CLEAN DEVELOPMENT MECHANISM

CDM-MP90-A03

Draft Small-scale Methodology

AMS-III.R.: Methane recovery from livestock and manure management at households and small farms ~~in agricultural activities at household/small farm level~~

Version 06.0

Sectoral scope(s): 15

United Nations
Framework Convention on
Climate Change

COVER NOTE

1. Procedural background

1. The Executive Board of the clean development mechanism (CDM) (hereinafter referred to as the Board), at its 116th meeting, considered the recommendation of the Methodologies Panel (MP) to approve the draft revised methodology "AMS-III.R.: Methane recovery in agricultural activities at household/small farm level", based on the bottom-up submission "SSC_826: Revision of AMS-III.R. to provide further clarity on monitoring requirements for biogas digester systems", and requested the MP to further work on the draft revised methodology, taking into account the feedback provided by the Board.

2. The Board also requested the MP to conduct further analysis and consider possible revisions to the following CDM methodologies and tool (e.g. addressing fugitive methane emissions from biogas digesters and use of updated International Panel on Climate Change (IPCC) methods) based on the recommendation of the MP:

   (a) "AMS-III.R.: Methane recovery in agricultural activities at household/small farm level";

   (b) "AMS-III.D.: Methane recovery in animal manure management systems";

   (c) "AMS-I.I.: Biogas/biomass thermal applications for households/small users";

   (d) "TOOL14: Project and leakage emissions from anaerobic digesters".

2. Purpose

3. The purpose of this revision is to provide further clarity on monitoring requirements for biogas digester systems as requested by SSC_826 and to address the above mandate from the Board.

3. Key issues and proposed solutions

4. In response to SSC_826, the proposed revision will:

   (a) Provide clarity on the two approaches to determine emission reductions (i.e. one approach where baseline emissions are determined based on the monitoring of the animal population using IPCC methods and the other approach where baseline emissions are determined based on monitoring of the net quantity of biogas consumed by the thermal application);

   (b) Require project participants to use the lower value between the modelled methane baseline emissions as per IPCC methods and the monitored quantity of methane, in line with AMS-III.D and "ACM0010: GHG emission reductions from manure management systems";

   (c) Change the title of the methodology to "AMS-III.R.: Methane recovery from livestock and manure management at households and small farms";

(d) Make editorial improvements such as consistent use of data/parameters in the methodology.

5. In addition, in response to the mandate from the Board, the proposed revision will address the following two additional issues:

(a) **Use of updated IPCC methods:** The existing approach to determine baseline emissions using IPCC default values of methane emission factors were based on 2006 IPCC Guidelines for National Greenhouse Gas Inventories, whereas Tier 1 and Tier 2 approaches in this area have been updated in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.[1] Therefore, the proposed revision updates the equations for baseline emissions in line with the IPCC 2019 Refinement;

(b) **Addressing fugitive methane emissions from biogas digesters:** Some studies found that fugitive methane leakage from biogas digesters may in some instances exceed the default value (10 per cent) assumed in the CDM methodologies/tools unless concrete measures are taken by project activities to prevent these leakages. In order to mitigate risks for physical leakage and venting of methane, the proposed revisions introduce new applicability conditions as shown in paragraph 4 (d) of the methodology.

4. Impacts

6. The proposed improvement of the methodological approaches in AMS-III.R. will provide more clarity on the approach to calculate emission reductions, ensure reliable calculation of the emission reductions and facilitate the implementation of CDM project activities and programme of activities that introduce biogas digester systems.

5. Subsequent work and timelines

7. The draft revised methodology is recommended by the MP for consideration and approval by the Board at its 117th meeting. No further work is envisaged.

6. Recommendations to the Board

8. The MP recommends that the Board adopt this draft revised methodology to be made effective at the time of the Board's approval.

[1] While methane emission factors are provided (per head) by livestock species type, region and temperature in the 2006 IPCC Guidelines, they are provided (per kg volatile solids) by livestock species type, productivity class (high or low), manure storage system and climate zone (cool, temperate, warm, etc.) in the IPCC 2019 Refinement.

