Monitoring report form

Monitoring report

Title of the project activity	Yuqing Rural Methane Digesters Project in Guizhou Province.
Reference number of the project activity	GS2644
Version number of the monitoring report	Version 4.0
Completion date of the monitoring report	11/12/2021
Monitoring period	01/01/2017 to 31/12/2019 (first day and last day included)
Project participant(s)	Guizhou Honor Carbon Asset Management Co., Ltd
Host Party(ies)	P.R. of China
Sectoral scope(s) and applied methodology(ies)	Sectoral scope(s): Scope 1: Energy industries (renewable/non-renewable sources) Scope 13: Waste handling and disposal Applied methodology(ies): AMS-I.C. (Version 19.0): "Thermal energy production with or without electricity" AMS-III.R.(Version 03.0): "Methane recovery in agricultural activities at household/small farm level"
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	150,207 tCO_2e
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	136,582 tCO_2e[1]

[1] The emission reductions in this monitoring period has not been claimed under other GHG mechanisms, REC, etc.

SECTION A. Description of project activity

A.1. Purpose and general description of project activity

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Yuqing Rural Methane Digesters Project in Guizhou Province Yuqing (here after referred as 'the proposed project') is located in Yuqing County, Zunyi City, Guizhou Province, P .R. China. And the annual average temperature is 16.2℃.

Within the Area, the households have contributed to anthropogenic emissions, of which the following are related to the Project activity: CH_4 emissions from swine farms (every family has pigs, and their manure is responsible for CH_4 emissions, naturally vented into the atmosphere); CO_2 emissions from cooking based on burning of coal briquette and/or firewood.

The Project has installed 18,551 Rural Methane Digesters ("RMD" that will collect swine manure and other wastes, store the produced CH_4 (avoiding the CH_4 generation) and utilize the CH_4 for cooking purposes (reducing emissions from coal consumption). Each RMD has $8m^3$ capacity and an annual production of around $385m^3$ of biogas.

The project started construction on 18/03/2009 and put into operation on 28/05/2013. The project actual situation is in line with its GS registered PDD. And this project with GS ID: 2644 that 18,551 biogas digesters have been involved in the project and each of them capacity is $8m^3$.

This monitoring report is for the monitoring period, which is from and including 01/01/2017 to 31/12/2019. Total emission reductions achieved in this monitoring period are 136,582tCO_2e.

A.2. Location of project activity

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The project site is located in the ten townships of Yuqing County, Zunyi City, Guizhou Province, P .R. China. The location of the Project is shown in Table A1

Table A.1 Location of project counties

Town	Longitude	Latitude
Songyan	107.5085°E -107.6878°E	27.5565°N -27.7032°N
Guanxing	107.6725°E -107.8069°'E	27.4755°N -27.6312°N
Aoxi	107.5865°E -107.6852°E	27.4556°N -27.6023°N
Longjia	107.5231°E -107.5869°E	27.4043°N -27.5722°N
Dawujiang	107.5725°E -107.7885°E	27.2828°N -27.5326°N
Longxi	107.6568°E -107.8886°E	27.2969°N -27.3828°N
Xiaosai	107.6869°E -107.8778°E	27.1878°N -27.3069°N
Goupitan	107.4398°E -107.6787°E	27.2269°N -27.3896°N
Baini	107.7589°E -108.0385°E	27.1324°N -27.2789°N
Huashan	107.4388°E -107.5765°E	27.2852°N -27.4589°N

Figure A.1 Geographical location of Guizhou province in China

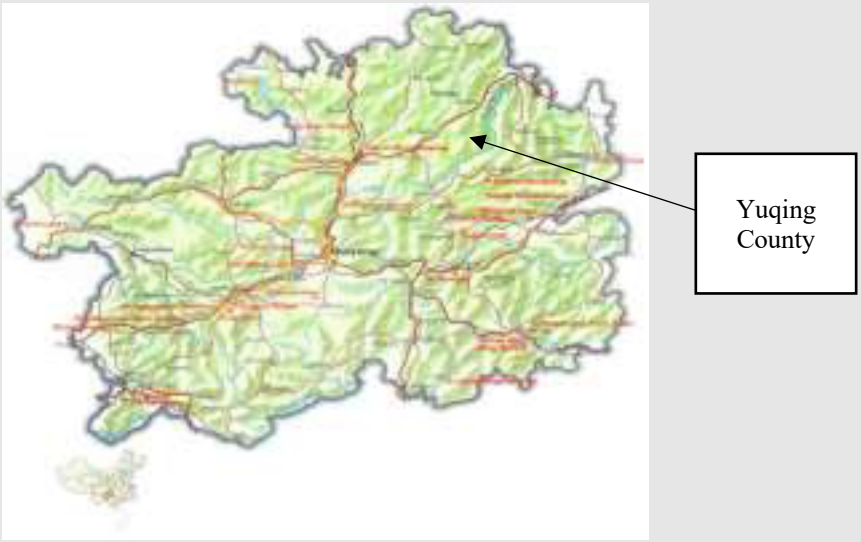

Figure A.2 Geographical location of Yuqing county in Guizhouprovince

Figure A.3 Geographical location of project activities in Yuqing county

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
P. R. China (Host)	Guizhou Honor Carbon Asset Management Co., Ltd (owner)	No

A.4. Reference of applied methodology

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The approved methodology that are applicable for the project includes "AMS-III.R: Methane recovery in agricultural activities at household/small farm level (Version 03.0) " and "AMS-I.C.: Thermal energy production with or without electricity (Version 19.0)"

The methodologies can be found from:

https://cdm.unfccc.int/methodologies/SSCmethodologies/approved

A.5. Crediting period of project activity

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The start date of the crediting period is 28/05/2013. Fixed 10 years.

The first monitoring period is 28/05/2013 – 31/12/2016.

The second monitoring period is 01/01/2017 – 31/12/2019.

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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The core of the project is the processor of decomposition of organic wastes. Under the anaerobic circumstance, the swine manure is decomposed by the cooperation of bacteria of hydrolysis, acidification and methanogen, generating methane. Given the methane digester be constructed, the manure is stored in deep pits and the methane from the slurry fermentation is emitted to the atmosphere. The generated methane is transmitted by pipe to the user and utilized as the energy resource for cooking and heating. The biogas slurry and residue are aerobically used as the organic in the dry vegetable fields. The following figure B.1 shows the process chart.

