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

Programme of Activity Information

GS ID of Programme	GS2747
Title of Programme	African Biogas Carbon Programme (ABC)
Version of POA-DD applicable to this monitoring report	07
Name and GS ID of fully Validated CPA/VPAs (i.e. non compliance check)	5 VPA's are fully validated[1] 1. GS2750: African Biogas Carbon Programme (ABC) – Kenya – KENAFF - VPA001 2. GS2751: African Biogas Carbon Programme (ABC) – Tanzania – CAMARTEC – VPA002 3. GS4236: African Biogas Carbon Programme (ABC) – Uganda -VPA003 4. GS5123: African Biogas Carbon Programme (ABC) – Tanzania – CAMARTEC – VPA004 5. GS5801 African Biogas Carbon Programme (ABC) - Kenya - VPA006

Key Project Information

GS ID (s) of Project (s)	GS5801
Title of the project (s) covered by monitoring report	African Biogas Carbon Programme (ABC) – Kenya – VPA006
Version number of the PDD/VPA-DD (s) applicable to this monitoring report	2.3
Version number of the monitoring report	1.5
Completion date of the monitoring report	08/11/2025
Date of project design certification	14/03/2019
Date of Last Annual Report	N/A
Monitoring period number	6
Duration of this monitoring period	01/04/2023 – 13/03/2024 both dates inclusive
Project Representative	ABPL
Host Country	Kenya

[1] *GS5124 African Biogas Carbon Programme (ABC) – Tanzania – SimGas - VPA005 is discarded from the registry.*

Activity Requirements applied	☒ Community Services Activities ☐ Renewable Energy Activities ☐ Land Use and Forestry Activities/Risks & Capacities ☐ N/A
Methodology (ies) applied and version number	Technologies and Practices to Displace Decentralized Energy Consumption (version 1.0)
Product Requirements applied	☒ GHG Emissions Reduction & Sequestration ☐ Renewable Energy Label ☐ N/A

Table 1 - Sustainable Development Contributions Achieved[2]

Sustainable Development Goals Targeted	SDG Impact	Amount Achieved	Units/ Products
SDG2 -Zero hunger	GS-3 Soil condition	99.5	%
SDG3 – Good health and well-being	GS-1 Air Quality	99.1	%
SDG5- Gender equality	Time savings	95.6	%
	Usage of saved time		
	Income generating including farming	72	%
	Recreation	22	%
	Helping my husband	8	%
	Social activity (voluntary work, etc)	29	
	Other	4	%
SDG7- Affordable and clean energy	GS-08 Access to affordable and clean energy services	4,433	Number
	GS-12 Technology transfer and technological self-reliance	0[3]	Number

[2] From tab Analysis A in the ER calculation sheet
[3] 0 masons were trained in this MP, however since 2016 a total of 537 masons are trained

SDG8- decent work and economic growth	GS-10 Technology transfer and technological self-reliance	67,071	Man-days
SDG13- Climate action	Verified emission reductions	10,124	VER

Table 2 – Product Vintages

		Amount Achieved
Start Dates	End Dates	VERs
01/04/2023	31/12/2023	7,987
01/01/2024	13/03/2024	2,137

SECTION A. DESCRIPTION OF PROJECT

A.1. General description of project

VPA006 is part of the African Biogas Carbon Programme (ABC) and is the second VPA that is implemented in Kenya. The overall objective of the VPA is to contribute to the achievement of the Sustainable Development Goals (SDGs) through the dissemination of domestic biogas systems as a local, sustainable energy source, as well as the development of a commercially viable, market-oriented biogas sector. By encouraging the switch from traditional non-renewable biomass (NRB) fuels to renewable biogas the VPA is reducing greenhouse gas (GHG) emissions.

The Kenya Biogas Programme provides biodigesters to individual households. The programme was founded by the Africa Biogas Partnership Programme (ABPP), a partnership between the Dutch government, Hivos and SNV Netherlands Development Organization. ABPP has supported national programmes in Kenya, Tanzania, Uganda, Ethiopia and Burkina Faso, with Hivos as fund and programme manager.

The Kenya Biogas Programme (KBP), is the lead implementing entity in Kenya with the responsibility of coordinating, facilitating, and monitoring sector functions and supporting the technical, financial and institutional architecture necessary for development of the domestic biogas sector in Kenya.

The VPA is implemented based on private sector market-oriented principles, but also develops governmental support for a favorable regulatory and policy environment, as well as general buy-in promotion and extension. The VPA stimulates the installation of domestic biogas systems of between 2 m^3 to 100 m^3 capacities. This VPA was retroactively included in the ABC PoA and includes biogas systems of which the construction started since 23/10/2015.

This VPA is a small-scale project.

A.2. Location of project

The host party of this VPA is Kenya. The co-ordinates of Kenya are represented approximately by 1 00 N, 38 00 E-[4].The VPA disseminates biogas over the entire territory of Kenya.

[4] Available from https://www.cia.gov/the-world-factbook/countries/kenya/

The VPA implementer is the Kenya Biogas Programme. The physical location of their office is: Along Lenana Road, ACS Plaza, Nairobi, P.O. Box 79875-00202 Nairobi Kenya. GPS Co-ordinates: S 1◦17'19'' S, E 36◦47'0.999''.

A.3. Reference of applied methodology

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Gold Standard methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (Version 1.0)

Requirements and guidelines: usage rate monitoring v2.0[5]

A.4. Crediting period of project

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7-year renewable. Crediting period 14/03/2017 – 13/03/2024, both dates inclusive

[5] https://globalgoals.goldstandard.org/standards/407G_V2.0_EE_ICS_TPDDTEC_Usage-guidelines.pdf

SECTION B. IMPLEMENTATION OF PROJECT

B.1. Description of implemented project

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The Kenya Biogas Programme (KBP), the lead implementing entity in Kenya, with the responsibility of coordinating, facilitating and monitoring sector functions and supporting the technical, financial and institutional architecture necessary for development of the domestic biogas sector in Kenya.

The VPA is implemented based on private sector market-oriented principles, but also develops governmental support for a favorable regulatory and policy environment, as well as general buy-in promotion and extension. The VPA stimulates the installation of domestic biogas systems of between 2 m^3 to 100 m^3 capacities. This VPA was retroactively included in the ABC PoA and includes biogas systems of which the construction started since 23/10/2015.

Installed technology

The technology implemented under the VPA006 covers biodigesters fed with a mixture of water and animal manure that is anaerobically digested. The generated biogas is intended for use as fuel for cooking. Models with a proven track record, and their lifespan, included in this VPA are:

Type	Model	Lifespan
Fixed dome	Modified Kenbim Model	The average lifespan of a well-constructed fixed dome digester is estimated to be at least 25 years but can easily reach more 35 years when quality materials are used during construction and O&M practices observed in its operation.
	KENBIM /MKD	
	AKUT	
	Modified camartec digester	
Plastic digester types	Flexi biodigesters	An average of 7-10 years, with a potential of max. of 15 years with good care and protection from UV with the greenhouse
	Home Biogas	7-10 yrs, with a potential of 30 years with better care from UV and against rodents
	Kentainer	
	Takamoto/topflame /blue flame bioSlurriGaz	An average of 7-10 years, with a potential of 15 years

Implementation status

The VPA is operational. The table below provides an overview of the number of units installed by size category included in the carbon database.

Table 2: Digester capacities installed in this MP in cubic meter[6]

From	To	Number
2	4	35
4	6	350
6	8	720
8	10	1631
10	15	1561
15	100	136
Total		**4,433**

The actual number constructed is 5818[7]. The difference is attributed to plants that are demolished, being repaired, or clients that are not reachable. These plants have bene excluded from the ER calculations, either permanently (if destroyed) or temporarily (if there the plant could be restored to full functionality).

The next table provides an overview of the number of units installed by digester model

Table 3: Number of units installed by digester design[8]

Design	Number installed
AKUT	122
BlueFlame BioSlurriGaz	57
FLEXI	328
Home Biogas	69
KENBIM	1759
MKD	1890
Modified Camartec Digester	41
Topflame	167
Grand Total	**4,433**

At the end of this MP, 35 digesters were reported for repair or maintenance. Out of those 11 were repaired, and 24 were excluded as repairs or follow up is ongoing[9]. The most common issues reported by farmers include 'The plant have not been working for a while now' and 'There is no gas production'. A full list of issues is included in the referenced excel file in column J[10].

[6] See VPA06 MPVI survey SDG ER sheet SDG 8 a3:c9

[7] See VPA06 MPVI survey SDG ER sheet DB_MPVI cell B5819

[8] VPA06 MPVI survey SDG ER , sheet plant type A3:B14

[9] VPA06 MPVI RMT sheet analysis A3:E9

[10] VPA06 MPVI RMT sheet analysis A3:E9 sheet VPA06 MP6 MRT column J

The technical specification of the technologies are:

- Mixing ratio: 1:1 (manure and water)
- Thermal capacity is 2.21 KW_{th} per unit on average (as per VPA006-DD page 43 eligibility criteria 11)

The total installed capacity is 4,433 digesters x 2.21 kWth = 9.80 MW_{th}

The specifications of the most commonly built digesters sizes are shown below[11]:

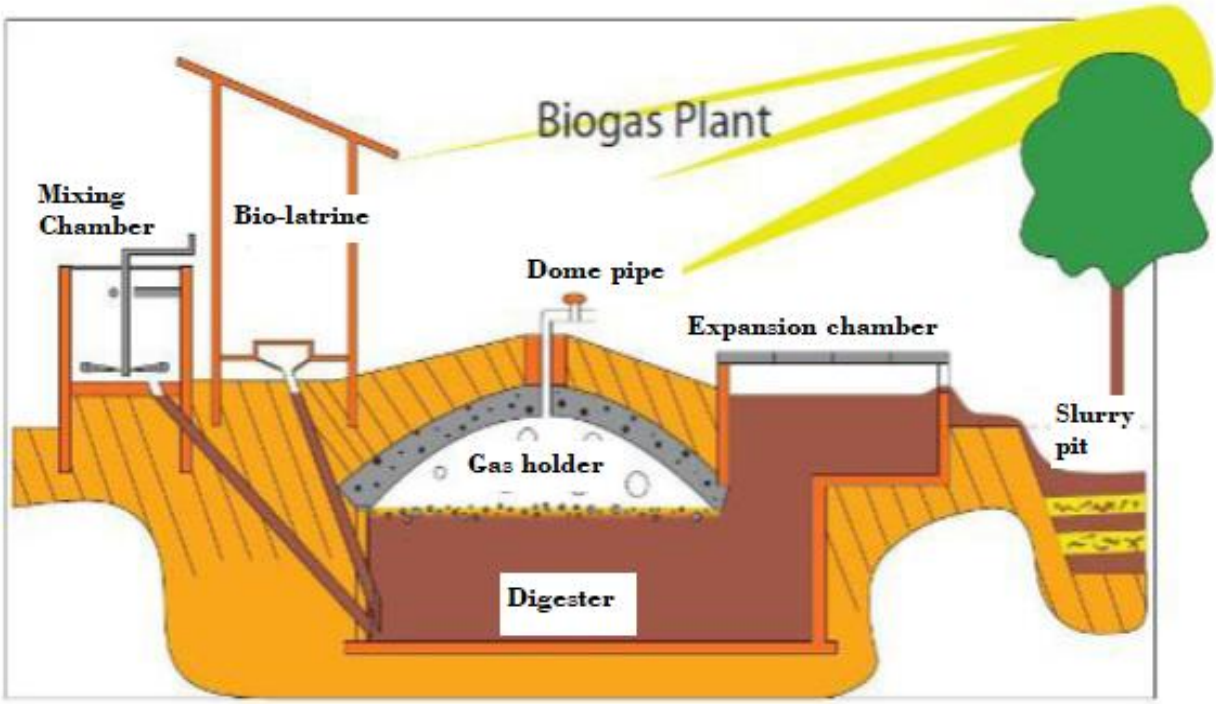
Table 4: Technical specifications of the 5 most common installed digester sizes