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1. Introduction

1. The following table describes the key elements of the methodology:

Table 1. Methodology key elements

Typical project(s)	Recovery and combustion~~destruction~~ of methane from manure or a mixture of manure and other agricultural wastes ~~from agricultural activities~~ through: • Installation of a methane recovery and combustion system to an existing source of methane emissions; or • Change in~~of~~ the management practice for~~of~~ manure ~~an organic waste or raw material in order~~ to achieve controlled anaerobic digestion (domestic biogas digester) that is equipped with a methane recovery and combustion system.
Type of GHG emissions mitigation action	GHG destruction: ~~• Fuel switch:~~ • Combustion~~Destruction~~ of methane and displacement of more-GHG-intensive energy generation

2. Scope, applicability, and entry into force

2.1. Scope

2. This ~~project category comprises~~ methodology covers project activities involving the recovery and combustion~~destruction~~ of methane from manure or a mixture of manure and other agricultural wastes[2] ~~from agricultural activities~~ that would ~~be~~ decay~~ing~~ anaerobically and emit~~ting~~ methane to the atmosphere in the absence of the project activity. ~~Methane emissions are prevented~~ ~~It~~ Recovery and combustion of methane can be achieved either by:

(a) Installing a methane recovery and combustion system to an existing source of methane emissions; or

(b) Changing ~~the~~ a manure management practice ~~of a biogenic waste or raw material in order~~ to achieve ~~the~~ controlled anaerobic digestion by installing a domestic biogas digester equipped with a methane recovery and combustion system.

2.2. Applicability

3. The methodology is applicable under the following conditions:

(a) The ~~category is limited to measures~~ domestic biogas digester, methane recovery and combustion systems are installed at individual households or small farms ~~(e.g. installation of a domestic biogas digester)~~;

(b) This ~~project category~~ methodology may be applied ~~is only applicable~~ in combination with “AMS-I.C.: Thermal energy production with or without electricity”

[2] A small amount of “other agricultural wastes” can be mixed but the baseline emissions arising from “other agricultural waste” cannot be reflected in the emission reductions.

and/or "AMS-I.I.: Biogas/biomass thermal applications for households/small users" and/or "AMS-I.E.: Switch from non-renewable biomass for thermal applications by the user";

(c) This methodology is applicable only to the ~~portion~~ fraction of the manure which would decay anaerobically in the absence of the project activity. The fraction of the manure decaying anaerobically ~~that should be~~ is established by a survey in accordance with paragraph 12 below;

(d) The annual average temperature of the site where manure would have decomposed anaerobically in the baseline is higher than 5 °C.

4. The project activity shall satisfy the following conditions:

(a) The average annual emission reductions achieved by each domestic biogas digester, ~~M~~methane recovery and combustion system~~s that achieve an annual emission reduction of~~ is less than or equal to five tonnes of carbon dioxide equivalent (~~Ct~~CO_2e) per system;[3] ~~are included in this category. Systems with annual emission reduction higher than five tonnes of CO_2e are eligible under "AMS-III.D.: Methane recovery in animal manure management systems".~~

(b) Final digestate must be handled aerobically, and the conditions and procedures of the aerobic handling of the final digestate (e.g. land application) shall be described in the project design document (PDD) and subsequently checked upon verification; ~~The sludge must be handled aerobically. In case of soil application of the final sludge, the proper conditions and procedures that ensure that there are no methane emissions must be ensured.~~

(c) Measures shall be used (e.g. ~~combusted~~ combustion~~or burnt~~ in a biogas burner for cooking needs) to ensure that all the methane collected by the recovery system is combusted;~~destroyed~~.

(d) In order to mitigate risks for physical leakage and venting, project participants shall provide documentation in the PDD which:

(i) Ensures that biodigesters are appropriately designed in terms of their sizing, considering manure inputs and the thermal energy requirements of households. Justifications shall be provided in the PDD and monitoring reports to demonstrate that gasholders are sufficiently large to capture and store all the biogas that would be generated until consumption;

(ii) Ensures that the construction or installation of biodigesters (in the case of prefabricated plants) complies with relevant national and/or international standards and that a quality assurance/quality control (QA/QC) system is put in place for the construction or installation;

(iii) Ensures that trainings are conducted for all users of biodigesters prior to their commissioning or installation and that the trainings shall be documented in a verifiable manner (e.g. protocol of trainings, documentation of on-site visits);

[3] Systems with annual emission reductions higher than five t CO_2e are eligible under "AMS-III.D.: Methane recovery in animal manure management systems".

(iv) Ensures that a plan for periodic inspection and maintenance is in place and rehabilitation services are available throughout the crediting period. Description of such technical support system shall be provided in the PDD and verified by the designated operational entity (DOE) during verification. If the rehabilitation is undertaken, the details (e.g. parts replaced, specifications followed, personnel conducting the repairs and date of retrofitting) on each domestic biogas digester, methane recovery and combustion system shall be documented.

