PART I. Generic component project activity (CPA) AMS III D

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

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The purpose of this generic CPA is to outline the potential projects in Botswana that might involve methane recovery in animal manure management systems. Typical site may include methane recovery from chicken farms, cattle feedlots, dairy farms and waste from livestock abattoirs. Animal manure from these project locations is currently being put in heaps or dumped at sites where they generate methane in the absence of methane capture. A potential CPA therefore would involve the capture of methane using manure at any of these potential sites.

SECTION B. Application of a baseline and monitoring methodology

B.1. Reference of the approved baseline and monitoring methodology(ies) selected

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Typical CPAs for possible inclusion under this PoA include small scale project activities where the following methodologies are applicable:-

1. Project activities stipulated in AMS- III.D: "Methane recovery in animal manure management systems" (Version 18). The baseline and monitoring methodology in AMS- III.D will be used for such a CPA. The methodology has three tools that can be used with this methodology i.e.
    a. "Tool to calculate baseline, project and/or leakage emissions from electricity consumption"
        i. The tool provides a procedure to calculate the baseline, project and/or leakage emissions from electricity consumption.
    b. "Tool to calculate project or leakage CO_2 emissions from fossil fuel combustion"
        i. The tool provides the methodology to calculate the CO2 emissions from fossil fuel consumption based on the type, quantity and properties of fuel used.
    c. "Tool to determine project emissions from flaring gases containing methane"
        i. The tool will be used to calculate the project emissions from the flaring of biogas produced through the project activities.

B.2. Application of methodology(ies)

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The CPA falling under the category of projects where the methodology AMS- III.D is applicable will typically be a cattle feedlot, chicken farm dairy farm or livestock[1] abattoir, where livestock population in the farm is managed under confined conditions and that currently has a waste water management system that does not capture biogas. The recovered biogas will be combusted through flaring, combustion heat applications, electricity generation or for cogeneration system to meet the electricity and thermal requirement of the project activity.

[1] The abattoir may be slaughtering cattle, goats sheet, game, chicken etc.

B.3. Sources and GHGs

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The main sources and GHGs of the project are shown in the table below and the leakages from the CPA will be accounted for according to the baseline monitoring methodologies.

	Source	GHG	Inclusion	Justification
Baseline	Emissions from animal Waste	CO_2	No	Excluded for simplicity
		CH_4	Yes	Main Source
		N_2O	No	Excluded for simplicity
	Emissions from Electricity Generation	CO_2	Yes	Catered for in the grid emission factor
		CH_4	Yes	Catered for in the grid emission factor
		N_2O	Yes	Catered for in the grid emission factor
Project Activity	Biogas recovery system	CO_2	No	Excluded for simplicity
		CH_4	Yes	Main Source
		N_2O	No	Excluded for simplicity
	Waste treatment system with biogas recovery	CO_2	No	Excluded for simplicity
		CH_4	Yes	Main Source
		N_2O	No	Excluded for simplicity
	Emissions from Cogeneration plant	CO_2	Yes	Main Source
		CH_4	No	Excluded for simplicity
		N_2O	No	Excluded for simplicity

B.4. Description of baseline scenario

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In the baseline scenario waste at Livestock Abattoirs, Cattle Feedlots, Dairy Farms and Chicken Farms in Botswana is currently subject to various treatment processes which do not capture methane. The abattoirs and chicken farms use electricity or coal to supply their energy and process heat requirements. For the case of the abattoirs, they generate both solid and liquid waste through the slaughter of livestock, which includes cattle, game and ostriches. The solid waste generated consists mostly of biodegradable offal material and its contents and rejected animal carcasses. The biodegradable stomach contents are either heaped at the abattoir where until they are sold as manure or disposed of at landfills together with other offal materials and rejected meat. In the case of Cattle Feedlots and Dairy Farms, the waste generated is piled in heaps onsite where is left to decomposed and generate methane. The manure from chicken farms is collected periodically and either disposed of at landfills or sold as manure.