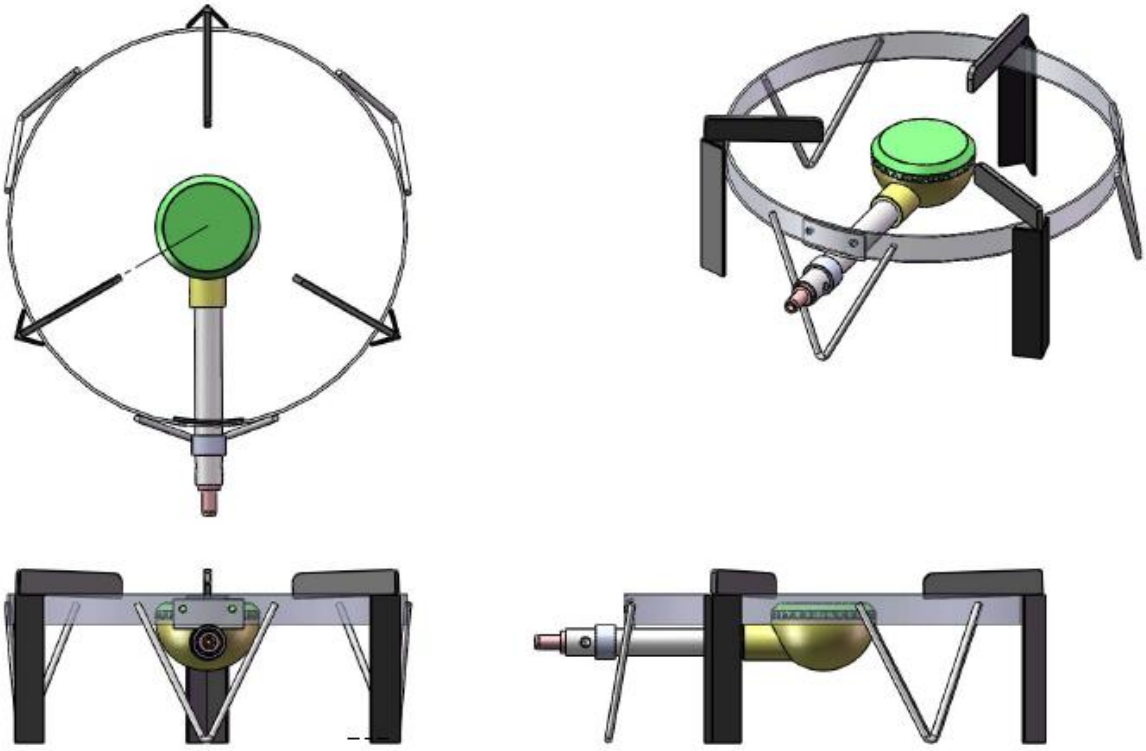
Volume (m3)	Max daily feeding in litres (manure+ water)	Max daily gas production (m^3)	Digester volume (m^3)	Effective gas storage (m^3)	V buffer (m^3)	Total biodigester volume (m^3)
4	30+30	1.05	2.36	0.69	0.49	3.53
6	50+50	1.75	3.74	0.90	0.60	5.24
8	70+70	2.45	5.30	1.35	0.85	7.50
10	100+100	3.50	7.27	1.94	1.17	10.37
12	120+120	4.20	9.44	2.37	1.43	13.24

Other digester sizes are built in much smaller quantities. Their performance will be proportional to the 10 m^3 digester. Thus the 70 m^3 digester for example, can be fed 700 kg manure daily (7*100), will produce 24,500 ltr (7*3,500) gas per day. The same applies to all other values.

A diagram of a typical biodigester and the stove is shown here below

[11] Construction manual MKD digester (2016) page 3





B.1.1 Forward Action Requests

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N/A

B.2. Post-Design Certification changes

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N/A

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

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- The registered VPA-DD listed fNRB as a monitoring parameter, but specified it would be fixed during the first monitoring period (MP1) for the entire crediting period. This was done in the MP1 review, where the conservative fNRB value of **89.48%** (from GS 5642) was adopted and approved by Gold Standard for the entire CP. This approval was re-confirmed in the MP2 review. This monitoring report continues to apply the approved fixed value of 89.48%.

- **BBb4,fuel (Fossil fuel in B4):** The BFT to establish this parameter was intended to be completed ex-ante, but this was delayed past the VPA-DD's finalization due to budgetary reasons. Therefore, the VPA-DD listed this parameter to be monitored **"Once per crediting period"**. This required one-time monitoring has since been completed and approved in a previous verification, establishing the values for this scenario as 0.24 tonnes/year/hh of LPG and 0.44 tonnes/year/hh of biomass. Since the one-time monitoring actions specified in the VPA-DD is now complete, they are reported as "fixed ex-ante" for the remainder of this crediting period.

B.2.2. Corrections

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- The VS excretion value for sheep was incorrectly described as 0.31 kgVS/dag in the registered VPA-DD. This in fact 0.32 kgVS/day as per IPCC 2006 guidelines volume 4 chapter 10 table 10A-9 and this is the value used in this MP.

- The Methane Conversion Factor (MCF) for the baseline manure management system was incorrectly described with the "Data unit" kg CH4 in the registered VPA-DD (section B.4.2). This unit should be %. The correct value of **3.39%** was correctly listed in the "Value(s) applied" field of that same table and correctly calculated in Table 8 of the VPA-DD. This Monitoring Report uses the correct methodological identifier MCFx,k, the correct unit (%), and the correct value of 3.39%

B.2.3. Changes to start date of crediting period

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N/A

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

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The PoA transitioned to GS4GG on 23/07/2019. The transition annex is applicable to all VPAs registered under the PoA. Most monitoring parameters remained the same but are now expressed in terms of contribution to the SDGs instead to the SD parameters with the exception of the following parameters

- A new SDG is monitored: SDG5 Achieve gender equality and empower all women and girls with the following indicators:
    - Time savings of the female member in charge of cooking
    - Usage of saved time

B.2.5. Changes to project design of approved project

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N/A

SECTION C. DESCRIPTION OF MONITORING SYSTEM APPLIED BY THE PROJECT

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The objective of the monitoring effort conducted under this VPA was to meet the monitoring requirements set forth in the methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (Version 1.0), as per the PoA-DD, VPA-DD and transition annex.

Tasks and responsibilities in the monitoring system
The implementation of the monitoring system is coordinated and managed by the CME, Hivos, in cooperation with Eric Buysman; independent consultant. Survey questionnaires were prepared by HIVOS and KBP and programmed into the app TaroWorks. The monitoring was implemented by an independent third party EcoFrontier. EcoFrontier also conducted the monitoring of the previous MR and of VPA02 in Tanzania. EcoFrontier was selected again as they demonstrated competence and collected high quality data. EcoFrontier carried out a review of the questionnaires, selected samples from the project database, recruited and trained enumerators[12] and implemented the carbon monitoring effort, including the biogas user. Finally, EcoFrontier was responsible for the presentation of the raw data and a report detailing the findings of the monitoring report. Subsequently, Eric Buysman was responsible for preparing the monitoring report, including the calculation of emission reductions.

Competency assessment

- **EcoFrontier** – EcoFrontier has implemented the previous 2 monitoring surveys without issues and is therefore well qualified for this monitoring survey.
- **EcoFrontier's enumerators**
    - EcoFrontier has the following selection criteria:
        - The experience of the enumerators in undertaking similar or related surveys in the field. In total, over 90% of the enumerators are those who have been engaged in BUS before either undertaking KPT or Monitoring surveys and therefore experienced in the biogas project. Care will be taken to ensure that no two new enumerators will be in the same team, a new enumerator will be paired with an experienced enumerator.
        - Gender composition of the team, the teams will be paired such that a male and female enumerator will form a team.
        - Academic qualification, at least a diploma in social and environmental sciences or related fields.
        - Good understanding of the local languages of the target regions, fluency in English and Swahili is a must-have.

[12] Separate training report is available (ABPL CM BUS SDG 2021 June2023 training report)

  - Readiness to travel far distances and ability to use mobile data collection techniques.
  - Prior experience in working with Eco-Frontier in similar assignments was a priority.
- **Eric Buysman** – seasoned carbon consultant and has been working on carbon projects since 2011, both as developer and for the Gold Standard as technical reviewer and for the UNFCCC on methodology development.

Data flow

The following graph provides an overview of the data flow in the monitoring process.

Task	Description	Responsible actor
Data collection	Survey conducted through visiting and calling selected households	EcoFrontier
Data recording	Survey data transferred from TaroWorks to electronic spreadsheet	EcoFrontier
Data quality control	Collected data is cross-checked for consistency and errors	Eric Buysman
Calculations	Collected data is analysed to calculate individual parameters for input into emission reduction calculations	Eric Buysman
Reporting	Parameters input into emission reduction calculations and reported in the Monitoring Report.	Eric Buysman

Figure 1: Data flow in the monitoring process

SECTION D. DATA AND PARAMETERS

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

SDG 13

Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".

Data / Parameter:	$f_{NRB,y}$
Data unit:	%
Description:	Fraction of biomass used in the absence of the project activity in year y that can be established as non-renewable biomass using nationally approved methods
Source of data:	GS 5642 BURN cookstove project PDD section B7.2, see https://impact.sustain-cert.com/document_files/6106)
Value(s) applied:	Kenya: 89.48
Choice of data or Measurement methods and procedures:	GS registered PDD in which a fNRB is calculated which is valid for the whole of Kenya (GS 5642)
Purpose of data	Calculation of baseline and project emissions
Additional comment:	Valid for this CP

Data / Parameter:	$EF_{b,\ bio}$
Data unit:	tCO_2/TJ
Description:	Emission factor of the woody biomass used in baseline scenario b
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	112
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of the baseline scenario
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC. CO_2 and non-CO_2 emissions factors for charcoal may be estimated from project specific monitoring or alternatively by researching a conservative wood to charcoal production ratio (from IPCC, credible published literature, project- relevant measurement reports, or project-specific monitoring) and multiplying this value by the pertinent EF for wood.

Data / Parameter:	$EF_{p, bio}$
Data unit:	tCO_2/TJ
Description:	Emission factor of the woody biomass used in project scenario p
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	112
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of project emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC.

Data / Parameter:	$EF_{p, fuel}$
Data unit:	tCO_2/TJ
Description:	Emission factor of fossil fuels used in project scenario p
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Kerosene = 71.9 LPG = 63.1
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC.

Data / Parameter:	NCV_{bio}
Data unit:	TJ/tonne
Description:	Net calorific value of the non-renewable biomass used in the baseline scenario
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	0.015
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	N/A

Data / Parameter:	$EF_{b, fuel}$
Data unit:	tCO_2/TJ

Description:	Emission factor of fossil fuels used in baseline scenario b
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Kerosene = 71.9 LPG = 63.1
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter:	NCV_{fuel}
Data unit:	TJ/tonne
Description:	Net calorific value of fossil fuels used in the baseline scenario
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Kerosene = 0.0438 LPG = 0.0473
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and Table 2.3, Chapter 2, Volume 2 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC

Data / Parameter:	VS_T
Data unit:	kg/head/day
Description:	Daily volatile solid excreted for livestock category T
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Dairy cows = 1.90 Other cattle = 1.50 Market Swine = 0.30 Breeding swine = 0.30 Goats = 0.35 Sheep = 0.32 Poultry = 0.02
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and sourced from Tables 10. A-4 through A-9, Chapter 10, Volume 4 of the 2006 IPCC Guidelines The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC. National data can replace the IPCC value, if available.