(e) Aggregated annual emission reductions of all systems included shall be less than or equal to 60 kilotonnes of~~kt~~ CO_2e ~~equivalent~~.

2.3. Entry into force

5. The date of entry into force is the date of the publication of the EB XX meeting report on dd mm yyyy.

2.4. Applicability of sectoral scopes

6. For validation and verification of clean development mechanism (CDM) projects and programmes of activities by a ~~designated operational entity (~~DOE~~)~~ using this methodology, application of sectoral scope 13 is mandatory and application of sectoral scope 1 is conditional.

3. Normative references

7. Project participants shall apply the General guidelines for SSC CDM methodologies, "TOOL21: Demonstration of additionality of small-scale project activities" and "TOOL22: Leakage in biomass small-scale project activities" available at <http://cdm.unfccc.int/Reference/Guidclarif/index.html#meth> mutatis mutandis.

8. This methodology also refers to the latest approved versions of the following approved methodologies, ~~and~~ tools and standard:

(a) "AMS-I.C.: Thermal energy production with or without electricity";

(b) "AMS-I.E.: Switch from non-renewable biomass for thermal applications by the user";

(c) "AMS-I.I.: Biogas/biomass thermal applications for households/small users";

(d) "AMS-III.D.: Methane recovery in animal manure management systems";

(e) "Standard for sampling and surveys for CDM project activities and programme of activities";

(f) "TOOL03: Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion";

(g) "TOOL05: Baseline, project and/or leakage emissions from electricity consumption and monitoring of electricity generation";

(h) "TOOL14: Project and leakage emissions from anaerobic digesters".

4. Definitions

9. The definitions contained in the Glossary of CDM terms shall apply.

5. Baseline methodology

5.1. Project boundary

10. The project boundary is the physical, geographical site of the methane recovery and combustion systems.

5.2. Baseline

11. ~~The baseline scenario is the situation where,~~ In the absence of the project activity, ~~biomass and other organic matter~~ manure and wastes from agricultural activities are left to decay anaerobically within the project boundary and methane is emitted to the atmosphere.

12. ~~The amount of waste or raw materials that would decay anaerobically in the absence of the project activity~~ The fraction of total annual volatile solids for each livestock type *LT* that is treated in a manure management system *MS* in climate region *k* ($AWMS_{LT,MS,k}$) is determined by a survey of a sample group of households/small farms participating in the project activity with a 90~~%~~ per cent confidence interval and 10 per cent~~%~~ margin of error. The survey should determine the baseline animal manure management practices applied. If the livestock is raised in shared centralized farms,[4] the project ~~proponent~~ participant shall be able to show the baseline animal manure management practices at each farm, either individually or through sampling.

13. Baseline emissions (BE_y) are calculated as follows[5]: ~~ex ante, using one of the following methods.~~

~~(a) A simplified method with the most recent IPCC Tier 1 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories) that only requires livestock population data by animal species/category and climate region or temperature; or~~

~~(b) The most recent IPCC Tier 2 approach (please refer to the chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories) to calculate the amount of the waste or raw material that would decay anaerobically in the absence of the project activity. Country/region specific values~~

[4] In shared centralized farms systems, multiple households raise their animals in a centralized farm, for example~~e.g.~~ in separate barns of a centralized farm. In the project activity, each family collects the manure of animals raised by it at the centralized farm and uses the collected manures as feedstock for the biodigester situated at the household.

[5] Refer to the chapter 'Emissions from Livestock and Manure Management' in the volume 'Agriculture, Forestry and other Land use' of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

~~shall be used if available. The option in "AMS-III.D.: Methane recovery in animal manure management systems", shall be used to calculate baseline emissions.~~

~~14. If option in paragraph 18 (a) is chosen, baseline emissions are determined as follows:~~

$$BE_y = GWP_{CH4} \times UF_b \times \sum_{LT} \left(\frac{EF_{LT} \times N_{LT,y}}{10^6} \right)$$ ~~Equation (1)~~