The baseline emissions in the situation where, in the absence of the project activity, animal manure is left to decay anaerobically within the project boundary and methane is emitted to the atmosphere Baseline emissions (BE_y)will be calculated according to the following two options:-

1) Using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC tier 2 approach[2]. For this calculation, information about the characteristics of the manure and of the management systems in the baseline is required. Manure characteristics include the amount of volatile solids (*VS*) produced by the livestock and the maximum amount of methane that can be potentially produced from that manure (B_o);

[2] Reference will be made 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

2) Using the amount of manure that would decay anaerobically in the absence of the project activity based on direct measurement of the quantity of manure treated together with its specific volatile solids (*SVS*) content.

Tools for Baseline calculations

In option (1) is chosen, baseline emissions are determined as follows:-

$$BE_y = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j} \qquad \textbf{(1)}$$

Where:

BE_y	Baseline emissions in year *y* (tCO_2e)
GWP_{CH4}	Global Warming Potential (GWP) of CH_4 (21)
D_{CH4}	CH_4 density (0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure)
LT	Index for all types of livestock
j	Index for animal manure management system
MCF_j	Annual methane conversion factor (MCF) for the baseline animal manure management system *j*
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type *LT* (m^3 CH_4/kg dm)
$N_{LT,y}$	Annual average number of animals of type *LT* in year *y* (numbers)
$VS_{LT,y}$	Volatile solids for livestock *LT* entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year)
$MS\%_{Bl,j}$	Fraction of manure handled in baseline animal manure management system *j*
UF_b	Model correction factor to account for model uncertainties (0.94)[3]

(a) The maximum methane-producing capacity of the manure (B_o) varies by species and diet. The preferred method to obtain B_o measurement values is to use data from country-specific published sources, measured with a standardised method (B_o shall be based on total as-excreted *VS*). These values shall be compared to IPCC default values and any significant differences shall be explained. If country specific B_o values are not available, default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 will be used;

(b) Volatile solids (*VS*) are the organic material in livestock manure and consist of both biodegradable and non-biodegradable fractions. For the calculations the total *VS* excreted by each animal species is required. The preferred method to obtain *VS* is to use data from nationally published sources. These values shall be compared with IPCC default values and any significant differences shall be explained. If data from nationally published sources are not available, country-specific *VS* excretion rates will be estimated from feed intake levels, via the enhanced characterisation method (tier 2) described in section 10.2 in 2006 IPCC Guidelines for National

[3] Reference: FCCC/SBSTA/2003/10/Add.2, page 25.

Greenhouse Gas Inventories Volume 4 chapter 10. If country specific VS values are not available IPCC default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A 4 to 10 A 9 will be used.

In case default IPCC values for *VS* are adjusted for a site-specific average animal weight, it shall be well explained and documented. The following equation shall be used:

$$VS_{LT,y} = \left(\frac{W_{site}}{W_{default}}\right) * VS_{default} * nd_y \qquad \textbf{(2)}$$

Where:

W_{site}	Average animal weight of a defined livestock population at the project site (kg)
$W_{default}$	Default average animal weight of a defined population, this data is sourced from IPCC 2006 (kg)
$VS_{default}$	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population (kg dm/animal/day)
nd_y	Number of days in year *y* where the animal manure management system is operational

(c) In case of sequential treatment stages, the reduction of the volatile solids during a treatment stage is estimated based on referenced data for different treatment types. Emissions from the next treatment stage are then calculated following the approach outlined above, but with volatile solids adjusted for the reduction from the previous treatment stages by multiplying by (1 - *RVS*), where *RVS* is the relative reduction of volatile solids from the previous stage. The relative reduction (*RVS*) of volatile solids depends on the treatment technology and should be estimated in a conservative manner. Default values for different treatment technologies can be found in the table in annex 1;

(d) Methane Conversion Factors (*MCF*) values are determined for a specific manure management system and represent the degree to which B_o is achieved. Where available country-specific *MCF* values that reflect the specific management systems used in particular countries or regions shall be used. Alternatively, the IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used. The site annual average temperature is taken from official data at the nearest meteorological station, or from data available from historical on site observations;