	The value of goat is 0.35 according to the VPA-DD and previous MR. In the transition annex however it is reported as 0.3. The correct value is the one reported in this table, 0.35 and is consistent with the IPCC 2006 guidelines chapter 10 volume 4 table 10a-9.

Data / Parameter:	Bo_T
Data unit:	m^3 CH_4/kg
Description:	Maximum methane producing capacity for manure produced by animal type T
Source of data:	2006 IPCC Guidelines for National Greenhouse Gas Inventories
Value(s) applied:	Dairy cows = 0.13 Other cattle = 0.10 Market swine = 0.29 Breeding swine = 0.29 Goats = 0.13 Sheep = 0.13 Poultry = 0.24
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and sourced from Tables 10. A-4 through A-9, Chapter 10, Volume 4 of the 2006 IPCC Guidelines The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC. National data can replace the IPCC value, if available

Data / Parameter:	$\eta_{biogas\ stove}$
Data unit:	%
Description:	Combustion efficiency of the new biogas stove introduced by the programme
Source of data:	US-EPA (1998) Greenhouse Gases from Small-Scale Combustion Devices in Developing Countries by Kirk R. Smith. R. Uma. V.V.N. Kishore. K. Lata. V. Joshi. Jufeng Zhang. R.A. Ramussen and M. A. K. Khalil referenced in Centre for Energy Studies, Institute of Engineering for the Nepal Biogas Support Programme (NBSP).
Value(s) applied:	99.4
Choice of data or Measurement methods and procedures:	KBP does not specify the type of biogas stove that should be installed by a household. Users however are trained on proper usage of the stove. It is reasonable to assume the combustion efficiency is maintained as incompletely combusted biogas is easily detectable due to its strong foul odour, prompting the user to examine issues with the stove.
Purpose of data	Calculation of project emissions
Additional comment:	NBSP is the mother programme of KBP.

Data / Parameter:	$MCF_{x,k}$
Data unit:	%
Description:	The methane conversion factor for the baseline manure management systems (x) in all the regions (k).
Source of data:	VPA06-DD
Value(s) applied:	3.39
Choice of data or Measurement methods and procedures:	As per requirement of the methodology and sourced from Tables 10.A-4 through A-9., Chapter 10, Volume 4 of the 2006 IPCC Guidelines. The IPCC is a standard, credible source of emissions factors.
Purpose of data	Calculation of baseline emissions
Additional comment:	IPCC (2006); May be updated according to any future changes by the IPCC

Data/Parameter	**$BB_{b1,bio}$**
Data unit	Tonnes/year
Description	Amount of woody biomass used in the baseline scenario b1
Source of data	KPT primary data 29Sept2015 B1(firewood), sheet '90/30 test'
Value(s) applied	3.66
Choice of data or measurement methods and procedures	Households have been asked how much fuelwood they use for cooking, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data/Parameter	**$BB_{b2,bio}$**
Data unit	Tonnes/year
Description	Amount of charcoal (in fuel-wood equivalents) used in the baseline scenario b2
Source of data	20170322 Survey C BFT Sample Size - KE, sheet 'B2 - 90|30 test'
Value(s) applied	7.48
Choice of data or measurement methods and procedures	Households have been asked how much charcoal they use for cooking and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data/Parameter	**$BB_{b3,bio}$**
Data unit	Tonnes/year
Description	Amount of fuelwood and charcoal (in fuel-wood equivalents) used in the baseline scenario b3
Source of data	20170322 Survey C BFT Sample Size - KE, sheet 'B2 - 90|30 test'
Value(s) applied	7.06
Choice of data or measurement methods and procedures	Households have been asked how much fuelwood and charcoal they use for cooking, and how much charcoal they use, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology.
Purpose of data	Calculation of baseline emissions
Additional comment	N/A

Data / Parameter:	$BB_{b4,fuel}$
Data unit:	Tonnes/year/hh
Description:	Amount of fossil fuels used in baseline scenario b4
Source of data:	VPA06 MR5
Value(s) applied	0.24
Measurement methods and procedures:	KPT protocol
Monitoring frequency:	Once per crediting period
QA/QC procedures:	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned.
Purpose of data	Calculation of baseline and project emissions
Additional comment:	n LPG using households used next to LPG on average 0.44 tonnes/year/hh of wood

Data/Parameter	**$BB_{b1,2,3,4}$**
Unit	Tonnes/year/hh
Description	Amount of fossil fuel used in the baseline scenarios b1, b2, b3 and b4
Source of data	See $BB_{b4,fuel}$, no fossil fuels are issued in the other scenarios
Value(s) applied	See $BB_{b4,fuel}$
Measurement methods and procedures	Households/communities/SMEs have been asked how much woody biomass and LPG they use, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology.

Measuring/reading/recording frequency	Not applicable: Option B BFT conducted once upfront and parameter fixed throughout the crediting period.
QA/QC procedures	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned.
Purpose of data	Calculation of baseline emissions
Additional comments	As per Annex 5 of the *Technologies and Practices to Displace Decentralized Thermal Energy Consumption* methodology.

Data/Parameter	**$EF_{awms,T}$**
Unit	kg CH4/ per head per year
Description	Emission factor for the defined livestock population category T by average temperature (Kenya: 20°C)
Source of data	2006 IPCC Guidelines for National Greenhouse Gas Inventories; Temperature: World Weather Online, http://www.worldweatheronline.com/v2/weather-averages.aspx?q=Nairobi,%20Kenya
Value(s) applied	**Animal T** / **Value** Dairy cow / 1 Goat / 0.017 Other cattle / 1 Sheep / 0.015 Market swine / 1 Poultry / 0.02 Breeding swine / 1
Choice of data or measurement methods and procedures	Calculated following the values provided from Tables 10.A-4 through A-9., Chapter 10, Volume 4 of the 2006 IPCC Guidelines. The IPCC is a standard,credible source of emissions factors
Purpose of data/parameter	Calculation of project emissions
Additional comments	IPCC (2006); May be updated according to any future changes by the IPCC. Applicable to IPCC Tier 1 calculation

Data / Parameter:	PL
Data unit:	%
Description:	Physical leakage of the biodigester
Source of data:	methodology 'Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (Version 1.0)

	default (page 52)
Value(s) applied:	Estimated using a 10% default rate of total methane production.
Choice of data or Measurement methods and procedures:	10 %
Purpose of data	Calculation of project emissions
Additional comment:	As per Annex 6 of the applied methodology

D.2 Data and parameters monitored

SDG 2: Indicator 2.4.1: Proportion of agricultural area under productive and sustainable agriculture

Data/parameter	GS-3 Soil condition
Unit	%
Description	Percentage of biogas users who use slurry as a fertilizer
Source of data	VPA06 MPVI_survey_SDG_ER, sheet Analysis A, C55
Value(s) applied	99.5
Measurement methods and procedures	Application of slurry as fertilizer on agricultural land will be monitored through sampling as part of the annual monitoring effort. Stakeholders will be asked how they use the slurry, if at all.
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of SDG contribution
Additional comments:	N/A

SDG3: 3.9.1: Mortality rate attributed to household and ambient air pollution

Data/parameter:	GS-1 Air Quality
Unit	-
Description	Perceived improvement in health by the user (incidence of eye problems and respiratory illness)
Source of data	VPA06 MPVI_survey_SDG_ER, sheet Analysis A, D48
Value(s) applied	99.1% of the user report perceived health improvement
Measurement methods and procedures	Users of the biogas digesters will be asked if they feel the incidence of eye problems and respiratory illness have a) increased, b) stayed the same or c) decreased as a result of getting a biogas digester.
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	N/A

SDG 5: Achieve gender equality and empower all women and girls

Data/parameter:	Time savings
Unit	Percentage
Description	Percentage of women that report time-savings attributed to the installation of a biodigester
Source of data	VPA06 MPVI_survey_SDG_ER, sheet Analysis A, D58:D60
Value(s) applied	Yes,more time available than before having biogas: 95.6% No,just the same as before (between before and after having Biogas): 4.4% Yes,less time available than before having biogas: 0.0%
Measurement methods and procedures	Survey methods. The female member of the household in charge of cooking and/or cooking fuel collection, will be asked: Did you save time compared to before you have installed a biodigester? (yes/no/same time investment)
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	N/A

Data/parameter	Usage of saved time
Unit	[-]
Description	Usage of saved time
Source of data	VPA06 MPVI_survey_SDG_ER, sheet Analysis A, F63:G68
Value(s) applied	Income generating including farming: 72% Recreation: 22% Helping my husband: 8% Social activity (voluntary work, etc): 29% Other: 4%
Measurement methods and procedures	The same female member will be asked – What did you do with your saved time? or if no time savings were reported, the reason why will beasked
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data	SDG impact monitoring
Additional comment	N/A

SDG 7: 7.1.2: Proportion of population with primary reliance on clean fuels and technology

Data/parameter:	GS-08 Access to affordable and clean energy services
Unit	Number
Description	Number of biogas units installed
Source of data	VPA06 MPVI_survey_SDG_ER, sheet SDG13 cell D18
Value(s) applied	4,433
Measurement methods and procedures	The total number of biogas digesters will be determined via the electronic Project Database
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	-

Data/parameter:	GS-12 Technology transfer and technological self-reliance
Unit	Number of masons and biogas enterprise staff attending training programmes
Description	Refers to changes compared to the baseline in activities that build usable and sustainable know-how in a region/country for a technology, where know-how was previously lacking. The number of constructors trained will be monitored.
Source of data	07MAR24 training list since 2016_VPA06
Value(s) applied	0
Measurement methods and procedures	Records will be kept of attendance at the vocational training programmes, including general training extended to entities outside of the programme.
Monitoring frequency	Annually
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring
Additional comments:	Trainings were organized just before and after this MP, but none took place in this particular MP. Since 2016 however, 537 masons were trained. See cell J23 in tab PVT in the excel file 07MAR24 training list since 2016_VPA06

SDG 8: 8.5 By 2030, achieve full and productive employment and decent work for all women and men,

Data/parameter:	GS-10 Quantitative employment and income generation
Unit	man-days

Description	Cumulative number of mason working days
Source of data	VPA06 MPVI_survey_SDG_ER sheet SDG8, J32
Value(s) applied	67,071
Measurement methods and procedures	This is calculated by multiplying the number of digesters constructed times the default number of days required for the construction. Non-masonry plants are defaulted to 0.25 working days, while the 4,6,8,10 and 12 m3 masonry plants require respectively 6,7,8,10 and 12 working days of a mason and the same amount of working days of a helper (causal laborer)
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	SDG impact monitoring.
Additional comments:	The unit is incorrectly presented as number of employees attending training programs in the transition annex. This should be man-days as described in the description of the parameter in the transition annex

SDG 13

Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalization of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".

Data/parameter:	$U_{p1,y}$
Unit	Fraction
Description	Cumulative usage rate for technologies in project scenario p1 in year y, based on cumulative adoption rate and drop-off rate (fraction)
Source of data	VPA06 MPVI_survey_SDG_ER, sheet Analysis B, I13
Value(s) applied	71.61%
Measurement methods and procedures	Survey methods. An assessment of the drop-off rate of usage requires that digesters of different age groups are assessed. Monitoring shall be carried out on a random sample of digesters of different ages. The minimum total sample size is 100, with at least 30 samples for biogas digesters of each age bracket (measured in annual increments) being surveyed.
Monitoring frequency	Annual

QA/QC procedures:	To account for void responses and lack of availability of some households on the day of the survey, additional households within each age group should be questioned. To ensure conservativeness, participants in a usage survey with technologies in the first year of use (age 0-1) must have technologies that have been in use on average longer than 0.5 years. For technologies in the second year of use (age 1-2), the usage survey must be conducted with technologies that have been in use on average at least 1.5 years, and so on.
Purpose of data:	Calculation of project emissions
Additional comments:	A single usage parameter is weighted to be representative of the quantity of project technologies of each age being credited in a given project scenario. In brackets are the cells which contain the values referred to in the sheet Analysis B in spreadsheet VPA06 MPVI_survey_SDG_ER The weighted average usage rate of all age groups is: 71.22% (G11). That percentage has been adjusted downward to account for the off-time of plants to 70.93% (Cell G12) and subsequently adjust upward for plants that went out of operation but worked for a period during this MP, see cell G13 As per USAGE guideline v2.0 mandatory guidelines, biogas projects can claim up to 90% usage rate in an individual age-group. Therefore, all age-group usage rate results have been capped to 90%.

