

TEMPLATE

MONITORING REPORT

PUBLICATION DATE 14.10.2020

VERSION v. 1.1

RELATED SUPPORT - **TEMPLATE GUIDE Monitoring Report v. 1.1**

This document contains the following Sections

Key Project Information

0 - Description of project

0 - Implementation of project

0_ - Description of monitoring system applied by the project

0 - Data and parameters

0_ - Calculation of SDG Impacts

0_ - Safeguards Reporting

0 - Stakeholder inputs and legal disputes

Key Project Information

GS ID (s) of Project (s)	GS1199
Title of the project (s) covered by monitoring report	Micro Scale Biogas CDM Project of CROSS
Version number of the PDD/VPA-DD (s) applicable to this monitoring report	PDD 05.1 dated 08/05/2021
Version number of the monitoring report	03
Completion date of the monitoring report	30/07/2023
Date of project design certification	CDM - 18/12/2012 GS - 04/03/2014
Date of Last Annual Report	16/12/2022
Monitoring period number	04
Duration of this monitoring period	01/01/2021 to 31/12/2022 (Inclusive of both the days)
Project Representative	M/s Community Reconstruction of Social Service (CROSS)
Host Country	India
Activity Requirements applied	☒ Community Services Activities ☐ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Methodology (ies) applied and version number	AMS I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, Version 11.
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A

Table 1 - Sustainable Development Contributions Achieved

Sustainable Development Goals Targeted	SDG Impact	Amount Achieved	Units/ Products
13 – Climate Action	GHGs emissions reduction per year	9,262 tCO ₂ emission reductions	GS VERs
3 – Good Health and Well-being	i. Continued improved indoor air condition and reduced respiratory problems especially for women and children.	i. 100% reduction in indoor air pollution.	%
5 – Gender Equality	i. Reduction in Hours for collection of woody biomass and cooking ii. Women in monitoring of the project activity iii. Income generation activities promoted due to the time saved for women	i. Reduction in time by 95% for collection of woody biomass and 58% for cooking ii. 29 Number of Women in monitoring of the project activity iii. Income generation activities such as agriculture related work and small businesses promoted due to the time saved for women	% Number Number
7 – Affordable and Clean Energy	i. Construction and maintenance of biogas units for rural communities. ii. Maintenance of constructed biogas units and elimination of use of firewood.	i. 3095 biogas units constructed ii. 66.24% (2050) biogas units operational	Number %
8 – Decent Work and Economic Growth	Number of jobs created	Project related 29 temporary and 7 permanent jobs created for men and women	Number
17 – Partnerships for the goals	Access to domestic or international carbon funding to implement clean technologies	Rs. 59.445 million carbon funding so far for the project activity. Rs 5.575 during this monitoring period (100% Carbon Funding to construct, repair, maintain and monitor the project)	Rupees

Table 2 – Product Vintages

Amount Achieved

Start Dates	End Dates	GS VERs	...	...
01/01/2021	31/12/2021	4,639		
01/01/2022	31/12/2022	4,623		
Total		9,262		

SECTION A. DESCRIPTION OF PROJECT

A.1. General description of project

>>

THIS IS A GS4GG CDM PROJECT TRANSITIONED TO GS VER PROJECT, WITHOUT DEREGISTERING FROM CDM. THE MONITORING REPORT IS SUBMITTED TO THE GOLD STANDARD FOR ISSUANCE OF GS VERs. THE MONITORING REPORT WILL NOT BE SUBMITTED AGAIN TO CDM FOR ISSUANCE OF CERs FOR THIS MONITORING PERIOD.

The purpose of the project activity is to set up 5,000 biogas plants (digesters) of 2m³ capacity each for single households in Chittoor district where the NGO, CROSS is working, and in this way replace Non-Renewable Biomass with biogas for cooking and heating water. In the baseline, traditional inefficient wood stoves were being used, leading to release of Greenhouse Gas emissions. By replacing the traditional inefficient wood stoves by biogas, there is reduction of GHGs thereby contributing to addressing climate change and sustainable development goals of the country.

A.2. Location of project

>> Host Party; INDIA

Region/state/province, etc.; Andhra Pradesh

City/town/community, etc.; All Mandals of Chittoor

Physical/geographical location:

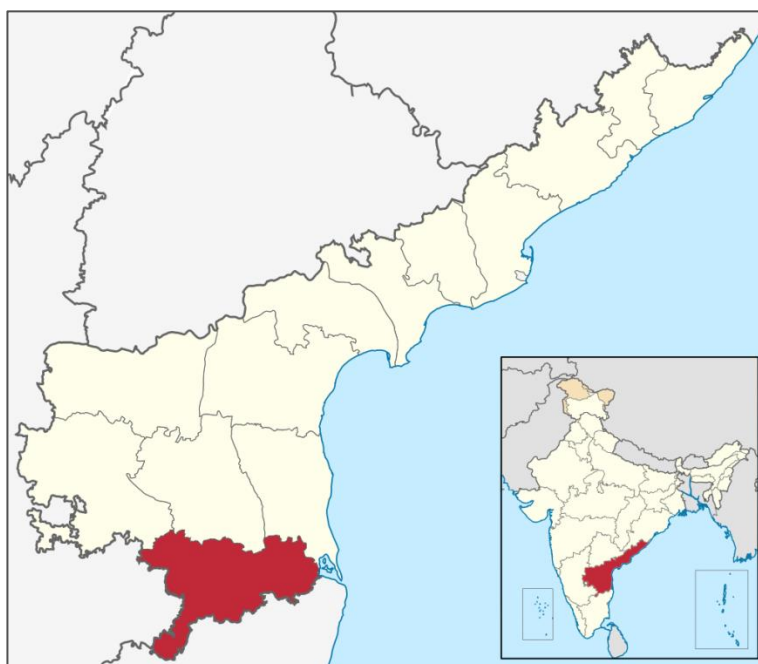


Fig 1: Map of Andhra Pradesh and Chittoor District in which the project is implemented

Taluk	Village	Number of Households
G.D.Nellore	A. Venkatapuram	8
	Agaramangalam	4
	Appireddykandriga	10
	Aravachenupalli	13
	Athmakur	14
	Balireddy Kandriga	7
	Bangareddypalli	5
	Bodapur	6
	Bommavaripalli	10
	Boppiganipalli	4
	Bukkapatnam	3
	C.D.Gunta	11
	C.R.Kandriga	1
	Chavatur	6
	Cherlopalli	1
	Chinnavepanjeri	29
	Dasarapalli	11
	Dhalavaipalli	2
	Doddipalli	10
	E R Kandriga	19
	Edigapalli	2
	Eguvakalva	3
	Ellapalli	5
	Gaddampalli	3
	Garampalli	21
	Gollapalli	1
	Guttakindapalli	5
	Jangalapalle	7
	K.Kothuru	8
	K.Nasampalli	10
	Kadapagunta	13
	Kondepalli	9
	Kotagaram	8
	Krishnareddy Kandriga	5
	Lakshmireddypalli	9
	M.Kandriga	11
	Manginayanikuppam	15
	Maredupalli	9
	Menatampalli	8
	Mothuranagani Palli	7
	Mukkalathur	29
	Murthinayagampalli	28
	Musalaiahgaripalle	7

	Naganna Kandrika	9
	Nagurpalli	12
	Nallarallapalli	9
	Nandanuru	21
	Naralakandriga	7
	Oddupalli	14
	Oggavaripalli	1
	Padmapuram	10
	Papireddypalli	22
	PB.Agraharam	15
	Pedakantipalli	8
	Peddakuntapalli	20
	Peddathamragunta	11
	Pidathalabailu	8
	Raghavareddypalli	1
	Ramanaidupalli	3
	Ramapuram	5
	Rasimareddypalli	11
	Reddypalli	4
	Samsapuram	6
	Samsireddypalli	7
	Sarvireddypalle	11
	Thimmireddypalli	4
	Thugundram	13
	V. Bandarlapalli	19
	Valasanellepalli	8
	Varathur	1
	Veerakanellore	12
	Vejjupalli	49
	Vejjupalli HW	3
	Vejjupalli MW	16
	Velkur	27
	Venkatapuram	35
	Vepanjari	11
	Vinjam	2
G.D.Nellore Total		812
Karvetinagaram	Allathuru	8
	Ammapalli	8
	Ammavarikunta	2
	Battuvaripalli	7
	Gajanki	23
	Gangamambapuram	30
	Gopichettipalli CHW	3
	Gopichettipalli HW -1	8
	Jandlapeta	8
	Jeelavarikandriga	3
	K.P.Agraharam	9
	Kathirapalli	32

	Kathirapalli AAW	2
	Kesavakuppam	23
	Kodandaramapuram	15
	Kothur	6
	Krishnapuram	3
	Lakshmipuram	11
	M.Krishnapuram	5
	Moolakandriga	18
	Mukkaravanipalli	30
	Nagireddypalli	14
	Padirikuppam	10
	Sikayapattadi	7
	Surendranagar	1
	T.T.Kandriga	6
Karvetinagaram Total		292
Nagalapuram	Adavikandriga	18
	Beera Kuppam	1
	Gopalapuram	32
	Jambukeswarapuram	30
	Kottakadu	22
	S.S.Puram	4
	Tripuranthakapuram Kota	37
	Vadlakuppam	7
	Vellore	19
	Vinobanagar	7
Nagalapuram Total		177
Nagari	Anandappanaidu Kandriga	21
	Ayanambakkam	27
	Chinnathangal	15
	Kaakivedu	4
	Mangadu	19
	Melapattu	3
	Nagarajakuppam	5
	Nagaripetai	15
	Natham Kandriga	4
	O.G.Kuppam	5
	Thamarapakkam	14
	Therani	22
Nagari Total		154
Narayanavanam	Bopparajupalem	14
	Chittoor Kandriga	23
	Erikambattu	3
	Kannikapuram	9
	Kasimmita	16
	Keelagaram	21
	Kondalacheruvu	5
	Palamangalam	41