(e) The annual average number of animals ($N_{LT,y}$) are determined as follows:

$$N_{LT,y} = N_{da,y} * \left(\frac{N_{p,y}}{365}\right) \qquad \textbf{(3)}$$

Where:

$N_{da,y}$	Number of days animal is alive in the farm in the year *y* (numbers)

$N_{p,y}$	Number of animals produced annually of type LT for the year y (numbers)

In case option (2) is chosen, baseline emissions are determined based on directly measured quantity of manure and its specific volatile solids content, as follows:

$$BE_y = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * Q_{manure,j,LT,y} * SVS_{j,LT,y} \quad \textbf{(4)}$$

Where:

$Q_{manure,j,LT,y}$	Quantity of manure treated from livestock type LT and animal manure management system j (tonnes/year, dry basis)
$SVS_{j,LT,y}$	Specific volatile solids content of animal manure from livestock type LT and animal manure management system j in year y (tonnes DM/year, dry basis)
MCF_j	Annual methane conversion factor (MCF) for the baseline animal manure management system j,
$B_{0,LT}$	Maximum methane producing potential of the volatile solid generated for animal type LT (m^3 CH_4/kg dm),

B.5. Demonstration of eligibility for a generic CPA

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Eligible CPA under this methodology include mostly CPAs with project activities that involve the replacement or modification of anaerobic animal manure management systems in livestock farms, where livestock population in the farm is managed under confined conditions, to achieve methane recovery and destruction by flaring/combustion or gainful use of the recovered methane. The CPA may also include treatment of manure collected from several farms in a centralized plant. The CPA should meet the following criteria:-

a. Manure or the streams obtained after treatment are not discharged into natural water resources;
b. The annual average temperature of baseline site where anaerobic manure treatment facility is located is higher than 5°C, which is often the case in Botswana;
c. The retention time of manure waste in the anaerobic treatment system is greater than one month, and in case of anaerobic lagoons in the baseline, their depths are at least 1 m;
d. No methane recovery and destruction by flaring, combustion or gainful use is taking place.
e. The residual waste from the animal manure management system shall be handled aerobically
f. The storage time of the manure after removal from the animal barns, including transportation, should not exceed 45 days before being fed into the anaerobic digester.

The CPA project activities will be limited to those that result in emission reductions of less than or equal to 60 kt CO_2 equivalent annually.

B.6. Estimation of emission reductions of a generic CPA

B.6.1. Explanation of methodological choices

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Project activity emissions consist of:

(a) Physical leakage of biogas in the manure management systems which includes production, collection and transport of biogas to the point of flaring/combustion or gainful use ($PE_{PL,y}$);

(b) Emissions from flaring or combustion of the gas stream ($PE_{flare,y}$);

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

(d) CO_2 emissions from incremental transportation distances;

(e) Emissions from the storage of manure before being fed into the anaerobic digester ($PE_{storage,y}$).

$$PE_y = PE_{PL,y} + PE_{flare,y} + PE_{power,y} + PE_{transp,y} + PE_{storage,y} \quad \textbf{(5)}$$

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)
$PE_{flare,y}$	Emissions from flaring or combustion of the biogas stream in the year y (tCO_2e)
$PE_{power,y}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities in the year y (tCO_2e)
$PE_{transp,y}$	Emissions from incremental transportation in the year y (tCO_2e), as per relevant paragraph in AMS-III.F
$PE_{storage,y}$	Emissions from the storage of manure (tCO_2e)

Project emissions due to physical leakage of biogas from the animal manure management systems used to produce, collect and transport the biogas to the point of flaring or gainful use is estimated as:

(a) 10% of the maximum methane producing potential of the manure fed into the management systems implemented by the project activity:[4]

(i) In case option (1) is chosen, it is determined as:

$$PE_{PL,y} = 0.10 * GWP_{CH4} * D_{CH4} * \sum_{i,LT} B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{i,y} \quad \textbf{(6)}$$

Where:

$MS\%_{i,y}$ Fraction of manure handled in system i in year y

If the project activity involves sequential manure management systems, the procedure specified in baseline calculations for such systems shall be used to estimate the project emissions due to physical leakage of biogas in each stage.

