.1 Emissions	Not required
Principle 7.2 Energy supply	Not required
Principle 8 Water	Not required
Principle 9 Environment, Ecology and Land Use	Required ⁴⁸

D.2. Assessment that project complies with GS4GG Gender Sensitive requirements

Question 1 - Explain how the project reflects the key issues and requirements of Gender Sensitive design and implementation as outlined in the Gender Policy?	The project reflects the key gender issues and requirements of Gender Sensitive design and implementation. To ensure gender sensitive design and implementation, the project shall address any gender inequalities and gender-related risks that may be identified in project gender analyses. Gender-sensitive approaches in stakeholder consultation has been ensured by promoting
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⁴⁸ For this project, the biogas will be generated during the treatment process, if biogas is not handled properly during the operation period of the project, methane leakage/explosion may be caused. So, the Mitigation Measures were needed. In this project, the mitigation measure for safeguarding principles was that project owner will conduct regular training on biogas safety and leakage to project employees to improve their proficiency in the treatment system and ensure that biogas leakage and safety hazards will not occur, and the employee training of biogas safety operation will be monitored through the training record. Also, the Mitigation Measure for Safeguarding Principles, i.e., the parameter of "Employee Training of biogas safety operation" was included in the monitoring plan in section B.7.1 and B.7.3.

	information sharing equitably with women and men stakeholders, which has been made available and presented in an accessible format across all stakeholder groups including those more marginalized. The approach also included opportunities for stakeholders to share information in a two-way exchange, give regular feedback during implementation and ensure their views and priorities are incorporated in project design and implementation.
Question 2 - Explain how the project aligns with existing country policies, strategies and best practices	The project does not involve and is not complicit in any form of discrimination based on gender, race, religion, sexual orientation or any other basis. The project respects all the rights to the women conferred to them by the Constitution of the People's Republic of China, the <i>Labour Law of the People's Republic of China</i>, <i>Special provisions on labour protection of female employees</i> and other related regulation and policies. All these articles embrace the gender equality and social inclusion principles in a way or other. The project has been implemented in the swine farm owned by Jiangxi Zhengbang Breeding Co. Ltd. This project creates the job opportunities for local people and advocated the employment of women. According to the labor contract signed with employees, 10 men and 10 women are employed, Also, the average monthly salary was the same for men and women.
Question 3 - Is an Expert required for the Gender Safeguarding Principles & Requirements?	No gender experts will be required for the Gender Safeguarding Principles & Requirements. The project shall neither contributes to discrimination against women nor shall it reinforce gender-based discrimination and/or inequalities. Gender equality will be attained by ensuring that both men and women will have equal opportunities to jobs created and trainings. The project will further ensure equal pay for equal value of work.

Question 4 - Is an Expert required to assist with Gender issues at the Stakeholder Consultation?	No gender experts will be required to engage in the Stakeholder Consultation. The physical meeting has been followed the <i>GS4GG Stakeholder Consultation and Engagement Requirements</i> (Version 1.2), which includes gender guidelines, and minimum group of stakeholders to be consulted. All assessment questions related to safeguarding principles, including principle 2 “Gender Equality and Women’s Rights”, have been discussed during the stakeholder consultation meeting. Refer to Appendix 1 of the PDD for more details of the results for Safeguarding Principal Assessment.
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TEMPLATE

SECTION E. SUMMARY OF LOCAL STAKEHOLDER CONSULTATION

The below is a summary of the 2 step GS4GG Consultation for monitoring purposes. Please refer to the separate Stakeholder Consultation Report for a complete report on the initial consultation and stakeholder feedback round.

E.1 Summary of stakeholder mitigation measures

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Local stakeholder consultation of the project was organized in line with the GS4GG stakeholder Procedure Requirements and Guidelines.

The project owner invited the stakeholders to participate in the stakeholder consultation meeting on the project through email and public notice. In order to facilitate the invitees to understand the purpose of the meeting and relevant information of the project, the project owner briefly introduced the key information of the project during the invitation. The project owner invited 47 people to participate the physical meeting and tried to invite the same number of males and females.