	Thiruvatyam	18
	Thumbur	2
	Veluthurkandriga	13
	Vethalathaduku	3
Narayanavanam Total		168
Nindra	Agaram	31
	Athuru	10
	Elakatur	28
	I.R.Kandriga	11
	Iruguvai	19
	Kavanur	17
	Koppedu	44
	Kunam Rajupalem	24
	Netteri	9
	Nindra	23
	Orurpeta	14
	Sri Ramapuram	9
Nindra Total		239
Pichatur	Akkagaripeta	19
	C.R.Kandriga	5
	Gollakandriga	35
	Govardanagiri	6
	Kuppamkandriga	20
	Malagunta	1
	Neervoy	17
	Pillayarkandriga	1
	Rajanagaram	14
	Reppalapattu	8
	Siddiraju Kandriga	12
	Sivagiri	16
	T.K.Puram	31
	Vengalathuru	19
Pichatur Total		204
Puttur	Cherlopalli	1
	Gattu	2
	Gollapalli	10
	Kalyanavenkateshapuram	72
	KBR.Puram	4
	Krishnasamudram	35
	Sirugurajupalem	4
	T.R.Kandriga	25
	Tirumalakuppam	30
	V.S.S.Puram	9
Puttur Total		192
Ramachandrapuram	Badur	4
	Balijapalli	4
	Chittathuru	2
	Ganeshwarapuram	5

	Gokulapuram	4
	Kalepalli	2
	L.V.Puram	7
	Mittoor	2
	Nadavaluru	5
	P.V.Puram	2
	Pillarikona	3
	Rekalachenu	1
	Sorakayalapalyam	11
	Uppilavanka	4
	Vepakuppam	14
	Yogappareddykandriga	8
Ramachandrapuram Total		78
S.R.Puram	48 Basivireddy Palli	15
	49 Kothapallimitta	7
	52 Kannikapuram	21
	C.M.Kandriga	16
	Chinnathayur	2
	Diguva Muddikuppam	23
	Diguvamangunta	6
	Eguva Kamma Kandriga	17
	Kapukandriga	6
	Kondepalli	11
	Kotarlappalli	7
	Mangunta Colony	45
	Marripalli	15
	Medavada	22
	Moolur	22
	Muddikuppam Colony	9
	Nelovai Colony	11
	Pillarikuppam	32
	Pilligundalapalli	18
	Pullur Mitta Colony	3
	Raghavarajupuram	25
	S.R.Puram	3
	Skheerasamudram	20
	Thatimakulapalli	8
	U.M.Puram	7
	Udamalakurthi	2
	Venugopalapuram	5
S.R.Puram Total		378
Vadamalapeta	Alimelumangapuram	1
	Buttireddikandriga	19
	Kallur	11
	Kayam	2
	Narayanapurambattikandriga	2
	Padiredu	3
	Pathiputhuru	3

	Ramasamudram	2
	T.C.Agraharam	3
	Vadamaala	13
Vadamalapeta Total		59
Vedurukuppam	Adareddypalli	1
	Aggichenupalli	18
	Allamadugu	12
	Allamavarikandriga	10
	Balupalli	2
	Bharathipuram	16
	Boppalamadugu	10
	Chenchugudi	12
	Chinthlagunta	9
	Damarakuppam	5
	Diguva Kannikapuram	15
	Diguvapallalu	4
	G.T.Kandriga	7
	Goduguchintha	4
	Kondakindapalli	18
	Kuruvikuppam	8
	M.M. Puram	14
	Mambedu	17
	Mittoor	1
	Nagarjuna Colony	11
	Peddabailu	4
	Perumallapalli	4
	Podalagunta	15
	Poolavarikandriga	5
	Reddy Palli	12
	Rentala Chenu	5
	Somendrapuram	15
	Sundarangapalli	5
	T.K.M.Puram	4
	Thellagundalapalli	8
	Thimmireddykandriga	4
	Thippinaidupalli	14
	Tirumalaiahpalli	4
	Tirumalarajupuram	13
	Vedurukuppam	12
	Veperi	17
	Yanamalamanda	7
Vedurukuppam Total		342
Grand Total		3095

A.3. Reference of applied methodology

>> Sectoral Scope 01, TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, Version 11

A.4. Crediting period of project

>> Type: Renewable

State date: 01-01-2014

Length of the first crediting Period: 7 years - 01 Jan 2014 - 31 Dec 20

Length of the second crediting Period, relevant to this monitoring period: 7

Years – 01 Jan 2021 – 31 Dec 28

SECTION B. IMPLEMENTATION OF PROJECT

B.1. Description of implemented project

>>

- a) Provide information on the implementation status of the project activity during this monitoring period in accordance with the applicable provision for description of implemented registered CDM project activity in the Project standard.

Community Reconstruction of Social Service (CROSS) is a Non-Governmental Organization (NGO) working in Chittoor district of Andhra Pradesh, India. CROSS works for the betterment of economically backward section of the district. The project activity is construction of 5,000 biogas plants in the project area. Of these, 3095 units were built till the end of the last monitoring period. The project involves construction and commissioning of household level biogas units, their maintenance and monitoring the emission reductions generated. The construction of biogas plants was done in a phased manner. The details of the units commissioned are as follows:

Taluk	2013	2014	2015	2016	2017	2018	2019	Total
G.D.Nellore	31	157	329	73	163	52	7	812
Karvetinagaram	30	61	136	11	46	6	2	292
Nagalapuram				118	25	26	8	177
Nagari				38	99	12	5	154
Narayanavanam				29	127	12		168
Nindra				27	181	29	2	239
Pichatur				96	78	24	6	204
Puttur				62	98	32		192
Ramachandrapuram				22	49	7		78
S.R.Puram	1	48	141	59	95	33	1	378
Vadamalapeta				6	41	3	9	59
Vedurukuppam		29	171	40	78	16	8	342
Grand Total	62	295	777	581	1080	252	48	3095

The list of beneficiaries, their unique user ID, village, and other details are provided in the ER calculations excel file. The dates of commission of all the biogas plants is listed in the excel sheet. The project activity of 3095 biogas units was implemented in 264 villages of 12 Mandals, Chittoor district, the details of which are as follows.

Mandal	Number of Villages	Number of Households
G.D.Nellore	78	812
Karvetinagaram	26	292
Nagalapuram	10	177
Nagari	12	154
Narayanavanam	12	168
Nindra	12	239
Pichatur	14	204
Puttur	10	192
Ramachandrapuram	16	78
S.R.Puram	27	378
Vadamalapeta	10	59
Vedurukuppam	37	342
Total	264	3095

During this monitoring period, there was no construction of biogas units and only repair and maintenance of constructed units were done. Of the constructed units, 66.24% (2050) units were operational at the end of this monitoring period. The remaining 33.76% units became non-operational at various times of the monitoring period.

The operational domestic biogas units are in continuous use after installation. In between, due to repair and maintenance, some of the biogas units were not be in operation for different durations of time. For each of the unit, the days not operational, is recorded. This information is included in the excel ER calculations sheet. The date on which the problem occurred and the problem was fixed is recorded in the village level monitoring sheets and then entered into the online monitoring solution, which is the basis for emission reduction calculations for only the operational units and operational days of installed units. The various reasons and days lost due to repairs and maintenance are as follows:

Problems	Non-operational biogas days ¹ for the monitoring period (1st Jan 2021 – 31st Dec 2022)	Number of biogas units with issues
Gobar Dried	2,34,447	323
Empty and Replaster Dome	1,52,419	209
Not Feeding	1,34,320	184
Unit Demolished	1,18,990	163
Kitchen not Used	46,720	64
Cattle Sold	43,162	60
Repair Outlet Tank	10,950	15
Burners repair	4,845	12
Change Nozzle	1,317	10
Repair Gas Pipe	4,200	8
Nozzle Jet	7	7
Gate Valve Broken	2,170	6
Replace Stove	2,191	4
Stove Repair	2	2
Replace Gas Pipe	2	2
Replace Gate Valve	1,460	2
Gobar Too Watery	730	1
Total	7,57,932	1,072

The beneficiaries inform the village volunteers or the biogas case workers of any repairs required. Minor repairs are done by them, while the major repairs such as repair of cracked domes and re-plastering of domes are done by trained masons.

The repairs done during the monitoring period is as follows:

¹ This is the total number of days in the monitoring period for all the biogas units which were under repair and not operational. Thus for a month of 30 days, the total biogas days for 3095 units are 3095 x 30 days = 92,850 days

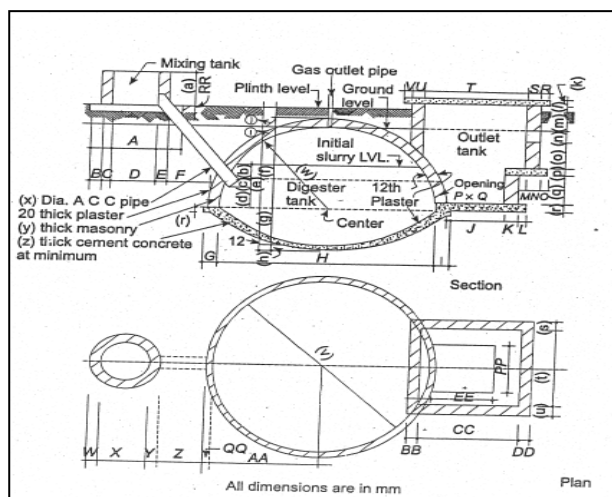
Problems addressed during the monitoring period	Fixed
Nozzle Jet	7
Change Nozzle	5
Burners repair	5
Stove Repair	2
Replace Gas Pipe	2
Gate Valve Broken	2
Repair Gas Pipe	2
Gobar Dried	1
Replace Stove	1
Grand Total	27

b) For the description of the installed technology(ies), technical process and equipment, include diagrams, where appropriate.