~~Where:~~

BE_y	=	~~Baseline emission during the year *y* (tCO_2e)~~
GWP_{CH4}	=	~~Global Warming Potential (GWP) of CH_4 applicable to the relevant period (t CO2e/t CH_4)~~
EF_{LT}	=	~~Emission factor for the defined livestock population as referred from table 10.14 and 10.15 of chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (kg CH_4/head)~~
$N_{LT,y}$	=	~~Annual average number of animals of type *LT* in year *y* (numbers)~~
UF_b	=	~~Net-to-gross adjustment factor to account for uncertainties. The value applied is 0.89~~ [6]

$$BE_y = \sum_{LT,MS,PS,k} \left(N_{LT,PS,y} \times \frac{AM_{LT,PS}}{10^3} \times VS\_rate_{LT,PS} \times 365 \times Bo_{LT,PS} \times 0.67 \times 10^{-3} \times \frac{MCF_{LT,MS,k}}{100} \times AWMS_{LT,MS,k} \right) \times GWP_{CH4} \times UF_b$$ Equation (2)

Where:

BE_y	=	Baseline emission during the year *y* (tCO_2e)
$N_{LT,PS,y}$	=	Annual average number of animals of livestock type *LT* in year *y* for productivity system[7] *PS* (i.e. high or low) (numbers), determined as per **Data/parameter table 1**
$AM_{LT,y}$	=	Animal mass for livestock type LT (kilogram (kg) per animal), determined as per **Data/parameter table 2**

[6] This is to account for uncertainties of the method (See Annex III (Table of conservativeness factors), FCCC/SBSTA/2003/10/Add.2~~, page 25~~).

[7] For the definition of high and low productivity systems, refer to chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

$VS\_rate_{LT,PS}$	=	Daily volatile solid excretion per head of livestock type *LT*, for productivity system *PS* (i.e. high or low) (kg VS per 1,000 kg animal mass per day). Use default values as provided in **Table 10.13A** of chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
365	=	Days per year
Bo_{LT}	=	Maximum methane producing capacity for manure produced by livestock type LT, (cubic metres (m^3) methane (CH_4) per kg of VS excreted). Use default values as provided in **Table 10.16** of chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories
0.67	=	Conversion factor of m^3 CH_4 to kg CH_4
$MCF_{LT,MS,k}$	=	Methane conversion factors for each manure management system *MS* by climate region *k* (per cent) Use default values as provided in **Table 10.17** of chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, following the definitions of manure management systems provided in **Table 10.18.**
$AWMS_{LT,MS,k}$	=	Fraction of total annual VS for each livestock type *LT* that is treated in manure management system *MS* in climate region *k*, estimated as per procedures mentioned in **paragraph 12 above**
GWP_{CH4}	=	Global warming potential (GWP) of CH_4 applicable to the relevant period (t CO_2e/t CH_4)
UF_b	=	Net-to-gross adjustment factor to account for uncertainties. The value applied is 0.89[8]

5.3. Project emissions

15. Project activity emissions consist of:

(a) Physical leakage of biogas ($PE_{PL,y}$);

(b) CO_2 emissions from use of fossil fuels for the operation of all the installed facilities ($PE_{FC,y}$);

(c) CO_2 emissions from use of electricity for the operation of all the installed facilities ($PE_{EC,y}$);

$$PE_y = PE_{PL,y} + PE_{FC,y} + PE_{EC,y}$$ Equation (3)

[8] This is to account for uncertainties of the method (See Annex III (Table of conservativeness factors), FCCC/SBSTA/2003/10/Add.2).

Where:

PE_y	=	Project emissions in year *y* (tCO_2e)
$PE_{PL,y}$	=	Emissions due to physical leakage of biogas in year *y* (tCO_2e)
$PE_{FC,y}$	=	Emissions from the use of fossil fuel for the operation of the system in the year *y* (tCO_2e)
$PE_{EC,y}$	=	Emissions from the use of electricity for the operation of the system in the year *y* (tCO_2e)

16. Project emissions due to physical leakage of methane from biogas digesters ~~is~~ are estimated as 10 per cent of the maximum methane-producing potential of the manure fed into the management systems implemented by the project activity:[9] ~~using one of the two options indicated in AMS-III.D~~.

$$PE_{PL,y} = 0.10 \times \sum_{LT,MS,PS,k} \left(N_{LT,PS,y} \times \frac{AM_{LT,PS}}{10^3} \times VS\_rate_{LT,PS} \times 365 \times Bo_{LT,PS} \times 0.67 \times 10^{-3} \times \frac{MCF_{LT,MS,k}}{100} \times AWMS_{LT,MS,k} \right) \times GWP_{CH4}$$ Equation (4)

17. Project emissions ~~consist of CO_2 emissions~~ from use of fossil fuels ($PE_{FC,y}$) or electricity ($PE_{EC,y}$) for the operation of the system ~~and the physical leakages of methane from the recovery system.~~ shall be estimated using ~~The relevant methodological tools~~ TOOL03 and TOOL05 ~~shall be followed~~. When applying the above tools, default values contained in TOOL14 may be used.