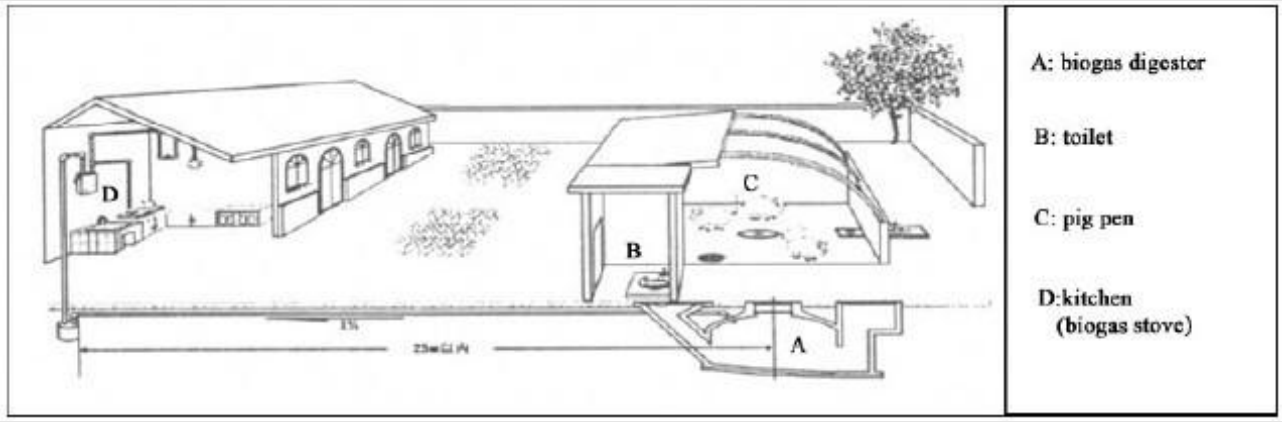

Figure B.1 Schematic diagram of methane production and utilization

According to the technical requirements of building methane digester in Yuqing County rural eco-energy construction technical specification, the methane digester of the Project was constructed in accordance with the design standard layout of Guizhou multi-function high-performance A, B-type pool. Its standard capacity is $8m^3$.

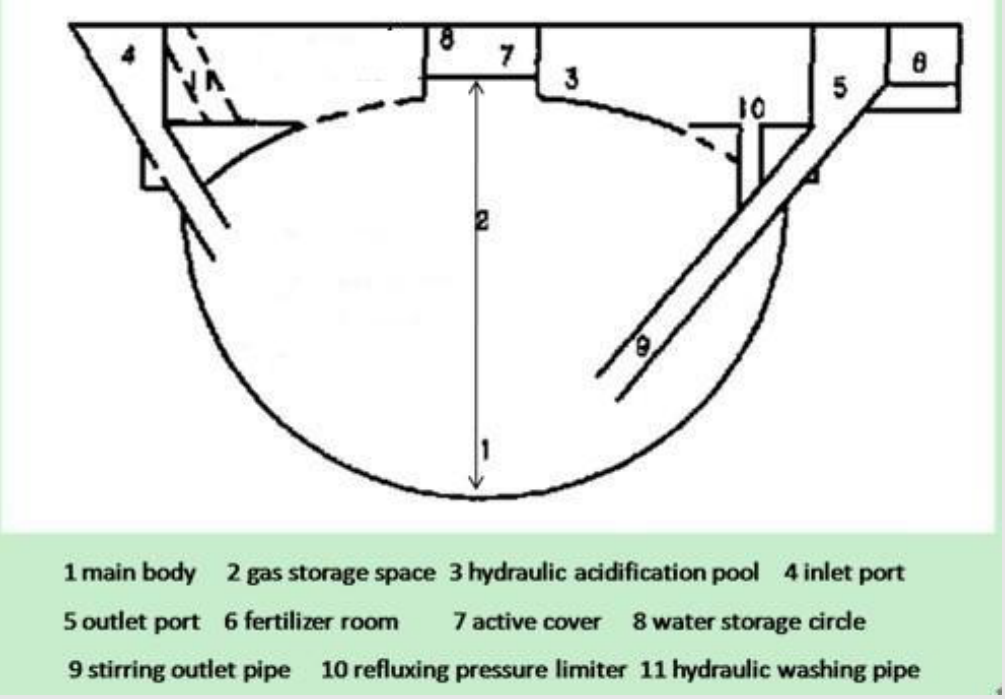

Figure B.2 Schematic diagram of A, B-type methane digester

The proposed project aims to install 18,551 domestic biogas stoves for rural households in Yuqing County to replace the traditional coal utilization for cooking and heating. This leads to the reduction of coal consumption and consequently the reduction of CO_2 emission. The rated power of each biogas stove is 2.33kW. Therefore, the total size of the project is 43.22MW (2.33*18,551*10-^{3}), below the 45 MW limit of the small scale CDM project.

The parameters of the biogas stove engaged in the project are listed below:

Parameters	Value	Justifications
Rated Power	2.33kW	The report by the third party.
Thermal Efficiency	≥55%	The minimum value stipulated by National Standard of P.R .China (GB/T3606-83) domestic biogas stove.
Technical life of equipment	15 year	Required by the project owner and confirmed by stove manufacturer.

B.2. Post registration changes

B.2.1. Temporary deviations from registered monitoring plan or applied methodology

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Not applicable. There are no temporary deviations from registered monitoring plan or applied methodology.

B.2.2. Corrections

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Not applicable. There are no corrections from registered PDD.

B.2.3. Permanent changes from registered monitoring plan or applied methodology

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Not applicable. There are no permanent changes from registered monitoring plan or applied methodology

B.2.4. Changes to project design of registered project activity

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Not applicable. There are no changes to project design of registered project activity

B.2.5. Changes to start date of crediting period

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No changes to the start date of crediting period.

B.2.6. Types of changes specific to afforestation or reforestation project activity

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Not applicable. The project is not an afforestation or reforestation project.