26 people, including local residents and experts from local government attended in the 1st round of Local stakeholder consultation physical meeting held on 02/08/2021 in the Conference room of Jiangxi Zhengbang Breeding Co. Ltd. (No. 569, Aixihu 1st Road, Hi-tech Development Zone, Nanchang City, Jiangxi Province). In the meeting, the project owner introduced the project activity and its social and environmental impacts in detail, published input & grievance mechanism, the determination of SDG selection, discussed and confirmed the ownership of GS emission reduction with stakeholders.

The comments received during the stakeholder consultation meeting can summarized below:

Comment: How long is the total creating period?

15years. The crediting period is 5 years for each Design Certification Renewal Cycle and in total two Design Certification Renewal Cycles.

Comment: How to deal with the biogas residue?

After anaerobic digestion, the biogas residue will be treated in aerobic composting system, which will be used as fertilizer. Wastewater from the new animal waste management systems will be treated aerobically and then used for agriculture irrigation.

Comment: Will the organic fertilizer produced after the manure treatment be distributed to nearby farmers for free?

The amount of organic fertilizer produced by the project is determined based on the amount of manure. The organic fertilizer produced will first be distributed to nearby farmers for free. If necessary, please come to receive it. Only surplus fertilizer will be sold externally, and the sales price will be lower than the market price.

Comment: Has your project activity received approval from the local government department?

Our breeding activity including subsequent manure disposal always will be supervised by the environmental protection authorities.

Comment: Will the odour of swine farm be improved?

All the manure will be put into closed anaerobic digestion to treat, which will significantly reduce the odour, and improve the working environment of the employees.

Comment: What is the main energy consumed by the project activity?

Only electricity will be used for the project activity. No Other fossil fuel is need.

Comment: Who will need the carbon credits issued?

Enterprises with targets for carbon neutral.

Comment: Who is the legal ownership of the carbon credits generated under Gold Standard Certification?

The project is invested and constructed by the project owner, therefore the legal ownership of the credits generated under Gold Standard belongs to the project owner.

Comment: Is it possible for the electricity generated by the project to be used by our local residents?

The electricity generated currently is still not enough to supply to the swine farms. If there is surplus electricity in the future and it will be supplied to local residents within permitted conditions.

The 2nd round of Stakeholder Consultation, the Stakeholder feedback round is held for two months between 05/07/2021 and 04/09/2021. All stakeholders that participated in the Stakeholder Consultation physical meeting were invited to the Stakeholder Feedback Round, including those who were invited but unable to attend. The electronic version and paper copy Project Information Note and PDD are sent to the stakeholders for review and feedback. People can give feedback by replying the invitation email, etc., and all the feedback will be recorded.

During the 2nd round of Stakeholder Consultation, the project owner invited and consulted relevant experts, including the staff of relevant institutions and organizations with professional knowledge related to project information and safeguarding requirements, to ensure that the

implementation of the project meets the requirements of GS4GG Requirements, and will not affect the rights of local residents or local ecology and hydrology while bringing benefits to local residents. On the aspects of human rights, gender equality and women's rights, community health, safety and working conditions, cultural heritage, indigenous people, displacement and reset, corruption, economic impacts, climate and energy, water, and environment, ecology and land use, the project owner consulted the experts of the Development & Reform Commission of Ganzhou City, Ecological Environment Bureau of Ganzhou City, Agriculture and Rural Affairs Bureau of Ganzhou City, Ministry of Ecology and Environment of the People's Republic of China, and Women's Federation of Jiangxi Province mainly through email. These experts affirmed the practice of creating jobs for the local area and encouraging the recruitment of women in the project, and also affirmed our work in the project will be no negative impact in these aspects during the implementation of the project, and there are no comments on project design and monitoring methods. In addition to experts' responses to safeguarding questions, no other stakeholder feedback was received during the Stakeholder Feedback Round.

E.2 Final continuous input / grievance mechanism

Method	Include all details of Chosen Method (s) so that they may be understood and, where relevant, used by readers.
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the grievance books were put in Front Desk Administration of the project owner i.e., each farm (the address of each farm is as below table. All stakeholders are allowed to record their grievances or comments in the book. The project owner will assign specific person to deal with related issues. When assessing the relevance and appropriateness of the stakeholders' comments, the project owner will apply a gender lens.