5.4. Leakage

18. The applicable requirements from TOOL22 shall be followed to calculate leakage related to use of biomass (other agricultural wastes), if applicable.

5.5. Emission reductions

~~5.5.1. Option 1~~

~~19. The emission reduction achieved by the project activity should be calculated as below under this option:~~

$$ER_y = BE_y - PE_y - LE_y$$ ~~Equation (5)~~

[9] ~~2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 guidelines specify a default value of 10% of the maximum methane producing potential (Bo) for the physical leakages from anaerobic digesters.~~ Leakage rate of 0.1 for low quality biogas digesters provided in the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories is proposed for conservativeness.

Where:

ER_y	=	Emission reductions achieved by the project activity for year *y* (tCO_2e)
PE_y	=	Project emissions for year *y* (tCO_2e)
LE_y	=	Leakage for year *y* (tCO_2e)

5.5.2. Option 2

20. The emission reductions of the project activity should be determined based on monitoring of the net quantity of biogas consumed by the thermal application as follows:

$$ER_y = \sum_k N_{k,0} \times n_{k,y} \times UF_b \times BS_{k,y} \times EF \times n_{PJ/BL} \times NCV_{biogas} - LE_y \quad \text{Equation (6)}$$

Where:

$N_{k,0}$	=	Number of thermal applications *k* commissioned (number)
$n_{k,y}$	=	Proportion of $N_{k,0}$ that remain operating in year *y* (fraction)
UF_b	=	Net-to-gross adjustment factor. Apply 0.89 [10] in cases where the operationality ($n_{k,y}$) is determined based on questionnaire survey. In other cases, apply 1.0.
$BS_{k,y}$	=	The net quantity of biogas consumed by the thermal application *k* in year *y* (mass or volume units, dry basis)
EF	=	CO_2 emission factor (tCO_2/GJ)
$n_{PJ/BL}$	=	Ratio of efficiencies of project equipment and baseline equipment (e.g. cook stove using coal) measured once prior to validation applying the same test procedure (e.g. lab test), as per a national or an international standard. Official data or scientific literature can be used for cross-check purposes
NCV_{biogas}	=	Net calorific value of the biomass (GJ/unit mass or volume, dry basis). Use default value: 0.0215 GJ/m^3 biogas (assuming NCV of the methane: 0.0359 GJ/m^3, default methane content in biogas: 60%)

21. The CO_2 emission factor is calculated as follows:

$$EF = \sum_j x_j \times EF_{FF,j} \quad \text{Equation (7)}$$

Where:

x_j	=	fraction representing fuel type *j* used by the baseline thermal applications displaced by biomass/biogas
$EF_{FF,j}$	=	CO_2 emission factor of fossil fuel type *j* (tCO_2/GJ)

[10] This is to account for uncertainties of the questionnaire survey method, estimated to be in the range 30-50% (See "Annex III Table of conservativeness factors", FCCC/SBSTA/2003/10/Add.2, page 25).

22. Project participants shall undertake direct measurement of the amount of biogas consumed by the thermal application. The emission reductions[11] achieved in any year are the lowest value of the following:

$$ER_y = min\left[\left(BE_y \times n_{k,y} - PE_{PL,y} - PE_{FC,y} - PE_{EC,y}\right), \left(MD_y - PE_{FC,y} - PE_{EC,y}\right)\right] - LE_y \quad \text{Equation (8)}$$

Where:

ER_y	=	Emission reductions achieved by the project activity for year *y* (tCO_2e)
$n_{k,y}$	=	Proportion of domestic biogas digester, methane recovery and combustion systems *k* commissioned that remain operating in year *y* (fraction)
MD_y	=	Methane combusted by the project activity in year *y* (tCO_2e)
PE_y	=	Project emissions for year *y* (tCO_2e)
LE_y	=	Leakage for year *y* (tCO_2e)
MD_y	=	Biogas consumed by the thermal application in year *y* (tCO_2e)

23. Methane combusted *(MD_y)* shall be determined as follows.

$$MD_y = \sum_k \left(N_{k,0} \times n_{k,y} \times UF_b \times BS_{k,y} \times w_{CH4,y} \times D_{CH4,y} \times GWP_{CH4}\right) \quad \text{Equation (9)}$$