SECTION C. Description of monitoring system

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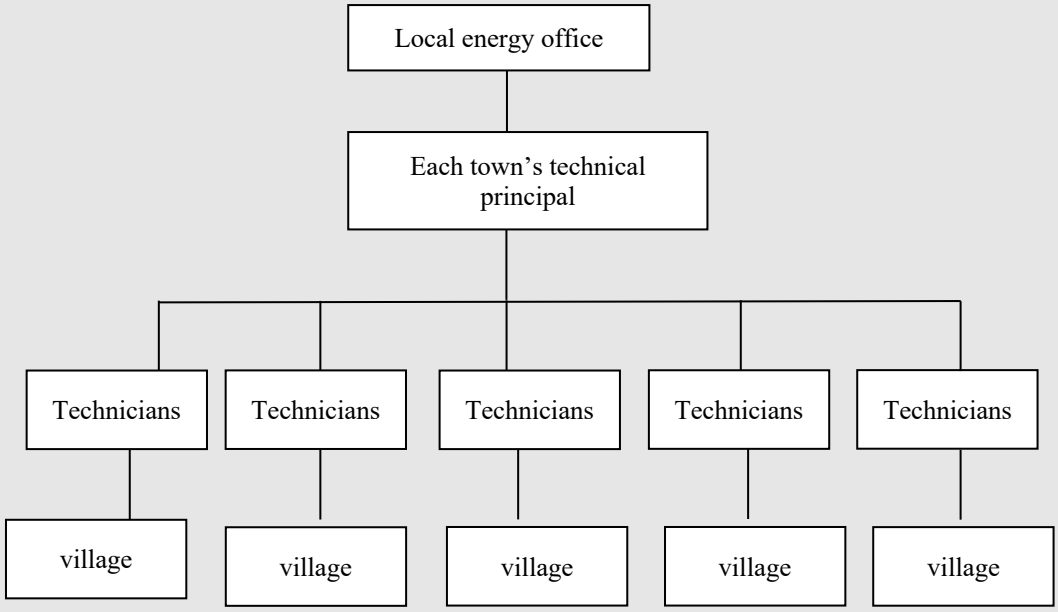
1. Monitoring structure and responsibility

In order to guarantee the proposed project's real, measurable and long-term GHG emission reductions, are liable, transparent and all-around monitoring plan is established, as well as a system for data estimating, measuring, tracking, collecting and archiving. The following six sections are included in the monitoring plan and sampling plan:

1.1 Structure



1.2 Responsibilities:

A. The local energy office

In charge of organizing technicians to repair and maintain the digesters, preparing the monitoring and sampling during the periods then collecting, gathering and storing the data. The local energy office has the list of all the RMD systems, and the unique ID (serial number) is given to every biogas digester of peasant household and used in the project management procedure with the relevant information of biogas digester, such as location and serial number put on record in the local energy office. They have reviewed the monitoring data collected by technicians to ensure no double counting of emission reductions would occur.

B. Each town's technical principals
Appoint persons to sample, collect, gather and report the data. Hold the responsibility for maintenance arrangement.

C.Technicians in each village
In charge of investigation, collection and reporting the sampling results, as well as take charge of maintenance and repairing the digesters all over the village. If the biogas stove or digester is not operated well or damaged, the household can phone the technician in the village. The technician will repair it immediately.

D. Farmers
Cooperate with technicians in filling up the monitoring sheets.

2. Quality assurance and quality control procedures

The sampling plan has been establishing at the beginning of the year by local rural energy office, according to which 328 households are monitored. Each technician who gains the qualification records and reports the monitoring data every month to principals who gather and report the data to local rural energy office. After these, all the database and information is kept by local rural energy office. And quality procedures are followed:

a. All the investigators and technicians acquire the relevant training (data collection, data analysis). Before starting work, they had taken the training of professional knowledge and GS knowledge, acquired the work permit.

b. All the survey forms were sent to every sampled peasant household at the beginning of each year, the technicians collected the forms at the ending of every year and kept them in the energy office. The sampled peasant households were renewed every year.

c. All the monitoring data of the project activity was kept as electronic form and paper version in the local rural energy office.

And all the date must be kept at least 2years after the end of the crediting period, as well regular verification.

2.1 **Sampling Objective**

This sampling plan is for 18,551 Rural Methane Digesters Project in Guizhou Province, China. The project had installed 18,551 household biogas digesters with the same type, same category and same technology in Yuqing county. There are 3 variables and two incidents to be sampling: the annual operating hours of the biogas digesters, the daily operating hours of the biogas stove, the pigs of each household bred, the proper soil application of the final sludge, and the amount manure generated by the swine and fed into the digester. The three variables and two incidents are determined according to "*Guidelines for sampling and survey for CDM project activities and programmed of activities (Version 02.0)"* during the crediting period, and with a 90/10 confidence/precision.

2.2 **Sample Method.**

Because the biogas digester of peasant households is numerous and scattered, the type and utilized technology of methane tanks are identical, stratified random sampling is adopted in order that each one can be selected with equal probability. The strata should be mutually exclusive: every element in the population must be assigned to only one stratum. The sample is drawn at random from the sampling frame. This can be done using random number tables, and the ordering of subjects on the sample should be random and free of any trend or cyclical pattern.

2.3 **Desired Precision/Expected Variance and Sample Size**

Step1: As per Elementary Statistics: a brief version, Allan G. Bluman, published by McGraw-Hill Higher Education

$$n_1 = \frac{Z^2\sigma^2}{d^2}$$

Where:

Z: the symbol used in general formula for confidence intervals. It is 1.645 when confidence interval is 90%;

σ: the population standard deviation, which is not available to PP;

d: the maximum error of estimate.

Step2: Deformation of basic formula

As per Sample Size Determination in Marketing Research, XIANG Caifa from Shanghai Statistics Information and Consulting Service Center published on Shanghai Statistics

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

Where:

V: the coefficient of variation, and V=σ/X. As population standard deviation σ shall be smaller than the sample mean value X, hence from conservative consideration point of view, making V=1 can get the biggest sample size. It is conservative.
e: the relative sampling error, and e=d/X, which is the precision. In this case, e=10% as discussed above.

Consequently, n1=Z2V2/e2 =1.6452/0.12=270.6, and round up to be 271.

Step3: Correction based on population size

As per Sampling Theory and Methodology, published by China Statistics Press

$$n_2 = \frac{n_1 N}{n_1 + N}$$

Where:

N, the population size, it is 18,551 under project context.

Consequently

n2=n1*N/(n1+N)=271*18,551/(271+18,551)=267.09, and round up to be 268, it take n2=268 is preferable.