Continuous Input /
Grievance
Expression Process
Book (mandatory)

Swine farm	Address
Guanxi	Guanxi Town, Longnan County, Ganzhou City
Jiading	Jiading Town, Xinfeng County, Ganzhou City
Datang	Datangbu Town, Xinfeng County, Ganzhou City
Baishu	Jiading Town, Xinfeng County, Ganzhou City
Zhongshi	Banshi Town, Anyuan County, Ganzhou City
Babaodong	Liren Town, Longnan County, Ganzhou City
Tangcun	Tangcun Village, Anyuan County, Ganzhou City
Taojiang	Taojiang Village, Longnan County, Ganzhou City
Tianxiang	Chemen Village, Jinxi County, Fuzhou City
Fuwang	Sunfang Town, Chongren County, Fuzhou City

GS Contact
(mandatory)

help@goldstandard.org

Other

Feedback can be made directly through visiting Jiangxi Zhengbang Breeding Co.

Ltd. (north of Hu Dong 4th Road and east of Chanye Road, Nanchang City, Jiangxi Province), calling+86 0791--8639 7834 or sending e-mail to 57566640@qq.com.

APPENDIX 1 - SAFEGUARDING PRINCIPLES ASSESSMENT

Complete the Assessment below and copy all Mitigation Measures for each Principle into [SECTION D](#) above. Please refer to the instructions in the [Guide to Completing](#) this Form.

Assessment Questions/ Requirements	Justification of Relevance (Yes/potentially/no)	How Project will achieve Requirements through design, management or risk mitigation.	Mitigation Measures added to the Monitoring Plan (if required)
Principle 1. Human Rights			
1. The Project Developer and the Project shall respect internationally proclaimed human rights and shall not be complicit in violence or human rights abuses of any kind as defined in the Universal Declaration of Human Rights 2. The Project shall not discriminate with regards to participation and inclusion	No	1.The project activity is designed to introduce new animal waste management systems to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. The project is in Jiangxi Province, China. The project is implemented under the laws of China and will not lead to violations or human rights abuses in any kind. 2.All farmers near the project region that respect the principles and values of sustainable development can equally participate and benefit from the project. The project does not discriminate on gender, race, religion, sexual orientation or any other aspect.	Not required
Principle 2. Gender Equality			

1. The Project shall not directly or indirectly lead to/contribute to adverse impacts on gender equality and/or the situation of women 2. Projects shall apply the principles of nondiscrimination, equal treatment, and equal pay for equal work 3. The Project shall refer to the country's national gender strategy or equivalent national commitment to aid in assessing gender risks 4. (where required) Summary of opinions and recommendations of an Expert Stakeholder(s)	No	1.The project will not directly or indirectly reinforce gender-based discrimination and shall not lead to/contribute to adverse impacts on gender equality and/or the situation of women. In fact, the project increases women's access to or control of resources, entitlements and benefits by providing easy access to equal job opportunities. 2. The project will not set up any barriers to the employment of women. All employees have benefits based on pregnancy, maternity/paternity leave, or marital status according to the Labour Law of the People's Republic of China, Special provisions on labour protection of female employees and other related regulation and policies. 3. The project complies with the Labor Law⁴⁹ and China's gender related policies. 4. There is no opinions and recommendations of an Expert Stakeholder(s). That's because the project will not directly or indirectly reinforce gender-based discrimination and shall not lead to/contribute to adverse impacts. Therefore, the safeguarding principle related to Gender Equality and Women's Rights is not triggered during the project design and implementation.	Not required
Principle 3. Community Health, Safety and Working Conditions			
1. The Project shall avoid community exposure to increased	No	The project activity is designed to introduce new animal waste management systems to treat the manure and wastewater from the 10 swine farms	Not required