Data/parameter:	$N_{p1,y}$
Unit	Number
Description	Cumulative number of project technology-days included in the project database for project scenario p1 against baseline scenario b in year y
Source of data	VPA06 MPVI_survey_SDG_ER, sheet Analysis B, cell C30
Value(s) applied	1,097,776

Measurement methods and procedures	New biogas digesters included under the PoA will be entered into the Project Database as and when they come online. This will enable a running cumulative total of biogas digesters installed to be kept. The operational rate is determined on a sampling basis through annual monitoring surveys.
Monitoring frequency	Calculation of baseline and project emissions
QA/QC procedures:	Proper database administration
Purpose of data:	Calculations of project emissions
Additional comments:	Calculated based on the sum of days that plants are in operation

Data / Parameter:	$O_{p1,y}$
Data unit:	Number
Description:	The average technology-days during which the biodigesters are operational for project scenario p1 against baseline scenario b1 in year y
Source of data:	VPA06 MPVI_survey_SDG_ER, sheet Analysis B, cell C29
Value(s) applied	249.21
Measurement methods and procedures:	The operational rate is determined on a sampling basis through annual monitoring surveys. In addition, households are required to notify provincial office staff in a situation when a biodigester stops working. This information is recorded in the Project database, allowing the identification per included biodigester the number of operational days per year. In a scenario where the biodigester stops operating, the number of non-operational days is recorded in the database.
Monitoring frequency:	Continuous
QA/QC procedures:	The average operational days will be confirmed upon verification.
Purpose of data	Calculation of baseline and project emissions
Additional comment:	-

Data / Parameter:	$LE_{p1,y}$
Data unit:	tCO_2e/year
Description:	Leakage in project scenario p during year y
Source of data:	Determined on VPA level; Collected through the annual Biogas User Survey.
Value(s) applied	0
Measurement methods and procedures:	Non-biogas digester users will be surveyed through a questionnaire to determine whether leakage has occurred.
Monitoring frequency:	Every two years
QA/QC procedures:	The leakage will be monitored annually using survey methods to satisfy the requirements put forth by the methodology *'Technologies and practices to displace*

	decentralized thermal energy consumption' (11/04/2011).
Purpose of data	Calculation of project emissions
Additional comment:	During MPI GS review it was determined by the VVB that the leakage risk is very low and can be ignored. In MPII, MPIV this was confirmed and accepted by the VVB and the GS.

Data/parameter:	$N_{T,h}$
Unit	Number
Description	Number of livestock category T in premise h
Source of data	VPA06 MPVI_survey_SDG_ER, sheet analysis A, C8:C14
Value(s) applied	Number of animals: #/hh Number of dairy cattle: 4.03 Number of other cattle: 0.38 Number of pigs (for market): 0.84 Number of pigs (for breeding): 0.17 Number of poultry: 21.09 Number of sheep: 2.10 Number of goats: 1.34
Measurement methods and procedures	Households/communities/SMEs will be asked how many animals of different categories they own, and the conditions under which they are kept (i.e., freely or in a confined space).
Monitoring frequency	Annually
QA/QC procedures:	Calculation of baseline and project emissions
Purpose of data:	N/A
Additional comments:	-

Data/parameter:	$BB_{b\ ratio}$
Unit	%
Description	Baseline scenario ratios
Source of data	VPA06 MPVI_survey_SDG_ER, sheet analysis A, D17:D20
Value(s) applied	Baseline scenario: Percentage B1: Firewood used to meet (more than 50%) of my cooking needs: 75.1% B2: Charcoal used to meet (more than 50%) of my cooking needs: 9.6% B3: Firewood & charcoal used to meet (more than 50%) of my cooking: 0.0% B4: Other fuels: 15.2%

Measurement methods and procedures	Survey methods. Households/communities/SMEs are asked which baseline scenario they fell into before receiving a biogas digester.
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of baseline emissions
Additional comments:	N/A

Data/parameter:	$BB_{p1,\ bio}$
Unit	Tonnes/year
Description	Amount of woody biomass used in the project scenario p1 (one value)
Source of data	VPA06 MPVI_survey_SDG_ER, sheet PE, D53
Value(s) applied	1.453
Measurement methods and procedures	Households/communities/SMEs will both be asked how much woody biomass they use per week, and undergo a Kitchen Performance Test as per the requirements of the TPDDTEC methodology.
Monitoring frequency	Once every two years
QA/QC procedures:	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned
Purpose of data:	Calculation of project emissions
Additional comments:	Conducted in this MP and valid for 2 years

Data/parameter:	$BB_{p1,fuel}$
Unit	Tonnes/year
Description	Projected amount of fossil fuels used in the project scenario p1
Source of data	VPA06 MPVI_survey_SDG_ER, sheet PE, D54
Value(s) applied	0.02
Measurement methods and procedures	Households/communities/SMEs will be asked how much fossil fuels they use per week for cooking.
Monitoring frequency	Once every two years
QA/QC procedures:	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned.
Purpose of data:	Calculation of project emissions
Additional comments:	Conducted in this MP and valid for 2 years

Data / Parameter:	$MS_{P,S,K}$
Data unit:	%
Description:	Fraction of livestock category T's manure not treated in bio-digester S, in climate region k
Source of data:	VPA06 MPVI_survey_SDG_ER, sheet Analysis A, C34:C40
Value(s) applied	

Animal T	Fraction
Dairy cattle	20.4%
Other cattle	25.4%
Market swine	54.7%
Breeding swine	18.3%
Poultry	92.4%
Sheep	97.9%
Goat	97.8%

Measurement methods and procedures:	Households/communities/SMEs will be asked to estimate the fraction of their animal's manure that is fed into the biogas digester for the different relevant livestock categories.
Monitoring frequency:	Annual
QA/QC procedures:	To account for void responses and lack of availability of some households/communities/SMEs on the day of the survey, at least 10 additional households should be questioned.
Purpose of data	Calculation of project emissions
Additional comment:	N/A

Data/parameter:	$MS_{T,S,k}$
Unit	%
Description	Fraction of livestock category T's manure fed into the bio-digester S in climate region *k*
Source of data	VPA06 MPVI_survey_SDG_ER, sheet Analysis A, C25:C31
Value(s) applied	

Animal T	Fraction
Dairy cattle	79.6%
Other cattle	74.6%
Market swine	45.3%
Breeding swine	81.7%
Poultry	7.6%
Sheep	2.1%
Goat	2.2%

Measurement methods and procedures	Households/communities/SMEs will be asked to estimate the fraction of their animal's manure that is fed into the biogas digester for the different relevant livestock categories.
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting

Purpose of data:	Calculation of project emissions
Additional comments:	Applicable to VPAs applying Tier 2 only

Data/parameter:	GWP_{CH4}
Unit	Unit
Description	Global Warming Potential of methane
Source of data	GS rule update: https://globalgoals.goldstandard.org/standards/RU-2020-PR-V1.2-GWP-values.pdf
Value(s) applied	28
Measurement methods and procedures	N/A
Monitoring frequency	Annual
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of baseline and project emissions
Additional comments:	N/A

Data/parameter:	Bio
Unit	-
Description	Use of bio-slurry
Source of data	VPA06 MPVI_survey_SDG_ER, sheet bio-slurry, cell B1:D16
Value(s) applied	
Measurement methods and procedures	Survey methods
Monitoring frequency	Annual

Parameter 'Bio' | Bio		
% Use directly for various purposes	**38.3%**	**of which**
	Used as fertilizer	**98.2%**
	"% of bio slurry sold	**0.7%**
	use as insecticide	**0.9%**
	used as animal feed	**0.3%**
other	**0.1%**	
% Bioslurry Stored	**61.1%**	**of which**
	composting without roof	**2.67%**
	Composting with roof	**0.31%**
	Liquid slurry (brown porridge type)	**62.24%**
	Solid storage	**12.49%**
	Uncovered lagoon (black watery mass.)	**12.29%**
	sundrying	**10.00%**
% Bioslurry Discarded	**0.5%**	
Sum	**100.0%**	

QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of project emissions
Additional comments:	N/A

SDG 13 and 7

Data/parameter:	$N_{op1,y}$
Unit	Number
Description	Cumulative number of project technologies included in the project database for project scenario p1 in year y
Source of data	VPA06 MPVI_survey_SDG_ER, sheet Analysis B, cell c31
Value(s) applied	4,433
Measurement methods and procedures	The date presented in the Sales Agreement for each biogas digester is recorded in the Project Database. The average length of time between when a digester is completed and when biogas begins to be used will be established on VPA level. $\mathbf{N_{0p1,y}}$ will be calculated from this date.
Monitoring frequency	Continuous
QA/QC procedures:	Transparent data analysis and reporting
Purpose of data:	Calculation of baseline and project emissions
Additional comments:	N/A

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

Data/parameter	Value obtained in this monitoring period	Value obtained in the last monitoring period
Percentage of biogas users who use slurry as a fertilizer	99.5	99
Perceived improvement in health by the user (incidence of eye problems and respiratory illness)	99.1%	98.9%
Time savings	Yes,more time available than before having biogas: 95.6 % No,just the same as before (between before and: 4.4%	Yes, more time available than before having biogas: 94.2 % No, just the same as before (between before and after having Biogas): 5.8% Yes, less time available than: 0.0%

	after having Biogas)		before having biogas	
	Yes,less time available than before having biogas	0.0%		
Usage of saved time	Income generating including farming	72%	Income generating including farming	73%
	Recreation	22%	Farming	0%
	Helping my husband	8%	Recreation	11%
	Social activity (voluntary work, etc)	29%	Helping my husband	19%
	Other	4%	Social activity (voluntary work, etc)	8%
			Other	17%
Number of biogas plants installed	4,433		4,455	
Number of masons and biogas enterprise staff attending training programmes	0		80	
GS-10 Technology transfer and technological self-reliance	67,071		75,946	
$U_{p1,y}$	71.61%		78.63%	
$N_{p1,y}$	1,097,776		1,149,098	
$O_{p1,y}$	249.21		263.40	
$LE_{p1,y}$	0		0	
$N_{T,h}$	**Number of animals**	**#/hh**	**Number of animals**	**#/hh**
	Number of dairy cattle	4.03	Number of dairy cattle	4.38
	Number of other cattle	0.38	Number of other cattle	0.36
	Number of pigs (for market)	0.84	Number of pigs (for market)	0.89
	Number of pigs (for breeding)	0.17	Number of pigs (for breeding)	1.19

	Number of poultry	21.09		Number of poultry	50.38
	Number of sheep	2.10		Number of sheep	2.01
	Number of goats	1.34		Number of goats	1.21

$BB_{b\ ratio}$	Baseline scenario	Percentage	Baseline scenario	Percentage
	B1: Firewood used to meet (more than 50%) of my cooking needs	75.1 %	B1: Firewood used to meet (more than 50%) of my cooking needs	76.4 %
	B2: Charcoal used to meet (more than 50%) of my cooking needs	9.6%	B2: Charcoal used to meet (more than 50%) of my cooking needs	7.9%
	B3: Firewood & charcoal used to meet (more than 50%) of my cooking	0.0%	B3: Firewood & charcoal used to meet (more than 50%) of my cooking	1.0%
	B4: Other fuels	15.2 %	B4: Other fuels	14.7 %
$BB_{b4,fuel}$	0.24 LPG and 0.44 biomass		0.24 LPG and 0.44 biomass	
$BB_{b1,2,3,\ fuel}$	0		0	
$BB_{p1,\ bio}$	1.453		0.612	
$BB_{p1,fuel}$	0.02		0.04	