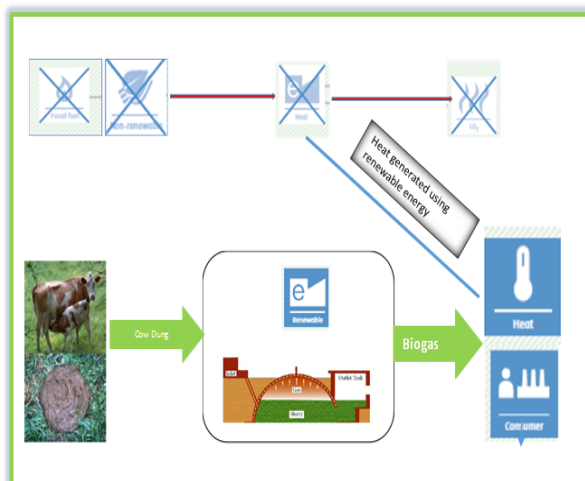
The biogas plant of Deenbandhu model (Fig 2) consists of a digester with a fixed, non-movable gas space. Users prepare batches of dung slurry in the mixing tank, before allowing the final mixture to flow into the digester for methane formation phase. By utilizing dung substrate in an anaerobic digestion and combustion system, biogas is made available. Biogas is generated by fermentation of cellulose rich organic matter under anaerobic conditions. In anaerobic conditions, the methane-producing bacteria become more active. The anaerobic digestion consists of three stages: I Hydrolysis; II Acid formation and III Methane fermentation. The processes are carried out by two sets of bacteria namely acid forming bacteria and methane formers. The acidogenic phase I is the combined hydrolysis and acid formation stages in which the organic wastes are converted mainly into acetate, and phase II is the methanogenic phase in which methane and carbon dioxide are formed. The recovered gas is combusted and used for cooking and water heating. The chosen methane recovery and combustion system is the time tested Deenabandhu model biogas technology which is well-known in India.

The individual plant consists of a mixing chamber where waste water and cow dung are mixed, an inlet pipe to feed the slurry into the reactor, the main biogas reactor/digester where methane formation/recovery takes place, a slurry outlet pipe, an outlet chamber, and a slurry platform. The outlet pipe and tank are provided to remove the digested/treated sludge or fermentation residue and the slurry platform is

provided to maintain the treated slurry in clean condition. A pipe leading from the top of the dome to the stove is provided to supply biogas to a 2-ring stove inside the house. The cross-section of a biogas unit is as shown in Fig 2.



Cross-section of biogas model
biogas unit



Technical process and equipment of



Deenabandhu Model Biodigester



Biogas Stove in the kitchen used for cooking

Fig 2: Deenabandhu 2 cum Biogas Unit installed in the project activity

B.1.1 Forward Action Requests

>> There are no forward action requests

B.2. Post-Design Certification changes

>>

B.2.1. Temporary deviations from the approved Monitoring & Reporting Plan, methodology or standardized baseline

>> There are no temporary deviations from registered monitoring plan and applied methodology

B.2.2. Corrections

>> There are no corrections to project information or parameters fixed at validation.

B.2.3. Changes to start date of crediting period

>> There is no change in the start date of crediting period.

B.2.4. Permanent changes from the Design Certified monitoring plan, applied methodology or applied standardized baseline

>> There was no permanent changes from the design certified monitoring plan and applied methodology.

B.2.5. Changes to project design of approved project

>> There was a change in project design to include all Mandals of Chittoor District. The change to the project design was approved by the UNFCCC on 26/10/2017²

² <https://cdm.unfccc.int/PRCContainer/DB/prcp333290370/view>

SECTION C. DESCRIPTION OF MONITORING SYSTEM APPLIED BY THE PROJECT

>> **Implementation Plan:** The project activity was implemented only after it was registered as a CDM project activity. Emission Reductions yet to be generated was sold, in advance, to a Carbon Investor under an ERPA drawn up for the purpose. Carbon Revenue is being used in a completely open and transparent manner to construct the 5,000 biogas units. Orders to various local entrepreneurs for construction of biogas units i.e. bricks, cement, sand, stoves, pipes, nozzle was placed after procuring the advance ER revenues as the project is funded only from carbon revenue. A CDM Team was appointed to facilitate construction and maintenance of the biogas units as described below.

Project Management and Monitoring: This Biogas CDM project is being implemented and monitored by CROSS to construct 5,000 domestic biogas units of 2m³ capacity, for as many farmer families in the Mandals of Chittoor district, Andhra Pradesh, India.

Biogas Project Management Unit within CROSS: A dedicated team has been set up within CROSS for management and monitoring of the Biogas CDM Project. This Project Management & Monitoring Unit consists of the following staff:

Biogas CDM Project Manager: The biogas CDM project manager is in overall in-charge of the project activity. He is responsible for overall project implementation and meeting the requirements of monitoring protocol. His main functions are to coordinate between Biogas CDM Staff and village functionaries, ensure quality from material supply, through construction, to commissioning of units and to set up a repair and maintenance system to attend to issues that cannot be locally addressed through the Village level systems.

IT Professional: The IT professional is responsible for maintenance of digitized monitoring solution and monitoring sheets for CDM Verification

- Ensure that authentic data is entered into the solution and make spot checks to verify
- Deal with the IT Company, TRISTLE that prepared the solution.
- Peruse the analytical reports in the digitized monitoring solution and recognise patterns to predict problem areas and under-performance

Accountant: He is responsible for ensuring a strict and diligent spending of carbon revenues and the recording thereof in a computerised accounting package. He reports to the Director, CROSS. He administers the following tasks:

- Arrange for the bulk purchase of cement and hardware and transfer them to the Mandal
- Arrange timely payments for material suppliers and masons
- Inspect quality of material (bricks and sand) before making payments
- Negotiate for the timely supply of high quality cement and hardware
- Prepare statutory reports for end of year audit

Biogas Field Workers: Biogas field workers have been appointed for overseeing the construction of biogas units. The field worker is in-charge of construction of the biogas units and report to the Project Manager and their tasks are:

- Inspect the number of cattle, distance from kitchen in each household, mark and arrange for excavation of pits
- Identify local suppliers of material (bricks and sand) for each village, get the price and quality approved by the Project Manager, and arrange for transportation to the villages
- Transport cement and hardware to the Village
- Assign Masons to particular villages and oversee the quality of their work and ensure that End User family labour is actively used
- Record the progress of processes in specially designed formats and enter the data into the digitized monitoring solution on a fixed day every week

Post construction of the biogas units, the biogas field workers continue to be responsible to:

- Form and support village level institutions; assist in selection of Volunteers, train and support them
- Record the monthly totals from the Daily Monitoring Books maintained by Volunteers and, once a month, enter the data into the digitized monitoring solution
- Contract Masons and attend to major repairs that cannot be handled by the village level institution.

Masons: Trained masons by NEDCAP were involved in construction of the biogas units in the region. Each of their personal and contact details is stored in the digitized monitoring solution to fix responsibility.

Similarly, the personal and contact details of each Material Supplier are also recorded, along with their bank account numbers. Payments are made only by crossed cheque to enable audit of the accounts for the project activity.

Management system at village level:

End User Groups: About 20-25 End User families are organized into SHGs for local management of construction and post construction, ensuring proper functioning of all biogas units in their respective villages. These SHGs are a support system for End User.

Volunteers: Every participating village has Volunteer, preferably women staff with either minimum SSLC or PUC qualification, to monitor usage of biogas units. She is a young woman, selected by the End User Group of her Village. She is responsible for post construction monitoring of usage and be the first to identify dysfunctional units. The Volunteer either prompt the End User Group to set right a problem or bring it to the notice of the Biogas Field Worker.