Step4: Correction based on sampling approach

As per Sampling Design and Methodology, written by SHEN Hao from Survey & Statistics Institute of BBI

n3=Bn2

Where:
B, the survey design effect. As discussed in Procedures for Administering Data Collection and Minimizing Non-Sampling Errors. The project adopts stratified random sampling approach.
In this case, B≤1 as per Sampling Design and Methodology. It's conservative consideration.
Consequently, n3=B*n2=1*n2=268

Step5: Correction based on responding rate

As per Sampling Design and Methodology, written by SHEN Hao from Survey & Statistics Institute of BBI

n4=n3/r

Where:
The responding rate is adopted to be less 90% according to registered PDD .

Consequently, n4=n3/r=268/90%=297.78, round up to be 298

Step6: Correction based on contingency consideration

n=110%n4

Where:

Consequently, the sample size n=110%*n4=110%*298=327.8, round up to be 328

3. Quality assurance

Stage 1. Calculate the ratio of household numbers of each town in the whole programme. According to the ratio household umbers of each town, calculate the sampling size of each town, and then set the amount of sampling 328 households, the ctual sampling size is the ratio of each town multiply by 328.

Table1: Sampling number of biogas system in each county

Town	Number	Portion	Sampling size
Songyan	2493	13.44%	44
Guanxing	1,310	7.06%	23
Aoxi	2,377	12.81%	42
Longjia	1,767	9.53%	31
Dawujiang	1,706	9.20%	30
Longxi	1,490	8.03%	26
Xiaosai	2,714	14.63%	48
Goupitan	2,694	14.52%	48
Baini	590	3.18%	11

Huashan	1,410	7.60%	25
Total	18,551	100%	328

Stage 2. On the basis of actual sampling size, take samples of peasant households randomly from every town, and monitoring period is one year. Renew the sampling box every year by method mentioned.

The survey forms are uniform formulated by local energy office, and they are sent to every sampled peasant household, train all the certified technicians unifiedly.

Every technician surveys the sampled peasant households fill in the date and signature monthly, the survey forms are collected by energy office, and energy offices summarizes and keep the survey forms. If any of the data are missing or unclear, the smaller value in the previous record is adopted as the record of this time for conservative calculation.

Implementation

This sampling process is carried out by local energy office under the supervision of the superior leaders. They have received the professional sampling training. After finish sampling, they have to sign the name on the sampling paper. Once the sampling households are determined, the technicians would hand out the monitoring sheets to the households listed in the sample. Then the result of questionnaires/monitoring sheets are recorded and checked monthly by the technicians. After the technicians report the results to the local energy office after this monitoring period, the local energy office type and summarize the data yearly. Finally the monitoring data is got out to verify the Emission Reductions of the project activity. The sampling box will be updated each year.

SECTION D. Data and parameters

D.1. Data and parameters fixed ex ante or at renewal of crediting period

Data / Parameter	GWP_{CH4}
Unit	dimensionless
Description	Global warming potential for CH_4
Source of data	The second commitment period of the Kyoto protocol
Value(s) applied	25
Choice of data or Measurement methods and procedures	/
Purpose of data	Baseline emission calculations
Additional comment	-

Data / Parameter	$B_{o,LT}$
Unit	$m^3CH_4kg^{-1}$of VS excreted
Description	Maximum methane producing potential of the manure type treated in the biogas
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.4, Ch.10. Table 10A-7
Value(s) applied)	0.29
Choice of data or Measurement methods and procedures	/
Purpose of data	Baseline emission calculations
Additional comment	-

Data / Parameter	$VS_{LT,y}$
Unit	kg dry matter animal/day
Description	Volatile solids for livestock LT entering the animal manure management system in year y
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories Vol.4, Ch.10. Table 10A-7
Value(s) applied	0.3
Choice of data or Measurement methods and procedures	There is no site-specific value in the project site. The average weight of swine is more than IPCC default. Therefore, in this case, the IPCC default value could be used. It's conservative
Purpose of data	Baseline and project emission calculations
Additional comment	NA

Data / Parameter	D_{CH4}
Unit	t/m^3
Description	Density of methane
Source of data	Methodology AMS-III.D (Version 19.0)
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	Baseline and project emission calculations
Additional comment	-

Data / Parameter	UF_b
Unit	/
Description	Model correction factor to account for model uncertainties
Source of data	Methodology AMS-III.D (Version 19.0)
Value(s) applied)	0.94
Choice of data or Measurement methods and procedures	According to methodology AMS-III.D (version 19.0)
Purpose of data	Baseline emission calculations
Additional comment	NA

Data / Parameter	$MS\%_{Bl,j}$
Unit	%
Description	Fraction of manure handled in baseline animal manure management system j
Source of data	/
Value(s) applied)	100
Choice of data or Measurement methods and procedures	In this propose project, the biogas digesters were constructed under the piggery, as the pigs are kept in a confined area and do not leave the area in baseline or project scenario, therefore, it just take swine to calculate the methane emission. It's conservative.
Purpose of data	Baseline emission calculations
Additional comment	NA

Data / Parameter	$\eta_{BL,thermal}$

Unit	%
Description	Thermal efficiency for the traditional coal furnace of the baseline situation
Source of data	1)Referenced literature value "Clean Energy for Development and Economic Growth: Biomass and Other Renewable Energy Options to Meet Energy and Development Needs in Poor Nations",UNDP,2002 Httpp://www.undp.org/energy/publications/2002/2002b.htm 2) The on-site measurement data of thermal efficiency of traditional coal stoves in project case by the Local energy office.
Value(s) applied	25
Choice of data or Measurement methods and procedures	1) According to the related referenced literature, it is cited in the page 8 of the publication reference issued by UNDP that "the most common method of cooking throughout rural areas of the developing country is the open hearth or three-stone fire, which typically transfers only 5-15 per cent of the fuel's energy into the cooking pot. Besides the reference of UNDP, it is also reported in page17 of "Improved Household Stoves in China: An Assessment of the National Improved Stove Program of the reference source that the measured efficiency for traditional coal stoves is 10-15% in China. 2)In this project, the highest efficiency of household coal cooking stove from test report of Local energy office is determined to be25%, according to the option (a) and (c) of paragraph 30 of methodology AMS-I.C.(Version19.0),following conservative principle, 25% shall be chosen as the baseline thermal efficiency for the traditional coal stoves.
Purpose of data	Baseline emission calculations
Additional comment	NA

Data / Parameter	$KW_{thermal}$
Unit	kW
Description	The thermal capacity of the biogas stove for household
Source of data	Test report by the third party on Feb. 2012
Value(s) applied	2.33
Choice of data or Measurement methods and procedures	Biogas stove failing to work should be repaired timely or if the stove is replaced, the rated power will be record according to the product technical specification provided by biogas stove manufacturers or the third party.
Purpose of data	Baseline emission calculations
Additional comment	NA