$MS_{P,S,K}$	Animal T	Fraction	Animal T	Fraction
	Dairy cattle	20.4%	Dairy cattle	9.30%
	Other cattle	25.4%	Other cattle	38.00%
	Market swine	54.7%	Market swine	76.43%
	Breeding swine	18.3%	Breeding swine	60.91%
	Poultry	92.4%	Poultry	94.31%
	Sheep	97.9%	Sheep	96.59%
	Goat	97.8%	Goat	100.00%

$MS_{T,S,k}$	Animal T	Fraction	Animal T	Fraction
	Dairy cattle	79.6%	Dairy cattle	90.7%
	Other cattle	74.6%	Other cattle	62.0%
	Market swine	45.3%	Market swine	23.6%
	Breeding swine	81.7%	Breeding swine	39.1%
	Poultry	7.6%	Poultry	5.7%

	Sheep	2.1%	Sheep	3.4%
	Goat	2.2%	Goat	0.0%
GWP_{CH4}	**28**		**28**	
Bio	**How do you apply bio-slurry**	**% of farmers**	**How do you apply bio-slurry**	**% of farmers**
	Use directly for various purposes	38.2%	Use directly for various purposes	31%
	Store it first	61.1%	Store it first	68%
	I don't use it / discarded	0.5%	I don't use it / discarded	1%
$N_{op1,y}$	4,433		4,455	

The PFT values are much higher this year, this is attributed to the moment when it was organized, which is in December, a month with a great number of out of the ordinary events, such children's holiday period, often children would otherwise reside at boarding schools, Christmas etc. However, due to budget limitations, it was not possible to redo the PFT during a more representative period.

Other than that, there is no material difference between the values. However, overall performance has declined to few new installations and a decreased usage rate. The latter is a natural development due to an increasing age of the digester fleet.

D.4. Implementation of sampling plan

The data collection targeted users of biogas technologies under the African Biogas Carbon Programme (ABC) – Kenya. The users/respondents will be drawn from the project database which will be provided by Hivos. The data collection will be obtained by three household surveys, that is: -

- **Survey A (User Survey)**; which will gather information about household socio-economic indicators, fuel use for cooking, renewability and non-renewability indicators, animal waste handling, use of bio-slurry on agricultural fields, perceived improvement of living conditions, financial and time savings, and user satisfaction with biogas, bio-slurry and trainings.
- **Survey B (Usage Survey)**; this will collect data about the actual functioning of the biogas digesters.
- **Survey C (Project Fuel Test-PFT)**; the consultant team will collect fuel use data of households with a biodigester in operation in form of Kitchen Performance Tests (KPTs).

Survey executed in this MP – survey A and B and PFT

i. Objectives and reliability requirements

The objective of the sampling effort was to meet the monitoring requirements set forth in the methodology '*Technologies and Practices to Displace Decentralized Thermal Energy Consumption' (version 1.0)*.

The target population for this survey were VPA06 households from 8 age clusters of biogas plants commissioned from 23st October 2015[13].

A multi-stage sampling approach was used in selecting biogas plants, considering the proportionate representation of different regions and counties in the sample. The sampling frame was stratified by age of biogas plant (8 age groups), and county (about 41 counties). In each strata the sample size was set at 35 plants for survey B and 15 for survey A. Survey A sample size totals 211 which is more than required by the methodology (n=100) and in the case of survey B, this is more than 30 required per age stratum.

In each stratum, the 35 samples were divided over the counties in the sampling frame based on the proportional representation of each county. Thereafter, simple random sampling was used to select the households in each selected county. The next table provides an overview of the sampling groups, the number reached per age-group and the sample size.

Table 5: Age group and age group sample size[14]

Age group	Sample period		Sampled period (conservative)		Survey B[15] household reached
1	01/01/2023	30/09/2023	01/01/2023	30/09/2023	34
2	01/01/2022	30/06/2022	01/01/2022	30/06/2022	35
3	01/01/2021	30/06/2021	01/01/2021	30/06/2021	35
4	01/01/2020	30/06/2020	01/01/2020	30/06/2020	35
5	01/01/2019	30/06/2019	01/01/2019	30/06/2019	35
6	01/01/2018	30/06/2018	01/01/2018	30/06/2018	35
7	01/01/2017	30/06/2017	01/01/2017	30/06/2017	34
8	23/10/2015	30/06/2016	23/10/2015	30/06/2016	35

Year 1 and 8 is a little bit longer than 1 year, this was unavoidable as the total period is not equal an exact number of years.

[13] Units are included from the 23th of October 2015 based on commissioning date but only if the start date of construction was past 23 October 2015

[14] Actual sample size is 245 for survey B and 191 for survey A (higher due to oversampling) In the ER database see sheet survey A and sheet survey B

[15] Survey B is the usage survey and administered at all households and survey A is the user survey and administered only a household with an plant in operation

Survey B has been implemented as per the mandatory guidelines as described below:

Mandatory requirements	**Definition**	**Implementation**
Define use and non-use	Use = using biogas at least once daily Non-use is defined as a period without using biogas. Monitored will be the 'down-time' of biogas plants, thus in case there are periods without biogas due to lack of feeding, technical issues or other reasons. The PFT will monitor fuel stacking next to biogas and account these as project emissions	Biodigester usage, non-usage, and temporarily non-usage has been monitored in survey B
In person household usage survey	The project developer shall carry out an in-person usage survey to determine the project technology use. The sampling will follow the guidance in the applied methodology. In addition, the usage survey will cover: - Kitchen observations to asses if the technology is indeed used - Interview with the main cook or a person frequently involved in cooking. In case the main cook is not available, it is permissible to follow up with phone calls to confirm collected data from other household members - Photo's of cooking areas (only after consent is obtained) - GPS coordinates collection	Kitchen observations took place and are recorded. The main cook was interviewed each time. Photos of the cooking areas are recorded GPS coordinates are standard and included in the excel sheets
Verification checks	The verification checks of survey data shall be performed by the project developer prior to verification by the Verification/Validation Body (VVB).	15 households were called, which is a bit more than 5%. All data was matching. See file survey B confirmation 2024

	At the conclusion of the data collection phase of the survey, the project developer representative shall telephone a randomly selected 5-10% of the surveyed households to verify that homes were visited by surveyors and the recorded responses are correct.	

For more information on the sampling, see chapter 3 in the inception report prepared by the survey consultant.

Out of the 35 randomly selected survey B households in each age-group, the households with a digester in operation were interviewed for survey A. In total 211 households were interviewed. Out of those, 14 plants were declared invalid, as these households did not have a functioning plant. Reason: survey A only targets plants in operation[16]

PFT samples
The Project Fuel Test (PFT) employed a cross-sectional sampling approach, drawing samples from two Voluntary Project Activities (VPAs): VPA06 and VPA01.

This method involved merging results from Survey A (VPA06) and the SDG survey (VPA01), specifically targeting households with operational biodigesters. The combined database was anticipated to comprise 220 households, with 120 from Survey A and a minimum of 100 from the SDG survey. From this merged database, a random selection of 60 households was conducted, with the intention of surveying at least 50 of them for PFT. In the end, 68 households participated in the PFT, which was sufficient to meet the 90/30 threshold[17]

ii. Collected data
Surveys A, and B and PFT were executed in the period November to December 2024. The period of execution includes contracting, data gathering, analysis, QC and reporting. All households were physically visited. The PFT was implemented in December 2025

iii. Analysis

Analysis was performed on the monitoring surveys' results to establish the required monitored parameters. For Surveys A and B, please refer to the Excel sheet 'VPA06

[16] See sheet excl plants in file VPA06_MPVI survey_ER
[17] VPA06 MPVI survey SDG_ER sheet PFT cell B75

MPVI_survey_SDG_ER ' sheets 'Analysis A' and 'Analysis B' and 'PFT' for a complete run-through of how the analysis for each parameter was conducted.

iv. Demonstration that the required confidence/precision level has been met

Demonstration of the required confidence/precision level is not relevant for Survey A and B, where instead a minimum sample size applies as per the *Technologies and Practices to Displace Decentralized Thermal Energy Consumption* methodology. The minimum sample is 100 for survey A and 30 per age group for survey B. In both cases more households were reached and therefore the requirement has been met.

The PFT threshold is 90/30 for confidence level and the level of precision. The achieved levels are 90/28[18]

i. Demonstration that the samples were randomly selected and are representative of the population

Plants were selected using a random number generator ensuring randomization. The sample was drawn from the whole population and all elements were selected by chance only. The sample drawn is therefore representative.

[18] VPA06 MPVI_survey_SDG_ER sheet PFT cell U32 and U39

SECTION E. CALCULATION OF SDG IMPACTS

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

Methodological approach to calculating the contribution to SDG2
SDG 2.4.1: Proportion of agricultural area under productive and sustainable agriculture

The contribution will be reported as the: *Percentage of biogas users who use slurry as a fertilizer*

The occurrence of application of slurry to agricultural land will be monitored through sampling as part of the annual monitoring effort. Stakeholders will be asked how they use the slurry, if at all. The outcome of the survey is the share of households that use bio-slurry.

A biodigester is required to produce and use bio-slurry, the baseline, the absence of the project, therefore is 0 household use bio-slurry

Methodological approach to calculating the contribution to SDG3
3.9.1: Mortality rate attributed to household and ambient air pollution

The contribution will be reported as the: *number of users with a reduced, increased or no change in the incidence of eye problems and respiratory illness.*

Users of the biogas digesters will be asked if they feel the incidence of eye problems and respiratory illness have a) increased, b) stayed the same or c) decreased as a result of getting a biogas digester. The incidence will be monitored through sampling as part of the annual monitoring effort.

The baseline is 0 households report a reduced incidence as before the project no biodigesters were installed in the target population

Methodological approach to calculating the contribution to SDG5
SDG 5: Achieve gender equality and empower all women and girls

The contribution will be reported as: *(1) Percentage of women that report time-savings attributed to the installation of a biodigester and (2) usage of saved time.*

1. Time savings will be determined as follows:

The female member of the household in charge of cooking and/or cooking fuel collection, will be asked:

- Did you save time compared to before you have installed a biodigester? (yes/no/same time investment)

2. Usage of saved time

The female member of the household in charge of cooking and/or cooking fuel collection, will be asked:

- What did you do with your saved time? or if no time savings were reported, the reason why will be asked

The contribution will be monitored through sampling as part of the annual monitoring effort.

Question 1 has 3 answer categories: Yes, no, and No, just the same as before (between before and after having Biogas). The contribution will be calculated by the sum of answers agreeing to a specific answer category divided by the number of female respondents. I.e. if 25 women replied yes to the first question (time savings) out of 50, the outcome is 25/50=50% for the answer category 'Yes'.

Question 2 is not a multiple-choice question; however, the answers will be grouped as much as possible into categories during the data analysis. I.e. the category farming, leisure or any other applicable. The calculation method will be the same as question 1.

The baseline is 0 females report time savings as before the project no biodigesters were installed in the target population

Methodological approach to calculating the contribution to SDG7

7.1.2: Proportion of population with primary reliance on clean fuels and technology

The contribution to this target will be determined by:

- Number of biogas units installed (captured in parameter $N_{op1,y}$(Cumulative number of project technologies included in the project database for project scenario p1 in year y). This data originates from the project database

The baseline is 0 as before the project no biodigesters were installed in the target population

- Number of masons and biogas enterprise staff attending training programmes. The source of data will be training records such as participants lists.