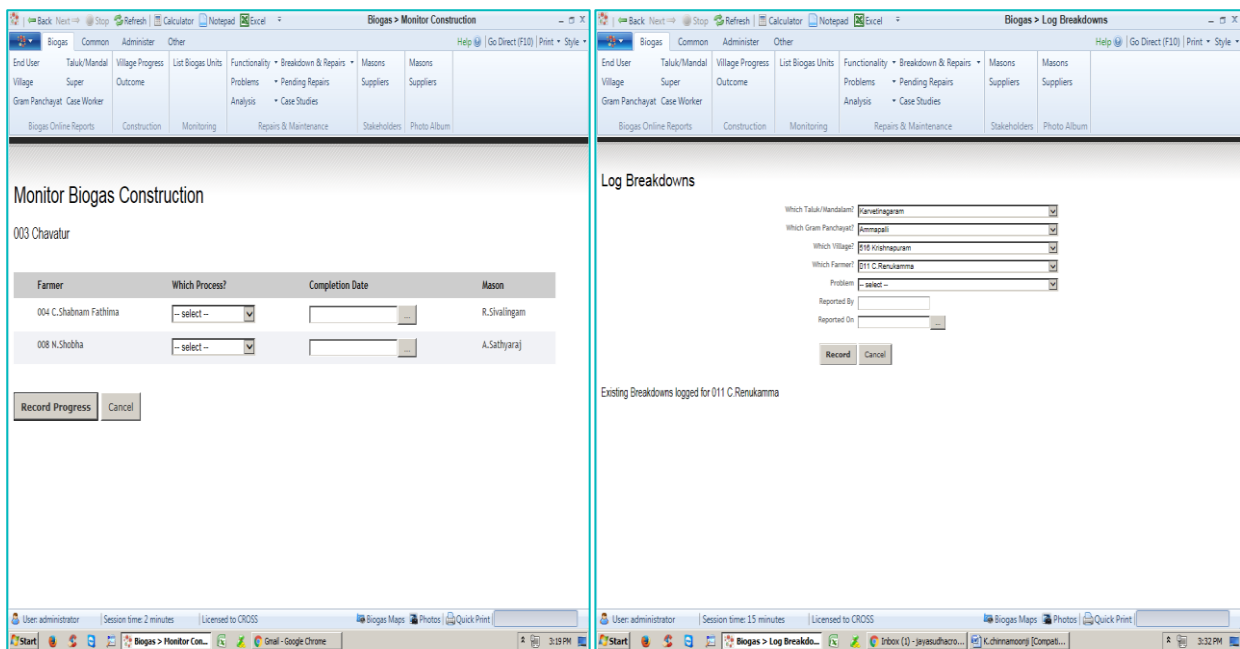
Digitized Monitoring system: A customized Biogas CDM Monitoring database Solution developed and tested by Tristle Technologies Pvt. Ltd. for CROSS, is used to maintain demographic data, construction processes, and the regular monitoring of the project activity. Tristle Technologies Pvt. Ltd. has developed a database which is permission driven, intuitive and easy to use by Project Staff and Volunteers. All activity processes, including financial transactions, are digitally entered and monitored at the CROSS head office. Open and transparent online reports are used by all the Project Staff and secondary stakeholders to know the Progress and Results. Reports can be generated at all levels – Project, Mandal, Gram Panchayat, Village and Participating Family. The database is updated on an everyday basis, as and when Project Staff return from their respective villages.

Real-time reports are available to everyone in an open and transparent manner for the following:

- Implementation Progress (overall project to village reports) on
 - Construction progress, time line & efficiency
 - Gender disaggregated analysis & dwelling details of participating families
 - Daily usage resume, Audit & Maintenance & CER generation to date
 - Total expenditure & average cost per unit
- Participating Families
 - Demographic details
 - Mason, Commissioned Date & Usage Days
 - Construction Details with Date, Process, & Who Monitored
- Construction Overview
 - Village-wise Progress

TEMPLATE- Monitoring Report

- Output, Outcome & Results
- Monitoring of operating units
- Masons & Suppliers
 - Masons
 - Suppliers
 - Photo Albums of Masons and Suppliers
- Reports that meet CER Verification requirements
 - Monitoring operating units
 - Full List of all the Commissioned Units
 - Non-usage days



Snapshot of the TRISTLE Monitoring Database Solution for construction

The solution is used to:

- Record the Mandals, Gram Panchayats and Villages where the CDM project is implemented
- Enter demographic details on participating Families
- Select Villages & Families
- Assign Staff and Volunteer responsibilities during the actual construction and monitoring phases, respectively

Monitoring during Construction Phase: Construction of Biogas Units is being carried out in a phased manner. The various processes involved in the implementation of the technology are as follows:

- Selection of Participating Families
- Defining Masons & Material Suppliers
- Monitoring Construction Progress
 - Marking
 - Excavation
 - Supplying crushed stone jelly, sand, bricks and cement
 - Supplying Hardware

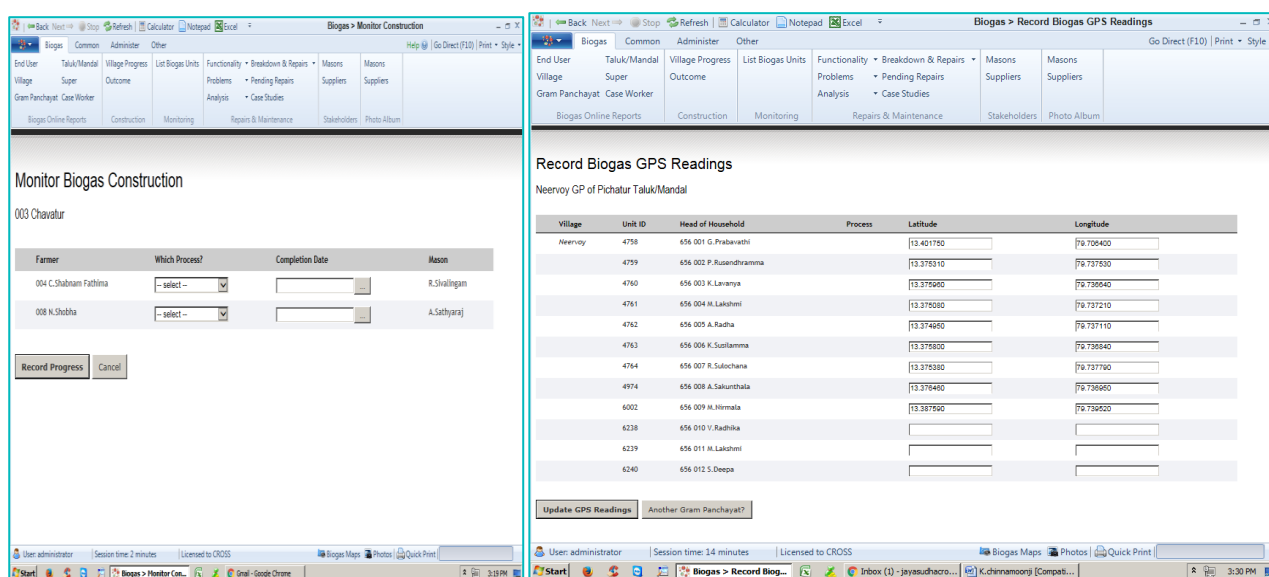
- Concreting, Brick Work & Plastering
 - Filling dung
 - Supplying & Fixing Pipes and Stove
 - Fixing the Safety Grill
- Commissioning the Biogas Units
- Generating End User Agreements
- Monitoring operating units
- Logging Breakdowns & Repairs – Non usage days

Project Staff ensures quality of installed Biogas Units. They check the quality and ensure that the required quantities of material are used during construction. All payments are made by cheque and Suppliers irrefutably identified with personal data and digital photographs fed into the computerized databank.

Each Biogas Unit is marked with a unique Identification Number. Along with the Village Code and Family Code, these irrefutably identify each of the installed biogas units on the digitized monitoring database.

After commissioning and satisfactory functioning of the Biogas Unit an End User Agreement is signed with the Participating Family. Full account of emission reduction is considered from Day 1 of commissioning. GPS coordinates of the units are also taken and entered into the monitoring solution.

Monitoring after Commissioning of biogas units: A Daily monitoring book is maintained in each of the villages where the volunteers record the problem with the biogas units and the number of non-usage days. This data is fed into the individual Biogas User's monitoring database solution, once a month, for days not used and reasons and the day it was repaired.



Snapshot of the TRISTLE Monitoring Database Solution for breakdown log

If any Biogas Unit is faulty or not functional, the problem report is automatically passed on to the Area Team for action. There is continuous database maintained of all the Biogas Units not operational on a day-to-day basis. The computerized solution provides all the details at the Participating Family level for the number of non-operational days, and the reasons of non-operation. This monitoring gives the operational Biogas Units and serve to triangulate the data.

This monitoring solution positively impacts Staff and Volunteers to enhance Performance and produce good Results. Project staffs understand exactly where they stand in terms of progress and results, like number of commissioned Units, recording of breakdowns, conducting timely repairs, etc. is used to measure their performance. The totally open and transparent reports track progress from marking to commissioning. These, along with budget realisations keep a wider audience constantly informed on progress and financial health. They also give up-to-date information on the volume of CERs generated and thereby serve as an indicator on financial viability and feasibility. Verification data needed by the DoE is generated as Excel files from the monitoring solution. All data are archived and stored throughout the crediting period and an additional 2 years.

End User Agreements: After commissioning each Biogas Unit (i.e. after the satisfactory functioning of the unit), a legally binding End User Agreement is signed between the Project Proponent (CROSS) and every single End User. These formally spell out the roles, entitlements and responsibilities of both parties.

Maintenance and Servicing: Volunteers record daily Monitoring data. They are the point persons who immediately identify problems. Minor repairs are conducted either by the End User family or the Volunteer herself, since she is trained and given a kit with tools and spare parts. If the repair involves the expenditure of monies for the purchase of material, the matter is discussed in the End User Group and resources obtained. If the problem is beyond their scope, the Biogas Field Worker is informed and the problem attended to.

Trainings have been conducted before project implementation at various stages to orient the end-users on the effects of climate change, CDM processes and about biogas. Women are trained on use and maintenance of bio-gas units and also on repair and maintenance of biogas units. The village volunteers are also trained for monitoring and repair of the units.

SECTION D. DATA AND PARAMETERS

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

>>

Data/Parameter	Rating Biogas
Unit	kW _{th} /digester
Description	Thermal capacity of a digester
Source of data	Calculated as shown in Section B.2 of the PDD
Value(s) applied	1.69
Choice of data or measurement methods and procedures	Calculated as shown in Section B.2 of the PDD
Purpose of data/parameter	Qualifies as a micro-scale project activity. This parameter is fixed for the entire crediting period
Additional comments	All the constructed units are of 2 cum and hence the value remains the same.