[4] 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.

(ii) In case option in option (2) is chosen, it is determined as:

$$PE_{PL,y} = 0.10 * GWP_{CH4} * D_{CH4} * \sum_{i,LT} B_{0,LT} * Q_{manure,LT,y} \times SVS_{LT,y} * MS\%_{i,y} \quad (7)$$

(b) Optionally a default value of 0.05 m³ biogas leaked/m³ biogas produced may be used for both options (1) and (2) as an alternative to calculations per equation 6 and equation 7.

In case of flaring/combustion of biogas, project emissions are estimated using the procedures described in the "Tool to determine project emissions from flaring gases containing methane".

Project emissions from electricity consumption are determined as per the procedures described in AMS-I.D "Grid connected renewable electricity generation". For project emissions from fossil fuel consumption the emission factor for the fossil fuel shall be used (tCO_2/tonne). A local grid emission factor shall be used.

The grid emission factor ($EF_{CO2,grid,y}$,) that will be used in this procedure has been calculated in a transparent and conservative manner as follows:

A combined margin (CM), consists of the combination of operating margin (OM) and build margin (BM) contributions according to the procedures prescribed in the "Tool to calculate the Emission Factor for an electricity system (version 2.2.1)". Table 1 summarizes the OM, BM and CM values that were calculated for the SAPP grid to which Botswana belongs (UNEP study)[5]. The grid emission factor (GEF) has been validated by Carbon Check of South Africa and is on the UNFCCC website. The value to be adopted for this PoA is 0.9644 t-CO_2/MWh[6]. This SAPP GEF is conservative for Botswana that individually has a higher emission factor of 1.0824 t-CO_2/MWh[7].

Table 1: Summary of the Regional SAPP GEF

OM Emission Factor (in t-CO_2/MWh)	**0.9958**		
BM Emission Factor (in t-CO_2/MWh)	**0.93317**		
	Weight of the OM	Weight of the BM	CM Emission Factor (in t-CO2/MWh)
Wind and solar power generation project a Activities for the first crediting period and for s ubsequent crediting periods	0.75	0.25	**0.9801**
All other projects for the first crediting period	0.5	0.5	**0.9644**
All other projects for the second and third crediting period	0.25	0.75	**0.9488**

[5] **Calculation of the Emission Factor of the Electricity System of the Southern African Power Pool Version 1.5, 22nd February 2012**

[6] **CDM-EB73-A03**

[7] **UNEP Risoe Center Analysis on Grid Emission Factors for the Electricity Sector in Sub-Saharan Africa The Case of the Southern African Power Pool**

If recovered methane is used to power auxiliary equipment of the project it should be taken into account accordingly, using zero as its emission factor.

Project emissions on account of storage of manure before being fed into the anaerobic digester shall be accounted for if both condition (a) and condition (b) below are satisfied:

a) The storage time of the manure after removal from the animal barns, including transportation, exceeds 24 hours before being fed into the anaerobic digester; and

b) The dry matter content of the manure when removed from the animal barns is less than 20%.

The following method shall be used to calculate project emissions from manure storage:

$$PE_{storage,y} = GWP_{CH_4} * D_{CH_4} * \sum_{LT,l} \left[\frac{365}{AI_l} \sum_{d=1}^{AI} (N_{LT,y} * VS_{LT,d} * MS\%_l * (1 - e^{-k\,(AI_l - d)}) * MCF_l * B_{0_{LT}}) \right] \quad \textbf{(8)}$$

Where:

$PE_{storage,y}$	Project emissions on account of manure storage in year *y* (tCO_2e)
AI_l	Annual average interval between manure collection and delivery for treatment at a given storage device *l* (days)
$VS_{LT,d}$	Amount of volatile solid production by type of animal *LT* in a day (kg VS/head/d)
$MS\%_l$	Fraction of volatile solids (%) handled by storage device *l*
k	Degradation rate constant (0.069)
d	Days for which cumulative methane emissions are calculated; d can vary from 1 to 45 and to be run from 1 up to AI_l
MCF_l	Annual methane conversion factor for the project manure storage device l from Table 10.17, Chapter 10, Volume 4 IPCC 2006 Guidelines.