The baseline is 0 as before the project no masons and biogas enterprise staff could attend trainings.

Methodological approach to calculating the contribution to SDG8

8.5 By 2030, achieve full and productive employment and decent work for all women and men

The contribution to this target will be determined by calculating the *number of man-days involved in the construction of biodigesters.*

$$MD_y = \sum_{DT,S}^{1} N_{DT,S} \times MD_{DT,S}$$

Where

MD_y	=	Man-days of employment generated through the construction of biodigesters (days)
$N_{DT,S}$	=	Number of biodigester constructed by type and size
$MD_{DT,S}$	=	Number of man-days required for the construction of a particular type and size of biodigester

The number of days required by digester type is determined based on the bill of quantities (BoQ) of each digester type and size. In the case of prefabricated digesters this is will be defaulted at 0.25 days per digester irrespective of the size unless otherwise indicated by the supplier. A small number of masonry digesters are larger than 12 m^3, in absence of reliable estimates on the labour requirements, the labour requirement of the 12 m^3 digester is used for those digesters, which is conservative.

The baseline is 0 as before the project no biodigesters were installed in the target population

Methodological approach to calculating the contribution to SDG13

Indicator 13.2.1 "Number of countries that have communicated the establishment or operationalisation of an integrated policy/strategy/plan which increases their ability to adapt to the adverse impacts of climate change, and foster climate resilience and low greenhouse gas emissions development in a manner that does not threaten food production".

1. Baseline emissions from fuel use:

Applicable baseline scenarios are defined by the typical baseline fuel consumption patterns in a population that is targeted for adoption of the biodigester technology. The amount of baseline scenarios were defined in the VPA-DD through a baseline survey. The ratio of each scenario are monitored, see the equation below:

$$BE_{b,CO2,y} = \sum_b BB_{b,fuel} * NCV_{fuel} * EF_{b,fuel}) + (BB_{b,bio} * NCV_{bio} * EF_{b,bio} * f_{NRB})$$

Where:

$BE_{b,CO2,y}$	5.425[19]	Cumulative baseline CO_2 emissions from the use non-renewable biomass and fossil fuels during year *y, in* tCO_2/year/hh
NCV_{fuel}	0.0473	Net calorific value of fossil fuel, in TJ/tonne
$EF_{b,fuel}$	63.1	CO_2 emission factor of fossil fuel in baseline scenario *b*, in tonnes/TJ
$BB_{b,bio}$ and $BB_{b4\ fuel}$[20]	$BB_{b1,bio}$ The quantity of biomass consumed in the baseline scenario 1 3.66 $BB_{b2,bio}$ The quantity of biomass consumed in the baseline scenario 2 7.48 $BB_{b3,bio}$ The quantity of biomass consumed in the baseline scenario 3 7.06 $BB_{b4,LPG}$ The quantity of LPG consumed in the baseline scenario 4 0.24 $BB_{b4,biomass}$ The quantiy of biomass consumed in baseline scenario 4 0.44	The quantity of biomass and LPG consumed in the baseline scenario *b*, in tonnes/year
NCV_{bio}	0.015	Net calorific value of biomass, in TJ/tonne
$EF_{b,bio}$	112	CO_2 emission factor of biomass in baseline scenario *b*, in tonnes/TJ
f_{NRB}	89.48%	Fraction of non-renewable biomass, in percentage

2. Accounting for baseline emissions from manure handling.

The baseline emissions from the handling of animal waste is determined with IPCC Tier 2. The baseline emissions per household shall be calculated as follows:

[19] VPA06 MPVI survey SDG ER sheet BE, cell E61

[20] VPA06 MPVI survey SDG ER sheet BE cell E41:F45

$$BE_{b,CH4,h,y} = \frac{(VS_T * 365) * (B_{0,T} * 0.67 kg/m^3 * MCF_{x,k} * MS_{T,x,k} * GWP_{CH4} * N_{T,h})}{1000}$$

Where:

<table>
<tr><td>$BE_{b,CH4,h,y}$</td><td>0.322[21]</td><td>Baseline emissions from manure handling during the year y in tCO_2e/hh/year</td></tr>
<tr><td>VS_T</td><td>Dairy cows = 1.90
Other cattle = 1.50
Market Swine = 0.30
Breeding swine = 0.30
Goats = 0.35
Sheep = 0.32
Poultry = 0.02</td><td>Daily volatile solid excreted for livestock category T in kg dry matter per animal per day</td></tr>
<tr><td>$B_{0,T}$</td><td>Dairy cows = 0.13
Other cattle = 0.10
Market swine = 0.29
Breeding swine = 0.29
Goats = 0.13
Sheep = 0.13
Poultry = 0.24</td><td>Maximum methane producing capacity for manure produced by livestock category</td></tr>
<tr><td>$MS_{T,s,k}$</td><td><table><tr><th>Animal T</th><th>Fraction</th></tr><tr><td>Dairy cattle</td><td>79.6%</td></tr><tr><td>Other cattle</td><td>74.6%</td></tr><tr><td>Market swine</td><td>45.3%</td></tr><tr><td>Breeding swine</td><td>81.7%</td></tr><tr><td>Poultry</td><td>7.6%</td></tr><tr><td>Sheep</td><td>2.1%</td></tr><tr><td>Goat</td><td>2.2%</td></tr></table></td><td>Fraction of livestock category T’s manure handled using manure management system x in climate region k (determined through survey method ex-post)</td></tr>
<tr><td>$MCF_{x,k}$</td><td>3.39%</td><td>Methane conversion factors for the animal waste handling system in the baseline situation by climate zone k, (%)</td></tr>
<tr><td>GWP_{CH4}</td><td>28</td><td>Global Warming Potential of methane</td></tr>
</table>

[21] VPA06 MPVI survey SDG ER sheet BE, cell E37

$N_{T,h}$	Number of dairy cattle	4.03	Number of livestock category T in premise *h*
	Number of other cattle	0.38	
	Number of pigs (for market)	0.84	
	Number of pigs (for breeding)	0.17	
	Number of poultry	21.09	
	Number of sheep	2.10	
	Number of goats	1.34	

The total calculated baseline emissions are shown below

Emission source	**tCO_2e**
Baseline emissions	17,286[22]

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

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The calculated project value is demonstrated in the table below

SDG	SDG Impact	Project value
2	GS-3 Soil quality (Percentage of biogas users who use slurry as a fertilizer) The calculation is the sum of all the ways that farmers use bio-slurry. The ways that farmers use bio-slurry is the following: **Table 6: Ways that bio-slurry is used[23]** Use directly for various purposes: 38.3% Store it first: 61.1% I don't use it / discarded: 0.5% The contribution is then 100% - 0,5% (% discarded) = 99.5%.	99.5%[24]
3	GS-1 Air Quality (Perceived improvement in health by the user (incidence of eye problems and respiratory illness)	99.1%[26]

[22] VPA06 MPV survey_SDG_ER sheet SDG13 cell C32
[23] *VPA06 MPVI survey SDG ER sheet bio-slurry cell B19 to D21*
[24] *See cell D55 in VPA06 MPVI survey_SDG_ER sheet Analysis A*
[26] *See cell D48 in VPA06 MPV survey_SDG_ER sheet Analysis A*

	The households that reported eye ailments prior to having a digester was 111, out of those 110 experienced an improvement after installing biogas[25]. The contribution is then calculated as 110/111 = 99.1%	
5	*Time savings* The calculation is simply the number of interviewed females that mentioned time savings divided by the sample of females interviewed. This is 130/136 and with that calculation the project value is obtained[27].	95.6%[28]
	Usage of saved time[29] The calculation is simply the number of females reporting what they use their saved time for divided by the total number of females reported time savings. For example, income generation is calculated by dividing 94 (females that reported this) divided by the total number of females reporting time savings (136)[30]. Since time saved is used can be used for more than 1 activity, sum of all activities is more than 100%. All other categories are calculated in a similar manner.	
	Income generating including farming	72%
	Recreation	22%
	Helping my husband	8%
	Social activity (voluntary work, etc)	29%
	Other	4%
7	GS-08 Access to affordable and clean energy services (Number) This is a summation of all units installed. Since each unit is unique, each unit is counted as 1, and the summation of all the units yields this number.	4,433[31]
	GS-12 Technology transfer and technological self-reliance (Number of masons and biogas enterprise staff attending training programmes) This is a summation of all masons trained.	0[32]

[25] *See cell C43 and C48 in VPA06 MPVI survey SDG ER sheet Analysis A*
[27] *See cell C58 and C61 in VPA06 MPVI survey SDG ER sheet Analysis A.*
[28] *See cell D58 in VPA06 MPV survey_SDG_ER sheet Analysis A*
[29] *See cell F63:G68 in VPA06 MPVI survey SDG ER sheet Analysis A*
[30] *See cell C58 and C63 in VPA06 MPVI survey SDG ER sheet Analysis A*
[31] See cell D17 in VPA06 MPV survey_SDG_ER sheet SDG13
[32] Trainings were organized just before and after this MP, but none took place in this particular MP. Since 2016 however, 537 masons were trained. See cell J23 in tab PVT in the excel file 07MAR24 training list since 2016_VPA06

<table>
<tr>
<td>8</td>
<td>GS-10 Technology transfer and technological self-reliance (man-days)

The contribution to this target is determined by calculating the <u>number of man-days involved in the construction of biodigesters.</u>

$$\boldsymbol{MD_y = \sum_{DT,S}^{1} N_{DT,S} \times MD_{DT,S}}$$

Where

MD_y = Man-days of employment generated through the construction of biodigesters (days)

$N_{DT,S}$ = Number of biodigester constructed by type and size

$MD_{DT,S}$ = Number of man-days required for the construction of a particular type and size of biodigester</td>
<td>67,071[34]</td>
</tr>
</table>

[34] See cell K32 in VPA06 MPVI survey SDG ER sheet SDG8

The number of days required by digester type is determined based on the bill of quantities (BoQ) of each digester type and size. In the case of prefabricated digesters this is will be defaulted at 0.25 days per digester irrespective of the size unless otherwise indicated by the supplier. A small number of masonry digesters are larger than 12 m^3, in absence of reliable estimates on the labour requirements, the labour requirement of the 12 m^3 digester is used for those digesters, which is conservative

The result is the following[33]:

	Masonry types					Non-masonry		
size in m3			Technical labc	Total		Non-masonry	installation days	Total days
2.0	0	0		0		24	0.25	6
3.0	0	0		0		6	0.25	1.5
3.2	0	0		0		1	0.25	0.25
3.3	0	0	0	0		4	0.25	1
4.0	262	6	7	3406		88	0.25	22
6.0	504	7	7	7056		188	0.25	47
6.2	0	7	7	0		25	0.25	6.25
7.0	0	7	8	0		3	0.25	0.75
8.0	1513	7	7	21182		22	0.25	5.5
9.0	0	7	10	0		96	0.25	24
10.0	760	10	12	16720		157	0.25	39.25
12.0	632	12	12	15168		6	0.25	1.5
13.0	3	12	12	72		0	0.25	0
14.0	3	12	12	72		0	0.25	0
15.0	14	12	12	336		0	0.25	0
16.0	67	12	12	1608		0	0.25	0
18.0	12	12	12	288		1	0.25	0.25
21.0	1	12	12	24		0	0.25	0
24.0	28	12	12	672		0	0.25	0
32.0	4	12	12	96		0	0.25	0
35.0	3	12	12	72		0	0.25	0
36.0	1	12	12	24		0	0.25	0
48.0	2	12	12	48		0	0.25	0
56.0	1	12	12	24		0	0.25	0
59.0	1	12	12	24		0	0.25	0
70.0	1	12	12	24		0	0.25	0
Grand Total	0	12	12	0		0	0.25	0
	3812			66916		621		155.25
			SDG8	67,071	days			