Data / Parameter	DI
Unit	%
Description	Thermal efficiency of biogas stove
Source of data	Biogas stove manufacturer technical evaluation value or experts assess value from the third party
Value(s) applied	55
Choice of data or Measurement methods and procedures	/
Purpose of data	Baseline emission calculations
Additional comment	NA

D.2. Data and parameters monitored

Data / Parameter	$N_{LT,y}$
Unit	head
Description	Average number of pigs in this monitoring period
Source of data	Sampling survey
Value(s) of data	4.290 (01/01/2017 - 31/12/2017) 4.231 (01/01/2018 - 31/12/2018) 3.315 (01/01/2019 - 31/12/2019)
Measurement methods and procedures	The monitoring is conducted monthly on the selected sample users determined at the beginning of each monitoring period. The data is summarized calculate and archived monthly.
Monitoring frequency	Every monitoring period
QA/QC procedures	Technician train and guide the farmers how to record. The consistency between the value and indirect information are cross checked by technician, and technician take on-site inspection monthly to confirm the actual situation.
Purpose of data	Used for emission reduction calculation
Additional comment	-

Data / Parameter	N_d
Unit	unit
Description	The annual number of biogas systems including the digesters and biogas stoves engaged in the proposed project
Source of data	Sampling survey
Value(s) of data	18,529 (01/01/2017 - 31/12/2017) 18,534 (01/01/2018 - 31/12/2018) 16,417 (01/01/2019 - 31/12/2019)
Measurement methods and procedures	The technician in every village monitors and records each system including biogas digester and biogas stove to confirm whether it works well.
Monitoring frequency	Monthly
QA/QC procedures	The unique ID (serial number) is given to every biogas digester of peasant household and used in the project management procedure, and the relevant information of biogas digester, such as name, location and serial number, is put on record in the local energy office. In the event of methane digester is disused, the technician writes down the reason clearly, and report it to the local energy office immediately. The energy office records it in the archives of participating households and verifies it. Since periodical patrol and maintenance is the work of Methane Service Centers, the number can be cross checked by them.
Purpose of data	Calculate the emission reduction
Additional comment	/

Data / Parameter	$H_{digester}$
Unit	h
Description	Annual operation hours of biogas digester
Source of data	Sampling survey
Value(s) of data	8752.945 (01/01/2017 - 31/12/2017) 8753.079 (01/01/2018 - 31/12/2018) 8753.141 (01/01/2019 - 31/12/2019)
Measurement methods and procedures	The monitoring will be conducted yearly on the selected sample uses determined at the beginning of each year. The data will be summarized calculate and archived yearly by the GS Department.
Monitoring frequency	Annually

QA/QC procedures	1. The project has established a perfect monitoring organization, in which all elements are equipped with corresponding personnel, and relevant personnel have received corresponding training. Yuqing Energy Office supervises and manages the whole monitoring system to ensure its reliable operation. 2. The sampling plan has been establishing at the beginning of the year by local rural energy office, according to which 328 households are monitored. The sampled peasant households were renewed every year. 3. The time that biogas digester cannot run normally due to maintenance and other reasons was deducted. Technicians personally check and sign for confirmation, and make statistics every year. At the same time, the technicians would check the use and monitoring of farmers from time to time and give guidance.
Purpose of data	Calculate the emission reduction
Additional comment	/

Data / Parameter	$MS\%_{i,y}$
Unit	%
Description	The amount of pig manure fed into the biogas digester
Source of data	Sampling survey
Value(s) of data	100
Measurement methods and procedures	As the biogas digesters are usually installed below the pig pen and the inlet will be directly connected to livestock room so that the manure can be drained into the digester directly, there is no incremental transportation as per the site of manure in baseline and project scenario. 100% swine manure generated in individual household will be fed into the biogas digesters, because the biogas digester was built under the pig pen, the pigs are kept in a confined area and do not leave the area in project scenario, all animal manure generated would fed in to the biogas digester, and the technicians will do random checks to ensure the manure is consistent with the capacity of the digester.
Monitoring frequency	Monthly
QA/QC procedures	/
Purpose of data	to calculate the emission reductions
Additional comment	-

Data / Parameter	Application of sludge
Unit	/
Description	The proper application of biogas sludge
Source of data	Sampling survey
Value(s) of data	100%
Measurement methods and procedures	The final sludge is used for soil application. The proper soil application of the final sludge is recorded on a sampling basis and reported to the local energy office after every application.
Monitoring frequency	Every application
QA/QC procedures	The technicians are in charge of treatment of methane manure, each time they check and record the exact methods of treatment and resolve the immediate rectification problem.
Purpose of data	Calculate the emission reduction
Additional comment	-

Data / Parameter	H_{stove}
Unit	h
Description	Average operating hours of the biogas stove for household during the monitoring period
Source of data	Sampling survey

Value(s) of data	1374.21 (01/01/2017 – 31/12/2017) 1379.90 (01/01/2018 - 31/12/2018) 1319.54 (01/01/2019 - 31/12/2019)
Measurement methods and procedures	The operating hours of the stoves are conducted and daily recorded on the stove operation record table by each household user, which can be determined on sample in selected households. The data is monthly analyzed of average, summarized by the local energy office.
Monitoring frequency	Monthly
QA/QC procedures	In daily operation, the technicians train and guide the farmers how to record. The technicians check the data recorded in the sheet and sign for confirmation.
Purpose of data	Calculate emission reductions
Additional comment	-

Data / Parameter	$EF_{FF,CO2}$
Unit	tCO_2/TJ
Description	Carbon emission factor per unit of energy of coal that would have been used in the baseline
Source of data	Published data by China DNA
Value(s) of data	87.3
Measurement methods and procedures	/
Monitoring frequency	Review appropriateness of the values annually
QA/QC procedures	/
Purpose of data	Calculate emission reductions
Additional comment	-