⁴⁹ http://www.npc.gov.cn/zgrdw/npc/xinwen/2019-01/07/content_2070261.htm

health risks and shall not adversely affect the health of the workers and the community		to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. As the biogas in this project is produced in a closed anaerobic fermentation process and all will be captured for power generation, the excess gas is stored in a closed double-membrane biogas tank or flared (the generator set is out of service). In addition, in order to ensure the safety of biogas, the regularly trains on biogas safety and leakage to project employees was conducted to improve their proficiency in the treatment system and ensure that biogas leakage and safety hazards will not occur and to ensure the biogas will not affect the health of the workers. After anaerobic digestion, the fermented sludge will be treated in aerobic composting system, which will be used as fertilizer. The fertilizer can be distributed to the local people for free regularly. So, the Project doesn't increase the exposure to health risks and adversely affect the health of the workers and the community. In fact, this project can bring benefits to the workers and the community.	
Principle 4.1 Sites of Cultural and Historical Heritage			
Does the Project Area include sites, structures, or objects with historical, cultural, artistic, traditional or religious values or intangible forms of culture?	No	The new animal waste management system is not used in sites, structures, or objects with historical, cultural, artistic, traditional or religious values or intangible forms of culture.	Not required

>>		The project does not utilise Cultural Heritage, including the knowledge, innovations, or practices of local communities, affected communities.	
Principle 4.2 Forced Eviction and Displacement			
Does the Project require or cause the physical or economic relocation of peoples (temporary or permanent, full or partial)?	No	The free distribution of the fertilizer produced by this project can help to reduce the costs of purchasing fertilizer for the local people. All the investment for the animal waste management system is provided by project owner. It obviously does not cause physical or economic relocation of peoples.	Not required
>>			
Principle 4.3 Land Tenure and Other Rights			
a. Does the Project require any change, or have any uncertainties related to land tenure arrangements and/or access rights, usage rights or land ownership?	No	This project is operated in the swine farm owned by the project owner. So, there is no uncertainties and changes the related to land tenure arrangements and/or access rights, usage rights or land ownership. The project does not require any change to land tenure arrangements and/or other rights such as resource access rights, community-based property rights and customary rights, which is confirmed by an expert invited by the project owner.	Not required
b. For Projects involving land use tenure, are there any uncertainties with regards to land tenure, access rights, usage rights or land ownership?			
>>			
Principle 4.4 - Indigenous people			

Are indigenous peoples present in or within the area of influence of the Project and/or is the Project located on land/territory claimed by indigenous peoples?	No	Indigenous people have the same and equal opportunity to obtain the fertilizer and they will not be affected directly or indirectly in a negative way by the project.	Not required
>>		In addition, there are no indigenous people present within the area of influence nor the project is located on territory claimed by indigenous people. This is confirmed by an expert invited by the project owner.	
Principle 5. Corruption			
1. The Project shall not involve, be complicit in or inadvertently contribute to or reinforce corruption or corrupt Projects	No	The project is implemented on the ground by the social enterprise. The ethical codes of the project partners are against corruption. In addition, the companies comply with all related economic laws and regulations of China. This Project has a zero tolerance to corruption policy, anything generated as project revenue shall be spent towards the project monitoring, repair and maintenance, project operation and costs against project verification and issuance of the emission reduction credits. Hence, the project doesn't involve any transaction of cash and/or kind between the project participant and the beneficiary.	Not required

Principle 6.1 Labour Rights

1. The Project Developer shall ensure that all employment is in compliance with national labour occupational health and safety laws and with the principles and standards embodied in the ILO fundamental conventions 2. Workers shall be able to establish and join labour organisations 3. Working agreements with all individual workers shall be documented and implemented and include: a) Working hours (must not exceed 48 hours per week on a regular basis), AND b) Duties and tasks, AND c) Remuneration (must include provision for payment of overtime), AND d) Modalities on health insurance, AND e) Modalities on termination of the contract with provision for voluntary resignation by employee, AND f) Provision for annual leave of not less than 10 days per year, not including sick and casual leave. 4. No child labour is allowed (Exceptions for children working on their families' property requires an <u>Expert Stakeholder</u> opinion)	No	The project complies with the <i>Labour Law of the People's Republic of China, Special provisions on labour protection of female employees</i> and other related regulation and policies. The project owner will sign contracts with employees. The labor contracts specify working hours, tasks and payments. All employees have benefits based on social security, pregnancy, maternity/paternity leave, or marital status according to the labor laws of China. Besides, the employees also have the right to establish labor unions and to carry on labor union activities. All employees would provide their age information document, e.g., ID, when signing the labour contract, and the project owner did not and will not employ any child labour.	Not required
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Principle 6.2 Negative Economic Consequences			
1. Does the project cause negative economic consequences during and after project implementation?	No	The equipment procurement cost of the project was borne by the project owner. The project has positive economic benefits due to the reduced cost of buying fertilizer for local farmer. The project will create fair job opportunities for local people, which is good for the local economy. No risks are foreseen for the local economy through the realization of the project.	Not required
>>			
Principle 7.1 Emissions			
Will the Project increase greenhouse gas emissions over the Baseline Scenario?	No	The project activity is designed to new animal waste management systems to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. The project activity will reduce of GHG in the atmosphere through avoiding methane emissions from anaerobic treatment of swine manure and wastewater.	Not required
>>			
Principle 7.2 Energy Supply			
Will the Project use energy from a local grid or power supply (i.e., not connected to a national or regional grid) or fuel resource (such as wood, biomass) that provides for other local users?	No	The project activity will replace the current open anaerobic lagoons with 10 new closed anaerobic digesters. The biogas generated during the treatment process will be captured for power generation. All the power is used by the AWMS and	Not required