Where:

$N_{k,0}$	=	Number of domestic biogas digester, methane recovery and combustion systems of category *k* commissioned (number)
$n_{k,y}$	=	Proportion of domestic biogas digester, methane recovery and combustion systems of category k commissioned that remain operating in year *y* (fraction)
UF_b	=	Net-to-gross adjustment factor. Apply 0.89 [12] in cases where $n_{k,y}$ is determined based on questionnaire survey. In other cases, apply 1.0
$BS_{k,y}$	=	The average quantity of biogas combusted in domestic biogas digester, methane recovery and combustion systems of category *k* in year *y* (volume units, dry basis)
$w_{CH4,y}$	=	Methane content[13] of the biogas in year *y* (volume fraction, dry basis)
D_{CH4}	=	Density of methane at the temperature and pressure of the biogas in year *y* (t/m^3)

[11] The emission reductions achieved by energy displacement are estimated and monitored according to one of the methodologies listed in paragraph 3 (b).

[12] This is to account for uncertainties of the questionnaire survey method, estimated to be in the range 30–50 per cent (See Annex III (Table of conservativeness factors), document FCCC/SBSTA/2003/10/Add.2).

[13] Biogas volume and methane content measurements shall be on the same basis (wet or dry).

6. Monitoring methodology

24. Emission reductions can only be ~~applied to~~ claimed if the systems ~~that~~ are demonstrated to be operational and commissioned in compliance with standards and/or manufacturer's requirements. ~~and in compliance with the manufacturer's required maintenance procedures.Survey methods are used to determine the annual average animal population, the amount of waste/animal manure generated on the farm and the amount of waste/animal manure fed into the system e.g. biogas digester.~~ It shall be verified if the amount of manure generated and fed to the digester, which is estimated as per paragraph 13 above, is consistent with the ~~animal population and with the~~ capacity of the biogas digester system.

25. The proper ~~soil~~ land application (~~not~~ resulting in negligible methane emissions) of the digestate ~~final~~ ~~sludge~~ shall be verified on a sampling basis following requirements in the "Standard for sampling and surveys for CDM project activities and programme of activities".

6.1. Data and parameters monitored

Data/parameter table 1.

Data/parameter:	$N_{LT,PS,y}$ ~~$N_{LT,y}$~~
Data unit:	Number
Description:	Annual average number of animals of livestock type *LT* in year *y* for productivity system *PS* (i.e. high or low) ~~Annual average number of animals of type *LT* for the year *y*~~
Source of data:	-
Measurement procedures (if any):	The ~~PDD~~ project design document should describe the system ~~on~~ for monitoring the number of livestock ~~population~~. Photographic evidence with timestamps and geographic information system (GIS) coordinates could also be used to determine average number of animals. The consistency between the value and indirect information (e.g. records of sales, records of ~~food~~ feed purchases) should be assessed.
Monitoring frequency:	Annually, based on monthly records
QA/QC procedures:	For all cases where sampling is applied, the "Standard: Sampling and surveys for CDM project activities and programmes of activities" shall be followed.
Any comment:	If the livestock is raised in the shared centralized farms, the project participant shall also determine the number of families/households sharing the farm and the annual average animal population ($N_{LT,PS,y}$) belonging to each household.

Data/parameter table 2.

Data/parameter:	$AM_{LT,y}$
Data unit:	kg per animal
Description:	Animal mass for livestock type LT
Source of data:	-

Measurement procedures (if any):	Determined using one of the following two options: a) Sampling measurement with a 90% confidence interval and 10% margin of error in accordance with the "Standard for sampling and surveys for CDM project activities and programmes of activities"; b) Use of default values for "*Low PS*" for conservativeness, as provided in Table 10A.5 of the chapter 'Emissions from Livestock and Manure Management' in the volume 'Agriculture, Forestry and other Land use' of the 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
Monitoring frequency:	For option (a), annually For option (b), once at the beginning of crediting period.
QA/QC procedures:	-
Any comment:	-

Data/parameter table 3.

Data/parameter:	$N_{k,0}$
Data unit:	Number
Description:	Number of domestic biogas digester, methane recovery and combustion systems ~~thermal applications~~of category *k* commissioned
Source of data:	Installation records
Measurement procedures (if any):	At the time of installation all project activity systems shall be inspected and undergo acceptance testing (commissioning) for proper operation in compliance with specifications. The installation date of each system shall be recorded
Monitoring frequency:	Once, at the time of installation
QA/QC procedures:	-
Any comment:	-

Data/parameter table 4.