Data / Parameter	T
Unit	℃
Description	Average ambient temperature at city weather station nearby Project site of this monitoring period
Source of data	Certification of Local Bureau of Meteorology
Value(s) of data	16.4℃ (01/01/2017 – 31/12/2017) 16.1℃ (01/01/2018 - 31/12/2018) 16.1℃ (01/01/2019 - 31/12/2019)
Measurement methods and procedures	/
Monitoring frequency	Office source meteorological data. Used to select the annual MCF from IPCC. MCF was selected based on the annual average temperature from Local Meteorological Station. Monthly monitoring and average annually
QA/QC procedures	Average the monthly mean temperature and get the average temperature during the monitoring period. The data is official source and no addition QA/QC procedures may need to be planned.
Purpose of data	Calculate emission reductions
Additional comment	-

Data / Parameter	MCF_j
Unit	%
Description	Annual methane conversion factors for each manure management system j
Source of data	Certification of Local Bureau of Meteorology
Value(s) of data	29 (01/01/2017 – 31/12/2017) 29 (01/01/2018 - 31/12/2018)

	29 (01/01/2019 - 31/12/2019)
Measurement methods and procedures	Yuqing county locates in the south of China. When the biogas digester was not constructed in the city, the livestock's manure was typically stored in an enclosed animal confinement facility (i.e. pit storage). According to the definition of manure management system in IPCC 2006 Guidelines for National Greenhouse Gas Inventories (volume 4 Chapter. 10: Livestock Emissions), pit storage below animal confinement is used for baseline calculation purposes. In accordance with the certification from the local Bureau of Meteorology, during the monitoring period (01/01/2017 – 31/12/2017) , the annual average temperatures is 16.4℃. So according to conservation, the methane conversion factors (MCF) is 29%. During the monitoring period (01/01/2018 - 31/12/2018) the annual average temperatures is 16.1℃, the methane conversion factors(MCF) is 29%. And during the monitoring period (01/01/2019 – 31/12/2019) the annual average temperatures is 16.1℃, the methane conversion factors (MCF) is 29%. Please refer to Table 10.17.
Monitoring frequency	Review appropriateness of the values annually
QA/QC procedures	Review appropriateness of the values annually
Purpose of data	Calculate emission reductions
Additional comment	-

SD parameters

Indicator		**Air quality**
Chosen Parameter		Concentrations and emissions of SO_2 and particulate pollutants
Current situation of parameter		Due to the implementation of the Project, as households stopped using coal as fuel, the production of sulfur dioxide and particulate matter was reduced. The 328 questionnaires of the monitoring survey show： that the indoor air is getting better 326 are scored +, 1 scored 0.(01/01/2017–31/12/2017) that the indoor air is getting better 325 are scored +, 2 scored 0. (01/01/2018–31/12/2018) that the indoor air is getting better 327 are scored +, 0 scored 0. (01/01/2019–31/12/2019)
Estimation of baseline situation of parameter		Under the baseline situation, there're emissions of sulfur dioxide and a lot of particulate pollutants caused by burning fossil fuel (coal) for cooking and heating.
Future target for parameter		Project activity involves switching over from coal to renewable biogas, generated from anaerobic biogas digesters by utilizing swine manure. Therefore, it has direct positive effects on the air and in particular to improvement of indoor air quality. It's indicated by the publicly accessible research that through the implementation of the project with replacing the consumption of fossil fuels, the emissions of sulphur dioxide and particulate pollutants are reduced.
Monitoring method		Survey local stakeholders. The questionnaires are sent to local stakeholders by the local rural energy office.
Way of Monitoring	How	Householders have been interviewed to compare and comment the smoke quantity in the kitchen along with ER monitoring survey. During the monitoring survey visit, each sampled household was interviewed on this parameter as "Do you have a lot of smoke in the kitchen while cooking? ("-"= a lot of smoke very often; "0"=just a little smoke; "+"=no smoke)" before and after digester construction and normally answered by the housewife who cooks in the kitchen. The monitoring result of this SD indicator is calculated as the average of the chosen index of each sampled household. The indices are "+" after biogas digester installation, respectively. It reached the target in the GS passport, i.e. the quantity of smoke in the kitchen is decreased.
	When	May 2017，May 2018，May 2019
	By who	PP

Indicator		Soil condition
Mitigation measure		-
Chosen parameter		Soil refilling
Current situation of parameter		All the households have got the training regard to how to deal with the sludge, and let them know the sludge is a good fertilizer. During the monitoring, the final sludge have been used for soil application. 100% for dry fertilizer (01/01/2017 – 31/12/2017) 100% for dry fertilizer (01/01/2018 – 31/12/2018) 100% for dry fertilizer (01/01/2019 – 31/12/2019)
Estimation of baseline situation of parameter		0
Future target for parameter		In the future, households will continue to use the sludge from biogas digesters to improve the soil fertility, increase the concentration of soil organic matter and the content of nitrogen, phosphorus, potassium and other nutrients.
Way of monitoring	How	Based on the results of the actual record form of 328 households sampled annually, the technician will record the time of dregs extraction at the time of dregs extraction, and check that the dregs of the digesters have been used as fertilizer. Statistics will be carried out at the end of each year.
	When	Annually (May 2017，May 2018，May 2019)
	By who	Local energy office representatives

Indicator		Quality of the employment
Mitigation measure		-
Chosen parameter		Training, labour conditions
Current situation of parameter		In each year of the monitoring period, all participating households and all technicians received training in biogas technology and use.
Estimation of baseline situation of parameter		The target locations are very mountainous and rural, and the households are unlikely to have the knowledge and capacity to operate and maintain the Related technology of biogas digester adequately by themselves.
Future target for parameter		Master the basic operation knowledge, maintenance knowledge and maintenance knowledge of biogas digester and stove.
Way of monitoring	How	Interview with biogas digesters and household technicians During the monitoring survey visit, each sampled household was interviewed on this parameter as “Have you got the training on the use of biogas and basic knowhow of maintenance of digesters and biogas stove?” The monitoring survey shows that all the sampled households have received such training. Training materials about the use of bio-digesters and biogas stove have been provided to the DOE.
	When	Annually (May 2017，May 2018，May 2019)
	By who	Local energy office representatives and PP

Indicator		Quantitative employment and income generation
Mitigation measure		-
Chosen parameter		Number of jobs created and the staff salaries paid by the project
Current situation of parameter		In this monitoring period, the technical personnel involved in the construction and maintenance of biogas digesters have received income. The technicians are also employed by the local energy office because of the project, and they have a fixed annual salary. The number of fixed jobs and salary in this monitoring period is shown as follows 27 jobs, 1,800CNY/month/person in 2017 27 jobs, 1,900CNY/month/person in 2018 27 jobs, 1,950CNY/month/person in 2019
Estimation of baseline situation of parameter		0
Future target for parameter		In the future, it will continue to provide employment opportunities for the technical personnel involved in the project, and continuously improve their employability and level through organizational training. Pay them on time.
Way of monitoring	How	During the monitoring investigation, the energy office provided a list of technicians involved in the daily maintenance of biogas digesters. According to the list, representatives of the energy agency, through a telephone interview with them, learned that they had earned income from the construction and maintenance of biogas digesters.
	When	Annually
	By who	Local energy office representatives and PP