>>		10 swine farms and will not be connected to another user or to the regional power grid. So, the project activity will use electricity from the proposed project and the Centra China Power Gird (only happened when the electricity consumption generated by the project is not sufficient or the generator set in a shutdown state), which is a reginal grid of China. It will not affect the energy consumptions or power supply or fuel resource supply that provides for other local users.	
Principle 8.1 Impact on Natural Water Patterns/Flows			
Will the Project affect the natural or pre-existing pattern of watercourses, groundwater and/or the watershed(s) such as high seasonal flow variability, flooding potential, lack of aquatic connectivity or water scarcity?	No	The project will not affect the natural or pre-existing pattern of watercourses, groundwater and/or the watershed(s) such as high seasonal flow variability, flooding potential, lack of aquatic connectivity or water scarcity. This is confirmed by an expert invited by the project owner.	Not required
>>			
Principle 8.2 Erosion and/or Water Body Instability			

a. Could the Project directly or indirectly cause additional erosion and/or water body instability or disrupt the natural pattern of erosion? b. Is the Project's area of influence susceptible to excessive erosion and/or water body instability? >>	No	All animal manure will be put into the new animal waste management systems to treat and is prohibited to discharge into the Groundwater and surface water. Therefore, AWMSs used in the project area could not directly or indirectly cause additional erosion and/or water body instability or disrupt the natural pattern of erosion. The fertilizer produced in this project meets the relevant Chinese fertilizer implementation standards ⁵⁰ , so the project also could not directly or indirectly impact on surface and ground waters or soil erosion on slopes.	Not required
Principle 9.1 Landscape Modification and Soil			
Does the Project involve the use of land and soil for production of crops or other products? >>	No	Comprehensive utilization and resourceful treatment of the manure waste are encouraged by the local government ⁵¹ . All the swine farms of the project have obtained necessary approval from the local government, including Planning Permit on Land for Construction Use, Environmental Impact Assessment etc. Hence, the project does not involve the use of land and soil for production of crops or other products.	Not required
Principle 9.2 Vulnerability to Natural Disaster			
Will the Project be susceptible to or lead to increased vulnerability to wind, earthquakes, subsidence, landslides, erosion, flooding, drought or other	No	The new animal waste management systems used in the project area does not involve any land use changes. It would not lead to the exacerbation of impacts caused by natural or man-made hazards,	Not required

⁵⁰ <https://www.163.com/dy/article/GDJC0BVN0537393M.html>

⁵¹ http://jxf.jiangxi.gov.cn/art/2020/7/24/art_39212_2648549.html

extreme climatic conditions?		such as landslides or floods.	
>>			
Principle 9.3 Genetic Resources			
Could the Project be negatively impacted by or involve genetically modified organisms or GMOs (e.g., contamination, collection and/or harvesting, commercial development, or take place in facilities or farms that include GMOs in their processes and production)?	No	The project does not involve the use of GMOs, so it will not have negatively impacted by the use of genetically modified organisms or GMOs.	Not required
>>			
Principle 9.4 Release of pollutants			
Could the Project potentially result in the release of pollutants to the environment?	No	The project is designed to introduces new animal waste management systems to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons. during the treatment process, the biogas was captured for power generation, the fermented sludge was treated in aerobic composting system, the wastewater was treated aerobically and then used for agriculture irrigation, so no pollutants release to the environment.	Not required
>>			
Principle 9.5 Hazardous and Non-hazardous Waste			