Data/Parameter	$BC_{BL,HH,y}$
Unit	Tonnes /household/year

Description	Average annual consumption of woody biomass per household before the start of the project activity
Source of data	Survey and Kitchen test conducted in the project area
Value(s) applied	3.71 tonnes/year/family
Choice of data or measurement methods and procedures	Based on survey conducted during the renewal of crediting period to estimate the average annual consumption of woody biomass. The average annual consumption of biomass is 2.695 kg/capita/day. The adult equivalent per family in the project area is considered as 3.77 based on the household size of all the 3095 households in which the project is implemented. $By = 2.695 \text{ kg/capita/day} \times 365 \text{ days} \times 3.77/\text{family} = \mathbf{3.71 \text{ t/family/yr.}}$
Purpose of data/parameter	Estimation of Baseline Emissions
Additional comments	This parameter is fixed for the entire crediting period

Data/Parameter	$f_{NRB, y}$
Unit	-
Description	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass
Source of data	Calculated based on following sources of data: 1. State of Forest Report, Forest Survey of India, 2019. 2. Kaul, M., Mohren, G.M.J., and Dadhwal, V.K., Phytomass carbon pool of trees and forests in India, Climatic Change, DOI 10.1007/s10584-010-9986-3, 2011 3. Wood is Good, Is India doing enough to meet its present and future needs? A status report by Centre for Science and Environment, CSE, 2017. 4. FAO database of round wood consumption
Value(s) applied	0.86
Choice of data or measurement methods and procedures	As per "TOOL30: Calculation of the fraction of non-renewable biomass, Version 3"
Purpose of data/parameter	Estimation of Baseline Emissions
Additional comments	This parameter is fixed for the entire crediting period

Data/Parameter	NCV_{biomass}
Unit	TJ/tonne

Description	Net Calorific Value of non-renewable woody Biomass
Source of data	AMS_I.E., Version 11 methodology
Value(s) applied	0.0156
Choice of data or measurement methods and procedures	The baseline fuel replaced is only woody biomass. IPCC default for wood fuel, 0.0156 TJ/tonne, based on the gross weight of the wood that is 'air-dried' may be used if fuel used in project device is also woody biomass given in methodology
Purpose of data/parameter	Estimation of Baseline Emissions
Additional comments	This parameter is fixed for the entire crediting period

Data/Parameter	EF_{projected_fossilfuel}
Unit	tCO ₂ /TJ
Description	Emission Factor for the substitution of non-renewable woody biomass by similar consumers.
Source of data	AMS-I.E., Version 11 methodology
Value(s) applied	64.4
Choice of data or measurement methods and procedures	AMS I.E. Methodology, Version 11.
Purpose of data/parameter	Estimation of Baseline Emissions
Additional comments	This parameter is fixed for the entire crediting period

Data/Parameter	Determination of Leakage
Unit	t/HH/yr
Description	woody biomass
Source of data	AMS I.E. Methodology
Value(s) applied	0.19 for household fuelwood use of 3.71 t/HH/Yr. Based on the fuelwood use determined ex-post ($BC_{BL,HH,y} - BC_{PL,HH,y}$) leakage will be determined by net to gross adjustment factor of 0.95 to account for leakage.
Choice of data or measurement methods and procedures	By is multiplied by a net to gross adjustment factor of 0.95 to account for leakages
Purpose of data/parameter	Leakage
Additional comments	Surveys will not be required to determine leakage.

D.2 Data and parameters monitored

>>

Data/Parameter	Date of commissioning of biogas units
Unit	Date
Description	Actual date of commissioning of the project device.
Measured/calculated/default	Measured
Source of data	Monitoring Solution
Value(s) of monitored parameter	The dates of commissioning for each of the 3095 biogas units are provided in the ER Calculations Sheet
Monitoring equipment	As and when commissioned
Measuring/reading/recording frequency	The construction processes were monitored on a day to day basis and database maintained from its initiation to completion dates for each of the biogas unit. Thus the start date of each of the unit installed recorded on the online monitoring solution.
Calculation method (if applicable)	As and when commissioned and fixed and recorded in the monitoring solution
QA/QC procedures	This can be triangulated with the End User Agreement.
Purpose of data/parameter	To estimate baseline emissions.
Additional comments	The date of commissioning is reported during verification in the ER calculations sheet.

Data/Parameter	N _{HH}
Unit	Number
Description	Number of households in the project activity in year y
Measured/calculated/default	Measured
Source of data	Monitored on a daily basis and entered into the monitoring database.
Value(s) of monitored parameter	3095
Monitoring equipment	The construction processes are monitored on a day to day basis and database maintained from its initiation to completion dates for each of the biogas unit. Thus the start date of each of the unit installed is fixed for each of the unit. In case of replacement of any unit due to demolition will be recorded and the loss days accounted for. This could be for the same user or new user in

	which case the baseline is the users were using fuel wood. A new end user agreement will be signed with them and recorded.
Measuring/reading/recording frequency	As and when the unit is commissioned and updated into the monitoring solution
Calculation method (if applicable)	There is no calculation method.
QA/QC procedures	All activity processes, including financial transactions for construction of biogas units, are digitally monitored using the online monitoring solution. This provides verification for the construction of biogas units. All data will be archived and stored throughout the crediting period and an additional 2 years.
Purpose of data/parameter	Baseline Emissions
Additional comments	ERs are calculated for only the installed and operational biogas units.

Data/Parameter	Number of biogas plants operating
Unit	Number
Description	Number of plants operating in year
Measured/calculated/default	Measured
Source of data	Log books maintained and entered in the digitized monitoring database for biogas units operating
Value(s) of monitored parameter	By the end of the monitoring period, 2050 units were operating accounting for 66.24% of the 3095 units constructed so far
Monitoring equipment	In every village, the women Volunteer monitors the biogas units that are non-operational. The days other than that non-operational will determine the biogas units which are operational. For the monitoring period, the operational days of installed biogas units will be calculated by subtracting the non-usage days. The emission reduction will be estimated only for operational days.
Measuring/reading/recording frequency	The data of non-operational units are done on a regular basis as and when a unit is dysfunctional. As and when

	biogas units are not operational, it is recorded. The remaining days are considered operational. The database is updated on monthly basis.
Calculation method (if applicable)	Total units constructed - Number of biogas units non-operational = Number of biogas units operating
QA/QC procedures	Log books and digitized database will be checked regularly by project staff and CDM coordinator.
Purpose of data/parameter	Baseline Emissions
Additional comments	All data will be archived and stored throughout the crediting period and an additional 2 years. This is to ensure that the units are repaired and provide sustainable thermal energy to the end user.

Data/Parameter	$BC_{PJ,HH,y}$
Unit	tonnes/household/year
Description	Average annual consumption of woody biomass per household in the pre-project devices during the project activity, if it is found that pre-project devices were not completely displaced but continue to be used to some extent
Measured/calculated/default	1. The days not used from the daily monitoring report for each of the unit done at the village level and data maintained on the digitized monitoring database. 2. Surveys for parallel use of traditional stoves.
Source of data	From both (1) and (2), the values are: 3.77 t/HH/MP; 5.575 – t/HH/yr for 2021 and 1.89 t/HH/yr for 2022.
Value(s) of monitored parameter	1. As and when biogas units are not functional, the beneficiaries report to the village level women volunteer, who in turn reports to the Case Worker of the project for the repair of the unit. A log book is maintained for the reason of non-function and days under repair. The data is entered into the monitoring solution for

	each of the unit. The appropriate fuelwood use for non-operational days of biogas units is accounted. 2. For parallel use of pre-project devices, monitoring consisted of estimation of a representative sample thereof, at least once every two years (biennial). A statistically determined sample size was sampled to determine the quantity of fuelwood used on pre project devices. A household level questionnaire survey was conducted.
Monitoring equipment	1. It was monitored on a day to day basis by the Village level volunteers, which was then entered into the monitoring solution for all the biogas units. 2. Once every two years (biennial)
Measuring/reading/recording frequency	The two pronged approach to determine the data/parameter results in emission reduction calculations that are based on real time data and have less uncertainty.
Calculation method (if applicable)	Baseline Emissions
QA/QC procedures	The objective to monitor the non-functional days is to ensure prompt operation and maintenance of the units so that the rural communities can continuously use biogas and are rid of drudgery they are facing using traditional biomass cook stove.
Purpose of data/parameter	Project emissions
Additional comments	100% monitoring ensures lesser uncertainty of emission reductions estimated for the project activity

Data/Parameter	Confirmation that non-renewable biomass has been substituted
Unit	-
Description	Confirmation that non-renewable biomass has been substituted
Measured/calculated/default	Measured
Source of data	Sample survey
Value(s) of monitored parameter	100% of non-renewable biomass is replaced
Monitoring equipment	A household level sample survey was conducted to confirm that non-renewable biomass was substituted.
Measuring/reading/recording frequency	

Calculation method (if applicable)	At least once every two years (biennial) simple random Sample Survey
QA/QC procedures	This survey will be done for a statistically determined number of households at 95/10 precision confidence level.
Purpose of data/parameter	Confirmation of replacement of non-renewable biomass
Additional comments	

SDG 3

Data/Parameter	Continued improved indoor air condition and reduced respiratory problems especially for women and children
Unit	% of respondents
Description	% of biogas-users responding positively to improved indoor air condition and reduced health problems during sample survey
Measured/calculated/default	Measured
Source of data	Based on experience by the communities for reduction in health problems. through sample survey
Value(s) of monitored parameter	100% of the surveyed families
Monitoring equipment	Sample survey and record the experience by the communities for reduction in health problems compared to baselines. ii. Laboratory Analysis of dung and biogas slurry
Measuring/reading/recording frequency	Once in 2 years
Calculation method (if applicable)	Based on sample survey, determine the number of households responding to the total households sampled
QA/QC procedures	A minimum of 30 households will be sample surveyed.
Purpose of data/parameter	To determine the impact of the project to the SDG 3
Additional comments	A total of 50 households were sampled