Indicator		**Livelihood of the poor**
Mitigation measure		-
Chosen parameter		Money spent to collect fuel
Current situation of parameter		0 CNYin 2017 0 CNYin 2018 0 CNYin 2019
Estimation of baseline situation of parameter		Local farmers spend about 350 yuan to buy coal. This project increases the cost of living. Before the project implementation, the local people consume about 1 ton coal annualy
Future target for parameter		The Project can help digester users reduce the expenditures from purchasing coal. The local agricultural labour will be hired to assist with the Project operation, maintenance and monitoring, which will increase their income.
Way of monitoring	How	Survey local stakeholders
	When	Annually (May 2017，May 2018，May 2019)
	By who	Local energy office representatives and PP

D.3. Implementation of sampling plan

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D.3.1 Sampling Objective

This sampling plan is for 18,551 Rural Methane Digesters Project in Guizou Province, China. The project had installed 18,551 household biogas digesters with the same type, same category and same technology in Yuqing county. The following variables and incidents are to be sampling: the annual operating hours of the biogas digesters, the daily operating hours of the biogas stove, the pigs of each household bred, the proper soil application of the final sludge, and the amount manure generated by the swine and fed into the digester, Air Quality, Soil condition, Quality of employment, Livelihood of the poor. The variables and incidents are determining the mean value of parameter during the crediting period, and with a 90/10 confidence/precision.

D.3.2 Sample Method.

Because the biogas digester of peasant households is numerous and scattered, the type and utilized technology of methane tanks are identical, stratified random sampling is adopted in order that each one can be selected with equal probability. The strata should be mutually exclusive: every element in the population must be assigned to only one stratum. The sample is drawn at random from the sampling frame. This can be done using random number tables, and the ordering of subjects on the sample should be random and free of any trend or cyclical pattern.

D.3.3 Desired Precision/Expected Variance and Sample Size.

Step1: As per Elementary Statistics: a brief version, Allan G. Bluman, published by McGraw-Hill Higher Education

$$n_1 = \frac{Z^2\sigma^2}{d^2}$$

Where:

Z: the symbol used in general formula for confidence intervals. It is 1.645 when confidence interval is 90%;

σ:the population standard deviation, which is not available to PP.

d: the maximum error of estimate.

Step2: Deformation of basic formula

As per Sample Size Determination in Marketing Research, XIANG Caifa from Shanghai Statistics Information and Consulting Service Center published on Shanghai Statistics

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

Where:

V, the coefficient of variation, and V=σ/X. As population standard deviation σ shall be smaller than the sample mean value X, hence from conservative consideration point of view, making V=1 can get the biggest sample size. It is conservative.

e: the relative sampling error, and e=d/X, which is the precision. In this case, e=10% as discussed above.

Consequently, n1=Z2V2/e2 =1.6452/0.12=270.6, and round up to be 271.

Step3: Correction based on population size

As per Sampling Theory and Methodology, published by China Statistics Press

$$n_2 = \frac{n_1 N}{n_1 + N}$$

Where:

N, the population size, it is 18,551 under project context.

Consequently

n2=n1*N/(n1+N)=271*18,551/(271+18,551)=266.3, and round up to be 268, it take n2=268 is preferable.

Step4: Correction based on sampling approach

As per Sampling Design and Methodology, written by SHEN Hao from Survey & Statistics Institute of BBI

$$n_3 = Bn_2$$

Where:

B, the survey design effect. As discussed in Procedures for Administering Data Collection and Minimizing

Non-Sampling Errors. The project adopts stratified random sampling approach.

In this case, B≤1 as per Sampling Design and Methodology. It's conservative consideration.

Consequently, n3=B*n2=1*n2=268

Step5: Correction based on responding rate

As per Sampling Design and Methodology, written by SHEN Hao from Survey & Statistics Institute of BBI

$$n_4 = \frac{n_3}{r}$$

Where:

The responding rate is adopted to be less 95% according to Rural Household Biogas Investigation report of Yuqing county, Zunyi city.

Consequently, n4=n3/r=268/90%=297.78, round up to be 298

Step6: Correction based on contingency consideration

n=110%n_4

Where:

Consequently, the sample size n=110%*n4=110%*298=327.8, round up to be 328

D.3.4 Quality Assurance

Stage 1. Calculate the ratio of household numbers of each town in the whole program. According to the ratio household numbers of each town, calculate the sampling size of each town, and then set the amount of sampling 328 households, the actual sampling size is the ratio of each town multiply by 328.

Table1: Sampling number of biogas system in each county

Town	Number	Portion	Sampling size
Songyan	2493	13.44%	44
Guanxing	1,310	7.06%	23
Aoxi	2,377	12.81%	42
Longjia	1,767	9.53%	31
Dawujiang	1,706	9.20%	30
Longxi	1,490	8.03%	26
Xiaosai	2,714	14.63%	48
Goupitan	2,694	14.52%	48
Baini	590	3.18%	11
Huashan	1,410	7.60%	25
Total	18,551	100%	328

Stage 2. On the basis of actual sampling size, take samples of peasant households randomly from every town, and monitoring period is one year. Renew the sampling box every year by method mentioned.

The survey forms are uniform formulated by local energy office, and they are sent to every sampled peasant household, train all the certified technicians unifiedly.

Every technician surveys the sampled peasant households fill in the date and signature monthly, the survey forms are collected by energy office, and energy offices summarizes and keep the survey forms. If any of the data are missing or unclear, the smaller value in the past record is adopted as the record of this time for conservative calculation.

Implementation

This sampling process is carried out by local energy office under the supervision of the superior leaders. They have received the professional sampling training. After finish sampling, they have to sign the name on the sampling paper. Once the sampling households are determined, the technicians would hand out the monitoring sheets to the households listed in the sample. Then the result of questionnaires/monitoring sheets are recorded and checked monthly by the technicians. After the technicians report the results to the local energy office after this monitoring period, the local energy office type and summarize the data yearly. Finally the monitoring data is got out to verify the Emission Reductions of the project activity. The sampling box will be updated each year.