Leakage

No leakage calculation is required.

Emission reductions

In determining the Emission Reductions of the CPA project activities the following steps will be followed:-

The emission reductions achieved by the project activity will be determined *ex post* through direct measurement of the amount of methane fuelled, flared or gainfully used. It is likely that the project activity involves manure treatment steps with higher methane conversion factors (*MCF*) than the *MCF* for the manure treatment systems used in the baseline situation, therefore the emission reductions achieved by the project activity is limited to the *ex post* calculated baseline emissions minus project emissions

using the actual monitored data for the project activity ($N_{LT,y}$, $MS\%_{i,y}$, $MS\%_{l}$, AI_l, and in case adjusted values for animal weight are used as defined in equation (2): $VS_{LT,y}$). The emission reductions achieved in any year are the lowest value of the following:

$$ER_{y,ex\ post} = \min[(BE_{y,ex\ post} - PE_{y,ex\ post}),(MD_y - PE_{power,y,ex\ post})] \qquad \textbf{(9)}$$

Where:

$ER_{y,ex\ post}$	Emission reductions achieved by the project activity based on monitored values for year y (tCO_2e)
$BE_{y,ex\ post}$	Baseline emissions calculated using equation 1 (for projects using option in paragraph 9 (a) in AMS III.D.) using *ex post* monitored values of $N_{LT,y}$ and if applicable $VS_{LT,y}$. For projects using option in paragraph 9 (b) in in AMS III.D., the *ex post* monitored values for $Q_{manure,j,LT,y}$ and $SVS_{j,LT,y}$ are used
$PE_{y,ex\ post}$	Project emissions calculated using equation 5 using *ex post* monitored values of $N_{LT,y}$, $MS\%_{i,y}$, $MS\%_{l}$, AI_l, $Q_{res\ waste,y}$ and if applicable $VS_{LT,y}$
MD_y	Methane captured and destroyed or used gainfully by the project activity in year y (tCO_2e)
$PE_{power,y,ex\ post}$	Emissions from the use of fossil fuel or electricity for the operation of the installed facilities based on monitored values in the year y (tCO_2e)

In case of flaring/combustion MD_y will be measured using the conditions of the flaring process:

$$MD_y = BG_{burnt,y} * w_{CH4,y} * D_{CH4} * FE * GWP_{CH4} \qquad \textbf{(10)}$$

Where:

$BG_{burnt,y}$	Biogas flared or combusted in year y (m^3)
$w_{CH4,y}$	Methane content in biogas in the year y (volume fraction)
FE	Flare efficiency in the year y (fraction)

The method for integration of the terms in equation above to obtain the results for one year of measurements within the confidence level, as well as the methods and instruments used for metering, recording and processing the data obtained, shall be described in the project design document and monitored during the crediting period.

In case of project activities covered under paragraph 3 of AMS-III-H for the use of biogas produced, the relevant procedure in AMS-III.H shall be followed.

Project activities where a portion of the biogas is destroyed through flaring and the other portion is used for energy may consider applying the flare efficiency to the portion of the biogas used for energy, if separate measurements of the respective flows are not performed. When the amount of methane that is combusted for energy and that is flared is separately monitored, a destruction efficiency of 100% can be used for the amount that is combusted for energy.

Where applicable, the proper soil application (not resulting in methane emissions) of the residual waste shall be monitored.