SDG 5

Data/Parameter	Reduction in drudgery of cooking – Save time
Unit	Hrs
Description	i. Reduction in Hours for collection of woody biomass and cooking ii. Women in monitoring of the project activity iii. Income generation activities promoted due to the time saved for women

Measured/calculated/default	Measured
Source of data	Sample survey
Value(s) of monitored parameter	i. Reduction in time by 95% for collection of woody biomass and 58% for cooking ii. 29 Number of Women in monitoring of the project activity iii. Income generation activities such as agriculture related work and small businesses promoted due to the time saved for women
Monitoring equipment	Sample survey and record the experience of women for reduction in time spent and other activities undertaken compared to baseline.
Measuring/reading/recording frequency	Once in 2 years
Calculation method (if applicable)	There are no calculation methods
QA/QC procedures	A minimum of 30 households will be sample surveyed.
Purpose of data/parameter	To determine the impact of the project to the SDG
Additional comments	50 households were sampled

SDG 7

Data/Parameter	i. Construction and maintenance of biogas units for rural communities. ii. Maintenance of constructed biogas units and elimination of use of firewood.
Unit	i. No. of biogas systems constructed ii. Number of units operational
Description	i. Number of biogas units constructed for the rural communities thereby reducing the use of fuelwood. ii. Number of biogas units repaired and maintained for continuous use of biogas units making them operational
Measured/calculated/default	Measured
Source of data	Based on data from online monitoring solution
Value(s) of monitored parameter	i. 3095 biogas units constructed ii. 66.24% (2050) biogas units operational

Monitoring equipment	The village level volunteers/biogas case workers collect data of the units that are non-operational and needs repairs. This information is entered into the monitoring solution for the project. As and when the units are repaired, it is entered in the monitoring solution. This data provides information of the parameter.
Measuring/reading/recording frequency	Continuous
Calculation method (if applicable)	i. Construction of biogas units is from the online monitoring solution, which was updated after the units were built ii. Based on monitoring conducted by village level volunteers and entered into the monitoring solution
QA/QC procedures	Real time data of all the units ensure high reliability and low uncertainty as every unit is monitored
Purpose of data/parameter	To assess the contribution to the SDG 7, with regard to affordable, reliable, and sustainable thermal energy to the rural communities
Additional comments	The information is based on real time data.

SDG 8

Data/Parameter	Number of jobs created
Unit	Number
Description	Number of permanent and temporary jobs created due to the project activity
Measured/calculated/default	Measured
Source of data	Financial transactions
Value(s) of monitored parameter	Project related 29 temporary and 7 permanent jobs created for men and women
Monitoring equipment	Based on documents and financial statements of the project
Measuring/reading/recording frequency	Continuous
Calculation method (if applicable)	Is based on salaries provided as proof
QA/QC procedures	With 100% carbon revenue, there is staff for repair and monitoring of the project activity ensuring better usage rate
Purpose of data/parameter	To assess the contribution to the SDG 8, with regard to jobs created

Additional comments	CDM Staff and Village level volunteers are involved in the monitoring, repair and maintenance of the project
---------------------	--

SDG 13

Data/Parameter	GHGs emissions reduction per year								
Unit	tCO ₂ eq per year								
Description	Reduction in GHG emissions due to the project activity that is determined applying the approved UNFCCC methodology I.E.								
Measured/calculated/default	Measured and calculated								
Source of data	Monitoring on field and entered to monitoring solution								
Value(s) of monitored parameter	<table> <tr> <th>Vintage Year</th><th>Emission Reductions (t CO₂e)</th></tr> <tr> <td>2021 (1/1/2021 to 31/12/2021)</td><td>4,639</td></tr> <tr> <td>2022 (1/1/2022 to 31/12/2022)</td><td>4,623</td></tr> <tr> <td>Total</td><td>9,262</td></tr> </table>	Vintage Year	Emission Reductions (t CO ₂ e)	2021 (1/1/2021 to 31/12/2021)	4,639	2022 (1/1/2022 to 31/12/2022)	4,623	Total	9,262
Vintage Year	Emission Reductions (t CO ₂ e)								
2021 (1/1/2021 to 31/12/2021)	4,639								
2022 (1/1/2022 to 31/12/2022)	4,623								
Total	9,262								
Monitoring equipment	The measurement methods and procedures are as described in the registered PDD								
Measuring/reading/recording frequency	Annual								
Calculation method (if applicable)	As per the approved methodology and the registered PDD								
QA/QC procedures	Emission Reduction calculations is based on real time monitoring of all the households								
Purpose of data/parameter	To determine the following SD Indicators that contributes to the SDG: Climate Action GHGs emissions reduction per year								
Additional comments	GHGs emissions reduction per year								

SDG 17

Data/Parameter	Access to domestic or international carbon funding to implement clean technologies
Unit	Rs.
Description	Domestic/international carbon funding to construct and maintain biogas units
Measured/calculated/default	Measured

Source of data	Audited statement for the project
Value(s) of monitored parameter	Rs. 59.445 million carbon funding so far for the project activity. Rs 5.575 during this monitoring period (100% Carbon Funding to construct, repair, maintain and monitor the project)
Monitoring equipment	There is no monitoring equipment
Measuring/reading/recording frequency	Continuous
Calculation method (if applicable)	There is no calculation method.
QA/QC procedures	Based on actual financial statements
Purpose of data/parameter	To assess the contribution to the SDG 17, with regard to strengthening domestic/international support to projects in developing countries
Additional comments	The carbon revenue will be accessible to the rural women, which can be transparently tracked through bank transfers after the ERPA period.

D.3. Comparison of monitored parameters with last monitoring period

Data/Parameter	Value obtained in this monitoring period	Value obtained last monitoring period
Biogas Units constructed	3095	3095
Number of biogas plants operating	2050 (66.24%)	2640 (85.30%)
Non-usage of biogas plants	757,932 biogas days	567,886 biogas days
Confirmation that non-renewable biomass has been substituted	100% 11,283.23 t	100% 26,007 t
SDG 3	i. 100% reduction in indoor air pollution	i. 100% reduction in indoor air pollution
SDG 5	i. Reduction in time by 95% for collection of woody biomass and 58% for cooking ii. 29 Number of Women in monitoring of the project activity	i. Reduction in time by 89% for collection of woody biomass and 46% for cooking

	iii. Income generation activities such as agriculture related work and small businesses promoted due to the time saved for women	ii. 29 Number of Women in monitoring of the project activity iii. Income generation activities such as agriculture related work and small businesses promoted due to the time saved for women
SDG 7	i. 3095 biogas units constructed ii. 66.24% (2050) biogas units operational	i. 3095 biogas units constructed ii. 85.30% (2640) biogas units operational
SDG 8	Project related 29 temporary and 7 permanent jobs created for men and women	Project related 29 temporary and 8 permanent jobs created for men and women
SDG 13	9,262 tCO ₂ emission reduction	12,461 tCO ₂ emission reduction
SDG 17	Rs. 59.445 million carbon funding so far for the project activity. Rs 5.575 million during this monitoring period (100% Carbon Funding to construct, repair, maintain and monitor the project)	Rs. 53.87 million carbon funding so far for the project activity. Rs 3.20 million during this monitoring period (100% Carbon Funding to construct, repair, maintain and monitor the project)

D.4. Implementation of sampling plan

>>

The parameters monitored through sample surveys are:

- (i) Confirmation that non-renewable biomass has been substituted
- (ii) Average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel.
- (iii) SDG Parameters other than SDG 13

In consideration of occupancy and demographics of the location there is no difference among the households. The socio-economic and cooking patterns of households are similar. All the households are from rural region of Chittoor District. Simple random sample was conducted to determine the parameter of interest. As a biennial

inspection is chosen a 95 per cent confidence interval and a 10 per cent margin of error requirement will be achieved for the sampling parameter.

In cases where survey results indicate that 95/10 precision is not achieved, the lower bound of a 95 per cent confidence interval of the parameter value will be chosen as an alternative to repeating the survey efforts to achieve the 95/10 precision.

The sampling plan to monitor the parameters is based on “Guidelines for sampling and surveys for CDM project activities and programme of activities, Version 4”, which details information relating to: (a) sampling design; (b) data that will be collected; and (c) implementation plan.

(a) Sampling Design

(i) Objectives: The objective of the sampling effort is to

- (i) Confirmation that non-renewable biomass has been substituted
- (ii) Average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel.
- (iii) SDG Parameters other than SDG 13

The sampling frequency is once in every two years (biennial). As a biennial inspection is chosen a 95 per cent confidence interval and a 10 per cent margin of error requirement will be achieved for the sampling parameter.

The population is homogeneous in terms of cooking patterns and socio-economic strata. The biogas units implemented in the region is also of single type – 2 cum deenabhandu model. Hence simple random sample was conducted for the project activity.

(ii) Target Population: The target population is the rural households for which biogas was constructed and operational in the Mandals of Chittoor District, Andhra Pradesh, India.

(iii) Sampling Method: The sampling method chosen for the project area is simple random sampling. Households with operational units are the population from which the sampling was randomly selected.