Will the Project involve the manufacture, trade, release, and/ or use of hazardous and non-hazardous chemicals and/or materials?	Potential	The project activity will replace the current open anaerobic lagoons with 10 new closed anaerobic digesters. The biogas generated during the treatment process will be captured for power generation. If biogas is not handled properly during the operation period of the project, methane explosion may be caused.	Required. For this project, the biogas will be generated during the treatment process, if biogas is not handled properly during the operation period of the project, methane leakage/explosion may be caused. So, the Mitigation Measures were needed. In this project, the mitigation measure for safeguarding principles was that project owner will conduct regular training on biogas safety and leakage to project employees to improve their proficiency in the treatment system and ensure that biogas leakage and safety hazards will not occur, and the employee training of biogas safety operation will be monitored through the training record. Also, the Mitigation Measure for Safeguarding Principles, i.e., the parameter of "Employee Training of biogas safety operation" will be monitored.
>>			
Principle 9.6 Pesticides & Fertilisers			
Will the Project involve the application of pesticides and/or fertilisers?	No	The project activity does not involve any application of pesticides and/or fertilizers.	Not required
>>			

Principle 9.7 Harvesting of Forests			
Will the Project involve the harvesting of forests?	No	The project activity does not involve the harvesting of forests.	Not required
>>			
Principle 9.8 Food			
Does the Project modify the quantity or nutritional quality of food available such as through crop regime alteration or export or economic incentives?	No	The project activity does not involve the modification of the quantity or nutritional quality of food available.	Not required
>>			
Principle 9.9 Animal husbandry			
Will the Project involve animal husbandry?	No	The project is designed to introduces new animal waste management systems in existing 10 swine farms to treat the manure and wastewater from the 10 swine farms to avoid methane emissions generated in the baseline uncovered anaerobic lagoons, belongs to waste disposal and resource utilization. The construction of the project will not affect existing swine farms, therefore it does not involve animal husbandry.	Not required
>>			
Principle 9.10 High Conservation Value Areas and Critical Habitats			

Does the Project physically affect or alter largely intact or High Conservation Value (HCV) ecosystems, critical habitats, landscapes, key biodiversity areas or sites identified?	No	The project is not located in an area within a high conservation value area or within critical natural habitats. The project activity does not physically affect or alter largely intact or High Conservation Value (HCV) ecosystems, critical habitats, landscapes, key biodiversity areas or sites identified. In addition, the "Measures for the Management of Livestock and Poultry Breeding in Jiangxi Province" clearly stipulate the prohibited construction area ⁵² , which contains the High Conservation Value (HCV) ecosystems, critical habitats, landscapes, key biodiversity areas or sites.	
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Principle 9.11 Endangered Species			
a. Are there any endangered species identified as potentially being present within the Project boundary (including those that may route through the area)?	No	There are no endangered species identified as potentially being present within the Project boundary. In addition, the new animal waste management systems used in the project will not pose a threat to any species.	Not required
b. Does the Project potentially impact other areas where endangered species may be present through transboundary affects?			
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⁵² http://jasygnlw.com/zhen/html/36082511/news_20181023162121.html

APPENDIX 2- CONTACT INFORMATION OF PROJECT PARTICIPANTS

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APPENDIX 3- LUF ADDITIONAL INFORMATION

Not applicable.

APPENDIX 4-SUMMARY OF APPROVED DESIGN CHANGES

Not applicable.

Revision History

Version	Date	Remarks
1.2	14 October 2020	Hyperlinked section summary to enable quick access to key sections Improved clarity on Key Project Information Inclusion criteria table added Gender sensitive requirements added Prior consideration (1 yr rule) and Ongoing Financial Need added Safeguard Principles Assessment as annex and a new section to include applicable safeguards for clarity Improved Clarity on SDG contribution/SDG Impact term used throughout Clarity on Stakeholder Consultation information required Provision of an accompanying Guide to help the user understand detailed rules and requirements
1.1	24 August 2017	Updated to include section A.8 on 'gender sensitive' requirements
1.0	10 July 2017	Initial adoption