SDG 13: Project value

This is calculated as the baseline emissions, as derived in section E1, minus the project emissions is the project value. The project emissions are calculated as follows

Source 1: *Accounting for project emissions due to the continued use of fossil fuels and non-renewable biomass*

The project scenario is defined by the fuel consumption of end users within the targeted population that adopts the biodigester technology. This formula calculates the project emissions per household:

[33] VPA06 MPVI Survey_SDG sheet SDG8 cell F2:N32

$$PE_{p,CO2,y} = \sum(BB_{p,fuel} * NCV_{fuel} * EF_{p,fuel}) + (BB_{p,bio} * NCV_{bio} * EF_{p,bio} * f_{NRB})$$

Where:

PEp,CO2,y	2.256[35]	Cumulative project CO2 emissions from the use non-renewable biomass and fossil fuels (tCO_2/hh/year)
$BB_{p,fuel}$	0.02	The quantity of fossil fuel consumed in the project scenario p, in tonnes/year
NCV_{fuel}	0.0473	Net calorific value of fossil fuel, in TJ/tonne
$EF_{p,fuel}$	63.1	CO2 emission factor of fossil fuel in project scenario *p*, in tonnes/TJ
BBp,bio	1.453	The quantity of biomass consumed in the project scenario p, in tonnes/year
NCVbio	0.015	Net calorific value of biomass, in TJ/tonne
EFp,bio	112	CO2 emission factor of biomass in project scenario *p*, in tonnes/TJ
*f*NRB	89.48%	Fraction of non-renewable biomass, in percentage

Source 2: *Accounting for project emissions due to the methane emissions from manure handling*

Project emissions of the methane avoidance component include both the physical leakage of biogas from the bio digester and the incomplete combustion of biogas. These shall be accounted for in accordance with equation (17) of the applicable methodology:

$$PE_{p,CH4,y} = GWP_{CH4} * \sum (N_{T,h,y} * EF_{awms,T}) * PL_y + \sum (N_{T,h,y} * EF_{awms,T}) * (1 - \eta_{new\ stove}) (1 - PL_y)$$

Where:

PEp,CH4,y	0.022[36]	Project emissions from manure handling during the year y in tCO_2/year/hh
GWPCH4	28	Global Warming Potential of methane

[35] VPA06 MPVI survey SDG ER sheet PE, cell D62

[36] VPA06 MPVI survey SDG ER sheet PE, cell D49

NT,h	<table><tr><td>Number of dairy cattle</td><td>4.03</td></tr><tr><td>Number of other cattle</td><td>0.38</td></tr><tr><td>Number of pigs (for market)</td><td>0.84</td></tr><tr><td>Number of pigs (for breeding)</td><td>0.17</td></tr><tr><td>Number of poultry</td><td>21.09</td></tr><tr><td>Number of sheep</td><td>2.10</td></tr><tr><td>Number of goats</td><td>1.34</td></tr></table>	Number of livestock category T in premise h
EFawms, T	See calculations below this table	Emission factor for the defined livestock population category T
Ply	10%	Physical leakage of the biodigester (through measurement or application of 10% default)
η new stove	99.4%	Combustion efficiency of the used type of biogas stove

In the above equation, $EF_{awms,\,T}$ is further defined as:

$$EF_{awms,h} = \frac{(VS_T * 365) * (B_{0,T} * 0.67 kg/m^3 * MCF_{x,k} * MS_{T,x,k})}{1000}$$

Where

$EF_{awms,\,Dairy\ cow}$	**0.0016**	CH4 emission factor for livestock category *T*, (m^3CH4per animal per year) [37]
$EF_{awms,\,Goat}$	**0.0000**	
$EF_{awms,\,other\ cattle}$	**0.0009**	
$EF_{wwms,\,Sheep}$	**0.0003**	
$EF_{awms,\,market\ swine}$	**0.0003**	
$EF_{awms,\,breeding\ swine}$	**0.0006**	
$EF_{awms,\,Poultry}$	**0.0000**	
VS(T)	Dairy cows = 1.90 Other cattle = 1.50 Market Swine = 0.30 Breeding swine = 0.30 Goats = 0.35 Sheep = 0.32 Poultry = 0.02	Daily volatile solid excreted for livestock category *T*, (kg dry matter per animal per day)

[37] VPA06 MPVI survey_SDG_ER sheet PE D37:D43

<table>
<tr><td>365</td><td>365</td><td>Basis for calculating annual VS production, (days per year)</td></tr>
<tr><td>Bo(T)</td><td>Dairy cows = 0.13
Other cattle = 0.10
Market swine = 0.29
Breeding swine = 0.29
Goats = 0.13
Sheep = 0.13
Poultry = 0.24</td><td>Maximum methane production capacity for manure produced by livestock category T, (m3CH4 per kg of VS excreted)</td></tr>
<tr><td>$MCF_{(BL,k)}$</td><td>3.39%</td><td>Methane conversion factors for the animal waste handling system in the baseline situation by climate zone k, (%)</td></tr>
<tr><td>$MS_{(T,S,k)}$</td><td><table><tr><th>Animal T</th><th>Fraction</th></tr><tr><td>Dairy cattle</td><td>79.61%</td></tr><tr><td>Other cattle</td><td>74.56%</td></tr><tr><td>Market swine</td><td>45.26%</td></tr><tr><td>Breeding swine</td><td>81.67%</td></tr><tr><td>Poultry</td><td>7.63%</td></tr><tr><td>Sheep</td><td>2.08%</td></tr><tr><td>Goat</td><td>2.17%</td></tr></table></td><td>Fraction of livestock category T's manure treated in the animal waste management system, in climate region k (dimensionless)</td></tr>
</table>

Source 3: *Accounting for project emissions due to bio-slurry*

Emissions from bio-slurry (i.e. the product excreted from the biogas digester in addition to combustible biogas) must be taken into account if it is found they account for more than 1% of project emissions. In order to estimate the project emissions occurring from bioslurry, the following steps are followed (see sheet bio-slurry in the file VPA06 MPV survey_SDG_ER for the calculations):

Step 1: estimation of the total amount of VS entering the biodigester
To estimate the total amount of Volatile Solids (VS) that enters the biogas digesterthe VS excretion in kg/day is multiplied with the average number of animals owned by households with a biodigester. This results in a total amount of VS excreted per day. Next, these totals are multiplied with the share of bioslurry fed into the biodigester for each animal, resulting in the total VS entering the biodigester per day. The sum of VS entering the biodigester from all animals combined is 6.72 $kgVS.day^{-1}$.

Step 2: assessment of remaining VS content of bio-slurry
The second step is the assessment of remaining VS content. A 55% efficiency is assumed for the digesters implemented through this project; the remaining VS content of bio-slurry is therefore 45% of total VS introduced to the digester. The figure is calculated by subtracting the percentage of VS that is destroyed in the biodigester from the total VS entering the biodigester. The resulting total VS in bio-slurry is:

$$6.72\ kgVS.day^{-1} \times 45\% = 3.02\ kgVS.day^{-1}.$$

Step 3: Assessment of the methane potential of bio-slurry

To assess the methane potential of bio-slurry under the project scenario, for each animal the maximum methane producing capacity of the manure is multiplied by the remaining CH_4 production capacity of liquid digestate ($F_{ww,CH4}$) (EB 96 Annex 7). The resulting figure is multiplied with the total VS entering the biodigester per animal and proportionally weighted, resulting in an average methane potential per digester of 0.026 m^3CH_4/kgVS per day.

Step 4: calculation of bio-slurry emissions

Next, to calculate the total project bio-slurry emissions, the following formula is applied:

$$PE_{p1\ bio\text{-}slurry} = (\text{total VS in biodigesters} * 365) * Bo_{,dig} * \Sigma DMS * MCF * (D_{CH4}/1000) * GWP_{CH4} \quad [38]$$

Where:

$PE_{p1\ bio\text{-}slurry}$	Project emissions from bio-slurry
Bo_{dig}	Maximum methane production capacity for the biodigester (m^3CH4/kgVS)
DMS	Bio-slurry management practice, as a fraction
MCF	Methane conversion factor
D_{CH4}	Density of methane conversion factor
GWP_{CH4}	Global Warming Potential of methane

$PE_{p1\ bio\text{-}slurry}$	0.103[39]		Project emissions from bio-slurry (tCO_2e/hh/year)
Total VS in bioslurry	3.02[40]		Total VS in bioslurry (kg/day/hh)
365	365		Days in a year
Bo_{dig}	0.026[41]		Maximum methane production capacity for the biodigester (m^3CH4/kgVS
DMS[42]	Applied directly	37.64%	Bio-slurry management practice, as a fraction
	Sundrying (drylot)	6.11%	
	Composting	1.82%	
	Slurry	38.03%	
	Uncovered lagoon (black watery mass.)	7.51%	
	solid storage	7.63%	
	Other (discarded +other)	1.26%	

[38] This equation is not mentioned in the VPA06-DD, PoA-DD nor in the transition Annex. It is copied from section F.2 in MRII

[39] Cell H78 in VPA06 MPVI survey_SDG_ER sheet bio-slurry

[40] Cell G46 in VPA06 MPVI survey_SDG_ER sheet bio-slurry

[41] sheet bio-slurry, cell F71 in VPA06 MPVI survey_SDG_ER

[42] sheet bio-slurry, cell F2:G8 in VPA06 MPVI survey_SDG_ER

MCF	18.80%[43]	Methane conversion factor
D_{CH4}	0.67	Density of methane conversion factor (kg/m3)
GWP_{CH4}	28	Global Warming Potential of methane

Parameter $PE_{p1\ bio\text{-}slurry}$ represents more than 1% of total emission reductions generated by the project. $PE_{p1\ bio\text{-}slurry}$ is therefore included from calculation (see spreadsheet "VPA06 MPVI survey_SDG ER sheet "Bio-slurry" for detailed step-by-step calculation and explanation).

Total Project Emissions under the VPA (and per household) are equal to the three above components (i.e. related to displacement of fossil fuels and non-renewable biomass, avoidance of methane emissions from manure handling, and bio-slurry):

$$PE = PE_{p1,CO_2,y} + PE_{p1,CH_4,y} + PE_{p1,bio-slurry}$$

PE[44]= 2.381 tCO_{2e}/yr/hh

The total project emissions in this monitoring period are the sum of all project emissions sources (source 1, 2 and 3 as discussed in this section) multiplied with the usage rate and the number of units installed by month. The calculated project emissions are 7,162[45] tCO_2e in this MP.

In the next table the project value is calculated as ER = BE-PE

Table 7: Calculation of project value

Emission source	tCO_2e	Source/comment
Baseline emissions	17,286[46]	Section E.1
Project emissions	7,162[47]	Calculated in this section
Emission reductions (project value)	10,124[48]	Difference between the baseline and the project emissions

E.3. Calculation of leakage

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Leakage emissions

[43] sheet bio-slurry, cell H9 in VPA06 MPVI survey_SDG_ER
[44] VPA06 MPVI survey_SDG_ER shee PE cell D66
[45] VPA06 MPVI survey_SDG_ER sheet SDG13 cell D34
[46] VPA06 MPVI survey_SDG_ER sheet SDG13 cell C34
[47] VPA06 MPVI survey_SDG_ER sheet SDG13 cell D34
[48] VPA06 MPVI survey_SDG_ER sheet SDG13 cell F34

The methodology states that the following potential sources of leakage are to be considered:

- The displaced baseline cook stoves- are reused outside the project boundary in place of lower emitting technology or in a manner suggesting more usage than would have occurred in the absence of the project;
- The non-renewable biomass or fossil fuels saved under the project activity are used by non-project users who previously used lower emitting energy sources;
- The project significantly impacts the NRB fraction within an area where other CDM or VER project activities account for NRB fraction in their baseline scenario.
- The project population compensates for loss of the space heating effect of inefficient technology by adopting some other form of heating or by retaining some use of inefficient technology;
- By virtue of promotion and marketing of a new technology with high efficiency, the project stimulates substitution within users who commonly used a technology with relatively lower emissions, in cases where such a trend is not eligible as an evolving baseline.