Data/parameter:	$n_{k,y}$
Data unit:	Fraction
Description:	Proportion of ~~$N_{k,0}$~~ domestic biogas digester, methane recovery and combustion systems of category *k* commissioned that remain operating at year *y* (fraction)
Source of data:	-

Measurement procedures (if any):	Monitoring of operationality of the biogas systems, including domestic biogas digester, methane recovery and combustion system, shall be conducted using one of the following methods: (a) Census of users or survey of the users at randomly selected sample sites; (b) Based on ongoing rental/lease payments or a recurring maintenance fee by users; (c) Measurement campaigns using biogas flow meters. For all cases where sampling is applied, the "Standard: Sampling and surveys for CDM project activities and programme of activities" shall be used for determining the sample size to achieve 90/10 (for annual monitoring) or 95/10 (for biennial monitoring) confidence/precision levels. For the case of measurement campaigns using biogas flow meters which record usage on a daily or more frequent interval, it may be undertaken at randomly selected sample sites in accordance with the "Standard: Sampling and surveys for CDM project activities and programme of activities". ~~The selected samples should take into account possible stratification of the population according to the capacity, biogas digester types and region where the digesters are installed (e.g. 6 cubic metre or 8 cubic metre capacity, fixed dome or floating dome type, regions where seasons influence average ambient temperature).~~ For each measurement campaign at each site, continuous measurement shall be carried out for at least 30 days. The operational rate of each system is determined by dividing the number of days in operation by the length of the campaign. An operational day is a day in which biogas is consumed.
Monitoring frequency:	At least once every two years (biennial) during the crediting period
QA/QC procedures:	Net-to-gross adjustment factor of 0.89 is applicable in cases where the operationality is determined based on a user-reported questionnaire survey (i.e. using option (a) above to account for uncertainties).
Any comment:	If the biogas digester is found to be operating but the associated combustion systems are not, then the entire biogas production of the unit must be considered as project emissions. Equation 1 shall be used to estimate the project emissions from the biogas digester.

Data/parameter table 5.

Data/parameter:	$BS_{k,y}$
Data unit:	Volume units, dry basis
Description:	The ~~net~~ average quantity of biogas combusted in domestic biogas digester, methane recovery and combustion systems of category *k* in year *y*
Source of data:	Direct measurement or conservative default

Measurement procedures (if any):	(a) ~~In the specific case of biogas project activities using~~ Biogas flow meters shall be used to monitor accumulated biogas supplied to thermal energy equipment: • Measurement campaigns shall be undertaken at randomly selected sample sites in each year of the crediting period; • The "Standard: Sampling and surveys for CDM project activities and programme of activities" shall be used for determining the sample size to achieve 90/10 confidence/precision levels; • The selected samples should take into account the need for ~~possible~~ stratification, as deemed appropriate, of the population according to the capacity, types and region where the digesters are installed (e.g. 6 cubic metre or 8 cubic metre capacity, fixed dome or floating dome type, regions where seasons influence average ambient temperature); • For each measurement campaign at each site, continuous measurement shall be carried out for at least 30 days; • To account for seasonal variation in biogas generation from biogas digesters, it may be measured over a year during several disjointed periods (e.g. one week per quarter), but still covering at least 30 days for a year. These figures are then turned into an annual figure for a biogas digester. However, if disjointed periods are not practical or too expensive, then a single period may be chosen, from which an annualized figure is derived taking into account seasonality. If adjustment for seasonality is not possible, then a conservative approach shall be taken where a single period is chosen corresponding to the least amount of biogas generation, which is then scaled. ~~(b) Alternatively, for biogas project activities, project proponents may use a default biogas generation rate of 0.13 Nm3.m-3.day-1 (i.e. volume of biogas generated in normal conditions of temperature and pressure per unit useful volume of the digester per day) for regions/countries where annual average ambient temperature is higher than 20°C~~
Monitoring frequency:	Annual
QA/QC procedures:	-
Any comment:	-

Data/parameter table 6.