(iv) Sample Size: The samples were drawn at random from the sampling frame. This was done using random number tables in Microsoft Excel. A pilot study was conducted based on which, the sample size was assessed as this is the first monitoring report for the second crediting period. Subsequently, the value of the previous survey will be considered. The largest of sample size for the 2 parameters of interest was considered to gather information.

i) The sample size was determined for "Confirmation that non-renewable biomass has been substituted" as follows:

$$n \geq \frac{1.96^2 N \times p(p-1)}{(N-1) \times 0.1^2 \times p^2 + 1.96^2 p(p-1)}$$

Where

n = sample size

N = Total number of households

p = expected proportions

1.96 = Represents the 90% confidence required

0.1 = Represents the 10% relative precision

Checking Reliability

The reliability was estimated as follows:

The standard error of proportion is calculated as

$$\sqrt{(1-f) \frac{pq}{n}}$$

Where p is the sample proportion and q = (1-p)

Precision associated with proportion is z-value x standard error of the proportion.

z-value is 1.96

The ratio of precision to the proportion gives the relative precision, which needs to be within 10%

ii) For the parameter Average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel, the sample size was determined as follows:

$$n = \frac{1.96^2 NV}{(N-1) \times 0.1^2 + 1.96^2 V}$$

Where:

$$V = \left(\frac{SD}{mean} \right)^2$$

n Sample size

N Total number of households

$Mean$ Expected mean

SD Expected standard deviation

1.96 Represents the 95% confidence required

0.1 Represents the 10% relative precision

Checking Reliability

The standard error of mean is calculated as

$$\sqrt{(1-f) \frac{s^2}{n}},$$

where

f is the sampling fraction – the proportion of the population that is sampled,

s^2 is the sample variance (s is the sample standard deviation).

Precision associated with mean is t -value $\times$ standard error of the mean.

t value is derived in Microsoft Excel using the TINV function. =TINV(0.10, (sample minus 1))

The ratio of precision to the mean gives the relative precision, which needs to be within 10%.

Based on pilot study, 42 households need to be sampled for $BC_{PL,HH,y}$ and zero for confirmation that non-renewable biomass has been substituted. A total of 50 households were sampled as follows:

Taluk	Village	Total
G.D.Nellore	Athmakur	2
	Boppiganipalli	1
	C.D.Gunta	1
	Chinnavepanjeri	1
	Garampalli	1
	K.Nasampalli	3
	Kotagaram	1
	Manginayanikuppam	1
	Mothuranagani Palli	1
	Papireddypalli	2

	Peddathamaragunta	1
	Samsireddypalli	1
	V. Bandarlapalli	1
	Vejjupalli	1
	Velkur	1
	Venkatapuram	2
	Vepanjeri	1
Karvetinagaram	Kathirapalli	2
	Moolakandriga	1
Nagalapuram	Vinobanagar	3
	Jambukeswarapuram	2
Nagari	Anandappanaidu	1
	Kandriga	
	Ayanambakkam	1
	Chinnathangal	1
	Mangadu	1
Narayanavanam	Palamangalam	2
Pichatur	Kuppamkandriga	1
	Sivagiri	1
	T.K.Puram	1
Puttur	Krishnasamudram	1
Ramachandrapuram	Sorakayalapeta	1
S.R.Puram	52 Kannikapuram	1
	Diguva Muddikuppam	2
	Marripalli	2
	Pillarikuppam	1
Vedurukuppam	Damarakuppam	1
	G.T.Kandriga	1
	Tirumalarajupuram	1
Grand Total		50

The surveys were conducted between January – February 2023. The details of the staff that conducted the surveys are as follows:

V.Jayasudha	Desk Worker	8790041067	jayasudhacross@gmail.com
K.Pavan	Case Worker	7330792579	kumarkaramala2719@gmail.com

Taduku Chaithanya	Case Worker	7036969852	chaithuchaithu597@gmail.com
Neelakanta Reddy.E	Case Worker	9121147566	edhulaneelakantareddy@gmail.com
K.Ganapathi	Case Worker	9347069766	kudimiganapathi95@gmail.com

(v) Sampling Frame: The sampling frame used is the complete listing of all the rural households for which biogas has been built and operational under the project activity in the Mandals of Chittoor District, Andhra Pradesh State. Each of the household has a unique identify number with all the required details of the family.

(b) Data:

(i) Field Measurements: The variable recorded/measured on field was Confirmation that non-renewable biomass has been substituted and the average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel and SDG Parameters.

A household level questionnaire was designed to collect information for the parameter of interest. It was field tested when administered for the first time and modified accordingly based on its ease of getting information on the field and its analysis. The frequency of measurement was once in two years.

(ii) Quality Assurance/Quality Control: The QA/QC procedure was to achieve good quality data through field measurements. The household level questionnaire was designed and field tested before administering the actual questionnaire survey. Oversampling was done to replace non-respondents, if any. The data collected was entered, checked and verified further for any typographic mistakes.

(iii) Analysis: The data entry was done in Microsoft excel sheet. The data was cross checked with the filled in questionnaire as QA/QC procedure. The data was analyzed for the parameter.

(iv) Results: Based on the survey, Average annual consumption of woody biomass per household in the pre-project devices during the project activity, used in parallel was as follows:

Details	Value
---------	-------

Average fuelwood use (kg/HH/week)	2.65
Standard Deviation	2.99
Number of samples	50
standard Error of Mean	0.0534
Precision	0.0895
Relative Precision	3.38%

The relative precision or reliability is within 10%. Hence the data is within the required specification. Based on the survey results, the parallel fuelwood use for a day is 0.00265 t/day/household, which is used for emission reductions calculations in the project scenario.

Based on the survey, the results of the proportion of families replacing non-renewable biomass are as follows:

Details	Value
Total Population	3095
Number of HHs with non-renewable biomass replaced	50
Number of samples	50
f (sampling fraction)	0.016
1-f	0.984
P	1.000
Q	0.000
Standard error of proportion	0.000
Precision	0.000
Reliability	0.00%

As can be seen the data is within the required specification of 10%.

SECTION E. CALCULATION OF SDG IMPACTS

E.1. Calculation of baseline value or estimation of baseline situation of each SDG Impact

>>

SDG 13

Baseline emissions

It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs.

Baseline emissions are calculated as:

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected_fossil_fuel} \quad \text{Equation (1)}$$

Where:

BE_y	=	Baseline emissions in the year y (tCO ₂ e)
B_y	=	Quantity of woody biomass that is substituted or displaced in year y (tonnes)
$f_{NRB,y}$	=	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass (fraction or %)
$NCV_{biomass}$	=	Net calorific value of the non-renewable woody biomass that is substituted (TJ/tonne)
$EF_{projected_fossil_fuel}$	=	Emission factor of fossil fuels projected to substitute non-renewable woody biomass by similar consumers (tCO ₂ e/TJ).

According to Para 29, B_y is determined by following option (a) as follows:

Calculated as the product of the number of households using cookstoves distributed under the project activity multiplied by the estimate of average annual consumption of woody biomass per household that is displaced by the project activity:

$$B_y = N_{HH,y} \times (BC_{BL,HH} - BC_{PJ,HH,y}) \quad \text{Equation (3)}$$

Where:

$N_{HH,y}$	=	Number of households with functional cookstoves distributed under the project activity in year y (number)
$BC_{BL,HH}$	=	Average annual consumption of woody biomass per household before the start of the project activity or at the renewal of each crediting period, whichever is later (tonnes/household/year)

$BC_{PJ,HH,y}$ = Average annual consumption of woody biomass per household in the pre-project devices during the project activity (tonnes/household/year). This parameter shall be considered if it is found that pre-project devices were not completely displaced but continue to be used to some extent

Baseline calculations for the Monitoring Period				
Activity Data	MR	2021	2022	Unit
Number of Households in the Project Activity (N_{HH})	3,095	3,095	3,095	Number
Average annual consumption of woody biomass per HH before the start of the project activity ($BC_{BL,HH}$)	7.42	3.71	3.71	tonnes/HH/Monitoring Period
Average annual consumption of woody biomass per HH in the pre-project devices during the Monitoring Period ($BC_{PJ,HH}$)	3.77	5.575	1.89	tonnes/HH/Monitoring Period
Quantity of Biomass that is substituted (B_y)	11,283.23	5,651.43	5,631.80	tonnes/HH/Monitoring Period
Fraction of f_{NRB}	0.86	0.86	0.86	-
NCV Biomass ($NCV_{biomass}$)	0.0156	0.0156	0.0156	TJ/tonne
Emission factor ($EF_{projected\ fossilfuel}$)	64.4	64.4	64.4	tCO ₂ /TJ
Baseline Emissions (BE_y)	9,749	4,883	4,866	tCO ₂ /Monitoring Period

The total emission reductions without leakage adjustment for the monitoring period 01/01/2021 to 31/12/2022 for the installed and operational 3095 biogas units are **9,749** tCO₂. The unit-wise calculations of emission reduction are as enclosed in the ER Calculations excel sheet.

Other SDGs

SDG	SDG Impact	Baseline estimate
13	GHGs emissions reduction per year	9,749 tCO ₂ emitted by using traditional cook stoves by 3095 households
3	i. Continued improved indoor air condition and reduced respiratory	i. Use of traditional cookstove causing indoor smoke and health hazards.

	problems especially for women and children	(0% of HHs having clear indoor air)
5	i. Reduction in Hours for collection of woody biomass and cooking ii. Women in monitoring of the project activity iii. Income generation activities promoted due to the time saved for women	i. Women spent approximately 85.8 mandays/yr in fetching, processing and storing fuelwood for cooking and 5.4 hours per day for cooking on traditional stoves ii. No women are involved in monitoring iii. No income generation activities
7	i. Construction and maintenance of biogas units for rural communities. ii. Maintenance of constructed biogas units and elimination of use of firewood.	No Biogas Units
8	Number of jobs created	No project related jobs created
17	Access to domestic or international carbon funding to implement clean technologies	No funding in the baseline scenario

E.2. Calculation of project value or estimation of project situation of each SDG Impact

>>

According to Para 36 of the methodology, if the project cook stoves use biomass, the sources of project emissions as detailed in Para 36 (a), i, ii, iii and iv and 36 (b) has to be considered as applicable, bearing in mind that some sources may be only relevant for specific fuels (e.g. production of bioethanol):

- Project Emissions is not applicable as the cook stoves do not use biomass.