A leakage investigation shall be conducted every two years using relevant survey methods that can be combined with monitoring surveys as is applicable. Leakage risks deemed very low will be ignored where the case for their insignificance can be substantiated. The latter was the case in the review of VPA06 MPI and MPII, MPIII and MPIV and MPV, in which the VVB declared that leakage is insignificant and can be ignored in this PoA.

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

SDG	SDG Impact	Baseline estimate	Project estimate	Net benefit
2	GS-3 Soil quality (Percentage of biogas users who use slurry as a fertilizer)	0	99.5	99.5
3	GS-1 Air Quality (Perceived improvement in health by the user (incidence of eye problems and respiratory illness)	0	99.1	99.1
5	Achieve gender equality and empower all women and girls	0	95.6	95.6
	Usage of saved time			
	Income generating including farming	0	72%	72%
	Recreation	0	22%	22%
	Helping my husband	0	8%	8%
	Social activity (voluntary work, etc)	0	29%	29%

	Other	0	4%	4%
7	GS-08 Access to affordable and clean energy services (Number)	0	4,433	4,433
	GS-12 Technology transfer and technological self-reliance (Number of masons and biogas enterprise staff attending training programmes)	0	0	0
8	GS-10 Technology transfer and technological self-reliance (man-days_	0	67,071	67,071
13	Verified emission reductions	17,286[49]	*7,162*[50]	10,124[51]

SDG 13.2.1 Net benefit

The emission reductions are calculated with the following calculation:

$$ER_{y,h} = U_{y,h} \times (BE_{y,h} - PE_{y,h}) \text{ x } No_{p1,y}$$

Where:

$ER_{y,h}$ = Annual average emission reductions in year y

$U_{y,h}$ = Cumulative usage rate for technologies in project scenario p in year y, based on cumulative adoption rate and drop off rate revealed by usage surveys

$BE_{y,h}$ = Annual average baseline emissions per household in year y

$PE_{y,h}$ = Annual average project activity emissions per household in year y

$N_{op1,y}$ = Total number of biogas units commissioned as of year y

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

SDG	SDG Impact	Values estimated in ex ante calculation of approved PDD for this monitoring period	Actual values[52] achieved during this monitoring period
2	GS-3 Soil quality (Percentage of biogas users who use slurry as a fertilizer)	Not estimated	99.5
3	GS-1 Air Quality (Perceived improvement in health by	Not estimated	99.1

[49] VPA06 MPVI survey SDG ER sheet SDG13 cell C34 and also in section E3
[50] VPA06 MPVI survey_SDG_ER sheet SDG13 cell D34 and also in section E3
[51] VPA06 MPVI survey_SDG_ER sheet SDG13 cell F34 and also in section E3
[52] Whenever emission reductions are capped, both the original and capped values used for calculations must be transparently reported. Use brackets to denote original values.

	the user (incidence of eye problems and respiratory illness)		
5	Achieve gender equality and empower all women and girls	Not estimated	95.6
	GS-08 Access to affordable and clean energy services (Number)	5,030[53]	4,433
7	GS-12 Technology transfer and technological self-reliance (Number of masons and biogas enterprise staff attending training programmes)	Not estimated	0
8	GS-10 Technology transfer and technological self-reliance (man-days)	Not estimated	67,071
13	Verified emission reductions(tCO_2)	26,310[54]	10,124

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

In this section the ex-ante calculation of the approved VPA-DD for this monitoring period is explained.

The ex-ante value in the VPA-DD is calculated based on the VPA01 baseline data, VPA01 estimates from the VPA01 BFT and PFT and the projected number of units for this MP.

The ex-ante calculation is otherwise identical.

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

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SDG	SDG Impact	Values estimated in ex ante calculation of approved PDD for this	Actual values achieved during this monitoring period	Explanation

[53] VPA06 MPVI survey SDG ER sheet SDG13 cell C47
[54] VPA06 MPVI survey SDG ER sheet SDG13 cell C42

		monitoring period		
2	GS-3 Soil quality (Percentage of biogas users who use slurry as a fertilizer)	Not estimated	99.5	The value is not estimated in the VPA-DD but calculated as being 0 in section E.4. The reason of the difference is the construction of biodigesters resulting in the availability of bio-slurry which is used by most users for farming
3	GS-1 Air Quality (Perceived improvement in health by the user (incidence of eye problems and respiratory illness)	Not estimated	99.1	The value is not estimated in the VPA-DD but calculated as being 0 in section E.4. The reason of the difference is the construction of biodigesters resulting in the access to clean cooking gas which resulted in an improvement in health
5	Time savings	Not estimated	95.6	The value is not estimated in the VPA-DD but calculated as being 0 in section E.4. The reason of the difference is the construction of biodigesters resulting in time savings of women compared to the baseline
	Usage of saved time			
	Income generating including farming	Not estimated	72%	The value is not estimated in the VPA-DD but calculated as being 0 in section E.4. The reason of the difference is that due to the usage of biodigesters time is saving which can be used for various purposes
	Recreation	Not estimated	22%	
	Helping my husband	Not estimated	8%	
	Social activity (voluntary work, etc)	Not estimated	29%	
	Other	Not estimated	4%	
7	GS-08 Access to affordable and clean energy services (Number)	5,030[55]	4,433	This value is lower but close to the ex-ante estimated value
	GS-12 Technology transfer and technological self-	Not estimated	0	The value is not estimated in the VPA-DD but calculated as being 0 in section E.4. No training programs

[55] VPA06 MPVI survey SDG ER sheet SDG13 cell C47

	reliance (Number of masons and biogas enterprise staff attending training programmes)			were implemented in this MP, so the result is 0
8	GS-10 Technology transfer and technological self-reliance (man-days)	Not estimated	67,071	The value is not estimated in the VPA-DD but calculated as being 0 in section E.4. The reason of the difference is the construction of biodigesters resulting in employment opportunities for masons and technicians
13	Verified emission reductions[56]	26,310	10,124	This value is lower than ex-ante estimated

SECTION F. SAFEGUARDS REPORTING

N/A no safeguards identified which require monitoring

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.

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715 grievances/inputs were received in VPA06[57] and 97 of which it is not known if these units belong to VPA01 or VPA06

Count of Account Name	**Column Labels**				
Row Labels		**VPA1**	**VPA6**	**VPA not known**	**Grand Total**
Closed	**21**	**357**	**460**	**84**	**922**
Excluded			1		1
Excluded - Another grievance exists			16	4	20

[56] See section E.5 for the source
[57] Sheet analysis VPA01 and 06 all grievances combined April 2024

Excluded - not part of the database		1	18		19
Excluded (Institutional)			2		2
Excluded -Non VPA				4	4
Included		73	384	72	529
Non VPA6				1	1
Temporarily Excluded - Data Issues	21	90	39	3	153
Included		193			193
Dropped		**14**	**10**	**5**	**29**
Excluded		14	10	5	29
Escalated	**4**	**37**	**26**	**3**	**70**
Temporarily excluded	4	30	26	3	63
Temporarily Excluded		7			7
On Hold	**1**	**39**	**29**	**3**	**72**
Excluded - not part of the database	1				1
Temporarily excluded		3	29	3	35
Temporarily Excluded		36			36
Ongoing	**50**	**63**	**190**	**2**	**305**
Excluded - not part of the database	36				36
Temporarily excluded	14	37	190	2	243
Temporarily Excluded		26			26
Grand Total	**76**	**510**	**715**	**97**	**1398**

Most of the grievances are closed (460), and 190 on-going at the end of this MP, 29 are on hold (waiting for client action), 16 are escalated for RMT (repair, maintenance, training) and 10 are dropped. The dropped plants and those out of operation are not included in the database used for the ER calculations.

Of the grievances where the VPA designation is not yet determined, the status is: Most of the grievances are closed (84), and 2 on-going at the end of this MP 2 are on hold (waiting for client action), 3 are escalated for RMT (repair, maintenance, training) and 5 are dropped. The dropped plants and those out of operation are not included in the database used for the ER calculations

Given the sheer number of grievances, it is not possible to list them in this report. A narrative of the main issues are:

Report on Actions Taken in Response to Grievances[58]

1. Functionality (1055 Grievances)

- **Status: 705 Closed, 350 Open**
- **Summary:** This is the most common category, representing the vast majority of grievances. Issues typically relate to the operational aspects of the biogas systems. Common complaints include problems with gas production (e.g., "No gas", "Low gas production"), issues with appliances ("A leaking burner", "Burner not lighting"), structural problems ("Cracked digester"), and general system failures ("System not working", "Plant not working").
- **Common Actions:** Actions frequently involve troubleshooting and repairs, such as fixing leaks, advising on proper feeding and maintenance, addressing pipe blockages ("Helped to properly lay the gas pipeline"), performing recommissioning, or scheduling technical visits for more complex repairs. Many issues are resolved through direct assistance or guidance.

2. RMT (Repair, Maintenance, and Technical Assistance) (168 Grievances)

- **Status: 76 Closed, 92 open)**
- **Summary:** These grievances specifically request repair, maintenance, or technical support. Farmers report broken systems often requiring technician visits ("A broken system that requires repair assistance", "Require a technician"). Other issues include requests for spare parts or follow-ups on previous repairs ("2nd visit for the repair update").
- Common Actions: Responses typically involve diagnosing the problem remotely if possible, scheduling technician visits for on-site repairs ("Repair work was completed", "Repair done"), replacing parts, and providing guidance on maintenance. Sometimes, issues identified require specific parts or more involved technical intervention.

3. General Inquiries (79 Grievances)

- **Status: 54 Closed, 25 Open**
- **Summary:** This category covers general questions and requests for information not directly related to immediate functionality problems or specific repair needs. Farmers might inquire about the program itself, best practices for operation ("Inquiry on feeding ratio"), potential upgrades, or follow-ups on communication. Common examples include "General inquiry", "Following up", and requests for contact information**.**
- **Common Actions:** Actions usually involve providing information, clarifying procedures, connecting the farmer with the appropriate personnel or resource, and following up on previous interactions ("Called back to confirm visit", "Advised accordingly").

4. Training Request (32 Grievances)

- **Status: 30 Closed, 2 Open**
- **Summary:** Grievances in this category are explicit requests for training on how to use or maintain the biogas system effectively. Farmers often state they "Need

[58] VPA01 and 06 all grievances combined april 2024 status sheet 'for narrative report'

training" or request specific guidance on aspects like feeding, troubleshooting common issues, or general operation.

- **Common Actions:** Responses involve scheduling training sessions, providing training materials or resources, conducting on-site or remote training ("Trained the user on operation and maintenance"), and offering specific operational advice.

Uncategorized (64 Grievances)

- **Status: 57 Closed, 7 Open**
- **Summary:** These 64 grievances were logged without a specific category assigned. Based on the comments, they appear to cover a mix of issues, often relating to functionality problems like "No gas production", requests for follow-up ("Following up"), reports of damaged components ("Damaged gate valve"), or general checks ("General checkup"). Some might be simple call logs or require further investigation to be properly categorized.
- **Common Actions:** Actions taken for these grievances are varied, reflecting the mixed nature of the underlying issues. Common actions include advising the farmer ("Advised accordingly", "Advised the farmer on feeding"), scheduling visits ("A visit will be scheduled"), making follow-up calls ("Made a follow up call"), or confirming system status ("System working well").

A separate file is available at request detailing the grievances[59]

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

N/A – no mitigation measures are identified or necessary

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

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No legal contests have arisen during this monitoring period

[59] VPA01 and 06 all grievances combined April 2024 excel file

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