The grievance book, including the GS email info@goldstandard.org and and phone number +41 (0) 22 788 7080 was put in the office of each village. The stakeholder who have comments on this project can put down his opinion and suggestions on the book. During this monitoring period, no comment was received for this project.

SECTION E. Calculation of emission reductions or GHG removals by sinks

E.1. Calculation of baseline emissions or baseline net GHG removals by sinks

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Calculation of baseline emissions or baseline net GHG removals by sinks

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

For Monitoring period (01/01/2017– 31/12/2017)

$N_{LT,Y}$= 4.290 head/household

$H_{digester}$= 8752.945h

$BE_{CH4,y}$=25×0.00067×0.94×29%×0.29×4.290×0.3×100%×(8752.945/24)=0.6215 tCO_2e/household

For Monitoring period (01/01/2018– 31/12/2018)

$N_{LT,Y}$= 4.231 head/household

$H_{digester}$= 8753.079h

$BE_{CH4,y}$=25×0.00067×0.94×29%×0.29×4.231×0.3×100%×(8753.079/24)=0.6219 tCO_2e/household

For Monitoring period (01/01/2019– 31/12/2019)

$N_{LT,Y}$= 3.315 head/household

$H_{digester}$= 8753.141h

$BE_{CH4,y}$=25×0.00067×0.94×29%×0.29×3.315×0.3×100%×(8753.141/24)=0.4802 tCO_2e/household

2. Baseline CO_2 emission from coal consumption

$$BE_{thermal,CO2,y} = (EG_{thermal,y} / \eta_{BL,thermal}) * EF_{FF,CO2}$$

For Monitoring period (01/01/2017– 31/12/2017)

$EG_{themal,y}$=kW_{themal}×H_{stove}×DI=2.33×1374.21×55%×3600 =6,339,780 KJ

$BE_{themal,CO2,y}$=(6,339,780/25%)×87,300×10^{-12}=2.2138 tCO_2e/household

For Monitoring period (01/01/2018– 31/12/2018)

$EG_{themal,y}$=kW_{themal}×H_{stove}×DI=2.33×1379.70×55%×3600 =6,365,107 KJ

$BE_{themal,CO2,y}$=(6,365,107/25%)×87,300×10^{-12}=2.2226 tCO_2e/household

For Monitoring period (01/01/2019– 31/12/2019)

$EG_{themal,y}$=kW_{themal}×H_{stove}×DI=2.33×1319.54×55%×3600 =6,087,565 KJ

$BE_{themal,CO2,y}$=(6,087,565/25%)×87,300×10^{-12}=2.1257 tCO_2e/household

Total baseline emission: $BE_y = BE_{CH4,y} + BE_{thermal,CO2,y}$

For Monitoring period (01/01/2017– 31/12/2017), $BE_y = BE_{CH4,y} + BE_{thermal,CO2,y}$ =2.8353 tCO_2e/household

For Monitoring period (01/01/2018– 31/12/2018), $BE_y = BE_{CH4,y} + BE_{thermal,CO2,y}$ =2.8355 tCO_2e/household

For Monitoring period (01/01/2019– 31/12/2019), $BE_y = BE_{CH4,y} + BE_{thermal,CO2,y}$ =2.6059 tCO_2e/household

E.2. Calculation of project emissions or actual net GHG removals by sinks

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

For Monitoring period (01/01/2017– 31/12/2017)

$PE_y = PE_{PL,y}$=0.1×25×0.00067×0.29×4.290×0.3×100%×（8752.945/24）=0.2280 tCO_2e/household

For Monitoring period (01/01/2018– 31/12/2018)

$PE_y = PE_{PL,y}$=0.1×25×0.00067×0.29×4.2310×0.3×100%×（8753.079/24）=0.2249 tCO_2e/household

For Monitoring period (01/01/2019– 31/12/2019)

$PE_y = PE_{PL,y}$=0.1×25×0.00067×0.29×3.315×0.3×100%×（8753.141/24）=0.1762 tCO_2e/household

E.3. Calculation of leakage

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According to AMS.I.C (version 20) and AMS.III.R (version 03.0), the project leakage needs not to be considered since all the biogas digester are newly built and no equipment transfer is involved in the project activity, therefore, leakage emissions are not considered in the project activity.

LEy=0

E.4. Summary of calculation of emission reductions or net anthropogenic GHG removals by sinks

The emission reduction during the period:

$ER_y = BE_y - PE_y - LE_y$

Period	Item	Baseline emission BE_y (tCO_2e)	Project emissions PE_y (tCO_2e)	Project leakage LE_y (tCO_2e)	Emission reduction ER_y (tCO_2e)
01/01/2017-31/12/2017	The average value of every household	2.8353	0.2280	0	2.6073
	Number of operating biogas system	18,529	18,529	0	18,529
	The total value	52,535	4,225	0	48,310

01/01/2018-31/12/2018	The average value of every household	2.8355	0.2249	0	2.6106
	Number of operating biogas system	18,534	18,534	0	18,534
	The total value	52,553	4,169	0	48,384
01/01/2019-31/12/2019	The average value of every household	2.6059	0.1762	0	2.4297
	Number of operating biogas system	16,417	16,417	0	16,417
	The total value	42,781	2,893	0	39,888
Total		147,869	11,287	0	136,582

Item	Baseline emissions or baseline net GHG removals by sinks (tCO_2e)	Project emissions or actual net GHG removals by sinks (tCO_2e)	Leakage (tCO_2e)	Emission reductions or net anthropogenic GHG removals by sinks (tCO_2e)
01/01/2017-31/12/2017	52,535	4,225	0	48,310
01/01/2018-31/12/2018	52,553	4,169	0	48,384
01/01/2019-31/12/2019	42,781	2,893	0	39,888
Total	147,869	11,287	0	136,582

E.5. Comparison of actual emission reductions or net anthropogenic GHG removals by sinks with estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO_2e)	150,207	136,582

E.6. Remarks on difference from estimated value in registered PDD

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The emission reductions estimated in the PDD were 50,069 tCO_2e. The ex-ante estimation of ER for this monitoring period are 150,207 tCO_2e (50,069 tCO_2e/365d*1095d). The actual emission reductions in this monitoring period are 136,582 tCO_2e, the actual emission reductions in this monitoring period are 9% less than the estimation.

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