According to Para 37 of the methodology, in case of electric cook stoves, if back up diesel generators are used, project emissions due to use of diesel shall be accounted for, using the latest version of "TOOL03: Tool to calculate project or leakage CO2 emissions from fossil fuel combustion".

- Project Emissions is not applicable as the project cook stoves are not electric stoves.

Other SDGs

SDG	SDG Impact	Project estimate
13	GHGs emissions reduction per year	487 tCO ₂ emitted as leakage
3	i. Continued improved indoor air condition and reduced respiratory problems especially for women and children	i. Reduction in indoor air pollution (100% of HHs)
5	i. Reduction in Hours for collection of woody biomass and cooking ii. Women in monitoring of the project activity iii. Income generation activities promoted due to the time saved for women	i. Women spend 4.66 man days/yr for collection of woody biomass and 2.31 hrs per day for cooking ii. 29 women in monitoring of the project activity iii. Income generation activities such as agriculture related work and small businesses promoted due to the time saved for women
7	i. Construction and maintenance of biogas units for rural communities. ii. Maintenance of constructed biogas units and elimination of use of firewood.	i. 3095 biogas units constructed ii. 66.24% (2050) biogas units operational
8	Number of jobs created	Project related 29 temporary and 7 permanent jobs created for men and women

E.3. Calculation of leakage

>>

If the cookstoves distributed under the project activity involve the use of biomass, leakage emissions (LE_y) shall be calculated using the latest version of "TOOL16: Project and leakage emissions from biomass", including leakage emissions due to production of processed renewable biomass and bioethanol (e.g. CO₂ emissions due to consumption of fossil fuels and electricity).

- Leakage Emissions is not applicable as the project cook stoves do not use biomass.

Leakage emissions related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The following potential source of leakage shall be considered: the use/diversion of non-renewable woody biomass saved under the project activity by non-project end-users that previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project end-users that is attributable to the project activity, then B_y is adjusted to account for the quantified leakage. Alternatively, B_y is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.

- B_y will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages. Hence survey will not be conducted to assess leakage related to non-renewable woody biomass saved by the project activity.

Project activities switching from baseline device using woody biomass to efficient project device using charcoal or switching from woody biomass to processed renewable biomass (briquette, pellets, and woodchips), shall take into account the leakage effects related to the charcoal or processed biomass production.

- Leakage Emissions is not applicable as the project cook stoves are not switching to charcoal or processed renewable biomass.

Emission Reductions is calculated based on the methodology as follows:

Leakage Calculations			
	MP	2021	2022
Quantity of Biomass that is substituted (t/yr) after considering leakage B_y	10,719.07	5,368.86	5,350.21
Fraction of NRB $f_{NRB,y}$	0.86	0.86	0.86
NCV Biomass (TJ/t) $NCV_{biomass}$	0.0156	0.0156	0.0156
$EF_{projected_fossilfuel}$ tCO ₂ /TJ	64.4	64.4	64.4
Emission Reductions after considering leakage ER_y tCO ₂ /yr	9,261	4,639	4,623

Vintage Year	Baseline GHG emissions or baseline	Project GHG emissions or actual	Leakage GHG emissions	Emission Reductions
--------------	------------------------------------	---------------------------------	-----------------------	---------------------

	net GHG removals	net GHG removals		
	(t CO2e)	(t CO2e)	(t CO2e)	(t CO2e)
2021 (1/1/2021 to 31/12/2021)	4,883	0	244	4,639
2022 (1/1/2022 to 31/12/2022)	4,866	0	243	4,623
Total	9,749	-	487	9,262

E.4. Calculation of net benefits or direct calculation for each SDG Impact

SDG	SDG Impact	Baseline estimate	Project estimate	Net benefit
13	GHGs emissions reduction per year	9,749 tCO ₂ emitted by using traditional cook stoves by 3095 households	487 tCO ₂ emitted as leakage	9,262 tCO ₂ emission reductions
3	i. Continued improved indoor air condition and reduced respiratory problems especially for women and children	i. Use of traditional cookstove causing indoor smoke and health hazards. (0% of HHs having clear indoor air)	i. Reduction in indoor air pollution (100% of HHs)	i. 100% reduction in indoor air pollution.
5	i. Reduction in Hours for collection of woody biomass and cooking ii. Women in monitoring of the project activity iii. Income generation	i. Women spent approximately 44.18 man days/yr in fetching, processing and storing fuelwood for cooking and 4.45 hours per day for cooking	i. Women spend 4.66 hours/yr for collection of woody biomass and 2.31 hrs per day for cooking ii. 29 women in monitoring of the project activity	i. Reduction in time by 95% for collection of woody biomass and 58% for cooking ii. 29 Number of Women in monitoring of the project activity

	activities promoted due to the time saved for women	on traditional stoves ii. No women are involved in monitoring iii. No income generation activities	iii. Income generation activities such as agriculture related work and small businesses promoted due to the time saved for women	iii. Income generation activities such as agriculture related work and small businesses promoted due to the time saved for women
7	i. Construction and maintenance of biogas units for rural communities. ii. Maintenance of constructed biogas units and elimination of use of firewood.	No Biogas Units	i. 3095 biogas units constructed ii. 66.24% (2050) biogas units operational	i. 3095 biogas units constructed ii. 85.30% (2640) biogas units operational
8	Number of jobs created	No project related jobs created	Project related 29 temporary and 7 permanent jobs created for men and women	Project related 29 temporary and 7 permanent jobs created for men and women
17	Access to domestic or international carbon funding to implement clean technologies	No funding in the baseline scenario	Rs. 59.445 million carbon funding so far for the project activity. Rs 5.575 million during this monitoring period (100% Carbon Funding to construct, repair, maintain and	Rs. 59.445 million carbon funding so far for the project activity. Rs 5.575 million during this monitoring period (100% Carbon Funding to construct, repair, maintain and

	monitor the project)	monitor the project)
--	-------------------------	-------------------------

E.5. Comparison of actual SDG Impacts with estimates in approved PDD

SDG	Values estimated in ex ante calculation of approved PDD for this monitoring period	Actual values ³ achieved during this monitoring period
3: Good health and well-being	100% reduction in indoor air pollution Reduction of pathogen load in biogas slurry	100% respondents reported reduction in indoor air pollution and reduction in health issues 94% reduction of pathogen load in biogas slurry
SDG 5: Gender Equality	100% reduction in drudgery to women due to project activity, 50% women involved in the project; additional direct or indirect job opportunities due to time spent.	100% reduction in drudgery to women due to project activity. 95% reduction in time for collection of fuelwood and 58% reduction in cooking time. 81% (29/36) women involved in the project; additional direct or indirect job opportunities such labour and small businesses for beneficiary women
SDG 7: Affordable and Clean Energy	100% functionality of biogas units due to repairs and maintenance of biogas units	66.34% (2050) units functionality of biogas units due to repairs and maintenance of biogas units

³ Whenever emission reductions are capped, both the original and capped values used for calculations must be transparently reported. Use brackets to denote original values.

SDG 8: Decent work and economic growth	At least 7 (Number of temporary and permanent) jobs due to the project activity	29 (Number of temporary and permanent) jobs due to the project activity
SDG 13: Climate Action	31,140 metric tonnes CO ₂ for the monitoring period	9,262 metric tonnes CO ₂ for the monitoring period
SDG 17: Partnerships for the Goals	50% Carbon Funding to construct, repair, maintain and monitor the project	Rs. 59.445 million carbon funding so far for the project activity. Rs 5.575 million during this monitoring period (100% Carbon Funding to construct, repair, maintain and monitor the project)

E.5.1. Explanation of calculation of value estimated ex ante calculation of approved PDD for this monitoring period

>>

The emission reductions for the monitoring period is estimated based on the assumption that the targeted 5,000 biogas units would be constructed by this period. Hence the emission reduction estimated ex-ante is estimated as follows:

January 2021 - December 2021	15,233 tCO ₂
January 2022 – December 2022	15,233 tCO ₂
Total	30,466 tCO₂

E.6. Remarks on increase in achieved SDG Impacts from estimated value in approved PDD

>>

There is no increase in the achieved emission reductions.

SECTION F. SAFEGUARDS REPORTING

>>

There are no safeguards that need to be implemented and reported.

SECTION G. STAKEHOLDER INPUTS AND LEGAL DISPUTES

G.1. List all Inputs and Grievances which have been received via the Continuous Input and Grievance Mechanism together with their respective responses/mitigations.

>>

The list of inputs and grievances were with regard to repair and maintenance of biogas units. The problems encountered and resolved are as follows:

Problems addressed during the monitoring period	Fixed
Nozzle Jet	7
Change Nozzle	5
Burners repair	5
Stove Repair	2
Replace Gas Pipe	2
Gate Valve Broken	2
Repair Gas Pipe	2
Gobar Dried	1
Replace Stove	1
Grand Total	27

This was done through upfront carbon revenue for the project activity.

G.2. Report on any stakeholder mitigations that were agreed to be monitored.

>> There are no stakeholder mitigations that were agreed to be monitored.

G.3. Provide details of any legal contest that has arisen with the project during the monitoring period

>> There are no legal contest that arose with the project during the monitoring period.

Revision History

Version	Date	Remarks
1.1	14 October 2020	Hyperlinked section summary to enable quick access to key sections Improved clarity on Key Project Information Section for POA monitoring Forward action request section Improved Clarity on SDG contribution/SDG Impact term used throughout Clarity on safeguard reporting Clarity on design changes Leakage section added for VER/CER projects Addition of Comparison of monitored parameters with last monitoring period Provision of an accompanying Guide to help the user understand detailed rules and requirements
1.0	10 July 2017	Initial adoption