Data/parameter:	w_{CH4}
Data unit:	%
Description:	Methane content of the biogas in year *y*
Source of data:	Measurements by project participants

Measurement procedures (if any):	The fraction of methane in the biogas should be measured with a continuous analyser (values are recorded with the same frequency as the flow) or with periodical measurements at a 90/10 confidence/precision level by following the "Standard for sampling and surveys for CDM project activities and programmes of activities". Alternatively, a default value of 60 per cent methane content can be used. It shall be measured using equipment that can directly measure methane content in the biogas; the estimation of methane content of biogas based on measurement of other constituents of biogas such as CO_2 is not permitted. The methane content measurement shall be carried out close to a location in the system where biogas flow measurement takes place, and on the same basis (e.g. wet or dry).
Monitoring frequency:	Continuously or periodically
QA/QC procedures:	-
Any comment:	The option chosen should be clearly specified in the ~~PDD.~~ project design document.

Data/parameter table 7.

Data/parameter:	**Sizing of the digester**
Data unit:	-
Description:	As per paragraph 4 (d) (i) above
Source of data:	Design specification of biogas digesters
Measurement procedures (if any):	Confirm that biodigesters are appropriately designed in terms of their sizing, considering manure inputs and the thermal energy requirements of households. Justifications shall be provided in the project design document and monitoring reports to demonstrate that gasholders are sufficiently large to capture and store all the biogas that would be generated until consumption.
Monitoring frequency:	Once at construction or installation of biogas digesters
QA/QC procedures:	-
Any comment:	-

Data/parameter table 7.

Data/parameter:	**Compliance with standards and QA/QC system**
Data unit:	-
Description:	Check against standards and implementation of a QA/QC system
Source of data:	- Comparison against national and/or international standards followed for biogas digesters - QA/QC system
Measurement procedures (if any):	As per paragraph 4 (d) (ii) above, confirm that the construction or installation of biodigesters (in the case of prefabricated plants) complies with relevant national and/or international standards and that a QA/QC system is put in place for the construction or installation.
Monitoring frequency:	Once at construction or installation of biogas digesters

QA/QC procedures:	-
Any comment:	-

Data/parameter table 8.

Data/parameter:	**Training for all users of biodigesters**
Data unit:	-
Description:	As per paragraph 4 (d) (iii) above
Source of data:	Training records
Measurement procedures (if any):	Confirm that trainings are conducted for all users of biodigesters prior to their commissioning or installation. The trainings shall be documented in a verifiable manner (e.g. protocol of trainings, documentation of on-site visits)
Monitoring frequency:	At least once, prior to commissioning or installation of biogas digesters
QA/QC procedures:	-
Any comment:	-

Data/parameter table 9.

Data/parameter:	**Periodic inspection and maintenance**
Data unit:	-
Description:	Check as per paragraph 4 (d) (iv) above
Source of data:	Project implementation plan and monitoring surveys
Measurement procedures (if any):	Confirm that a plan for periodic inspection and maintenance is in place and rehabilitation services are available throughout the crediting period. Description of such technical support system shall be provided in the project design document and verified by the designated operational entity during verification.
Monitoring frequency:	Once at construction or installation of biogas digesters and annually
QA/QC procedures:	If the rehabilitation is undertaken, the details (e.g. parts replaced, specifications followed, personnel conducting the repairs and date of retrofitting) on each domestic biogas digester, methane recovery and combustion system shall be documented
Any comment:	-

~~6.2. Project activity under a Programme of Activities~~

~~26. The methodology is applicable to a programme of activities, no additional leakage estimations are necessary other than that indicated under leakage section above.~~

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Document information

Version	*Date*	*Description*
06.0	6 March 2023	MP 90, Annex 3 To be considered by the Board at EB 117. This version takes into account the comments from the Board at EB 116 meeting (EB116 meeting report, para.33).
05.0	11 October 2022	MP89, Annex 4 To be considered by the Board at EB 116. Revision to: • Revision to provide further clarity on monitoring requirements for biogas digester systems; and • Change title to “Methane recovery from livestock and manure management at households and small farms”.
04.0	27 May 2021	EB 110, Annex 7 Revision to allow the use of biogas flow meters to demonstrate operationality of the biogas system remotely.
03.0	13 September 2012	EB 69, Annex 23 To introduce the IPCC Tier 1 approach as an alternative method for calculation of baseline emissions.
02	18 February 2011	EB 59, Annex 4 • To allow the combination of this category with AMS-I.I. and/or AMS-I.E.; • To revise the guidance on calculation of project emissions from physical leakage and baseline emissions; • To revise sampling requirements; • To remove the conditions for PoA.
01	19 October 2007	EB 35, Annex 27 Initial adoption.

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