In case option (1) is chosen for baseline emission determination,

(a) The CPA-DD shall describe the system used for monitoring the fraction of the manure handled in the animal manure management system ($MS\%_{,i,y}$), the average weight of the livestock (W_{site}) and the livestock population ($N_{LT,y}$) taking into account the average number of days the animals are alive in the farm in a specific year. The consistency between these values and indirect information (records of sales, records of food purchases) shall be assessed. Significant changes in livestock population and average weight shall be explained;

(b) In case developed country *VS* values are being used the following shall be monitored:

(i) Genetic source of the production operations livestock originate from an Annex I Party;

The formulated feed rations (*FFR*). If equation 2 is used to estimate the value $VS_{default}$ (kg-dm/animal/day), the default average animal weight of a defined population (kg) shall be recorded and archived.

B.6.2. Data and parameters that are to be reported ex-ante
(Copy this table for each data and parameter.)

Data / Parameter	GWP_{CH4}
Unit	Fraction
Description	Global Warming Potential for methane
Source of data	IPCC value in AMS III.H./Version 16
Value(s) applied	21
Choice of data or Measurement methods and procedures	Based on IPCC value in AMS III.H./Version 16
Purpose of data	Value used to calculate global warming potential of methane
Additional comment	

Data / Parameter	D_{CH4}
Unit	t/m^3
Description	Density of methane
Source of data	IPCC value in AMS III.D./Version 18
Value(s) applied	0.00067 t/m^3 at room temperature (20 ºC) and 1 atm pressure
Choice of data or Measurement methods and procedures	Based on IPCC value in AMS III.D./Version 18
Purpose of data	Value used to calculate baseline/project emissions
Additional comment	

Data / Parameter	$N_{LT,y}$
Unit	Number
Description	Annual average number of animals of type *LT* in year *y*
Source of data	Annual records of CPA
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Animal head count
Purpose of data	Used for calculating Baseline/project emissions
Additional comment	

Data / Parameter	$VS_{LT,y}$
Unit	kg dm/animal/year
Description	Volatile solids for livestock *LT* entering the animal manure management system in year *y*
Source of data	National publication or IPCC default values
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Use data from nationally published sources. These values shall be compared with IPCC default values and any significant differences shall be explained. If data from nationally published sources are not available, country-specific *VS* excretion rates will be estimated from feed intake levels, via the enhanced characterisation method (tier 2) described in section 10.2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10. If country specific VS values are not available IPCC default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A 4 to 10 A 9 will be used.
Purpose of data	Used for calculating Baseline/project emissions
Additional comment	

Data / Parameter	$MS\%_{Bl,j}$
Unit	%
Description	Fraction of manure handled in baseline animal manure management system *j*
Source of data	Daily measurement and monthly aggregation
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	In case animal manure is treated in different treatment systems manure weight delivered to each system shall be directly measured or alternatively manure volume can be measured together with the density determined from representative sample (90/10 precision). The quantity of animal manure from different farms and different animal types shall be recorded separately for cross-check. Recording of the baseline animal manure management system where the animal manure would have been treated anaerobically is also required
Purpose of data	Used for calculating Baseline/project emissions
Additional comment	

Data / Parameter	UF_b
Unit	Fraction
Description	Model correction factor
Source of data	IPCC Default Value AMSIII.D Version 18
Value(s) applied	0.94
Choice of data or Measurement methods and procedures	IPCC default value
Purpose of data	Model correction factor to account for model uncertainties
Additional comment	

Data / Parameter	W_{site}
Unit	kg
Description	Average animal weight of a defined livestock population at the project site
Source of data	Daily measurement and monthly aggregation
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Daily measurement and or monthly aggregation
Purpose of data	Used to calculate site adjusted volatile solids of manure waste
Additional comment	

Data / Parameter	$W_{default}$
Unit	kg
Description	Default average animal weight of a defined population, this data is sourced from IPCC 2006
Source of data	Default IPCC values
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Default IPCC values
Purpose of data	Used to calculate site adjusted volatile solids of manure waste
Additional comment	

Data / Parameter	$VS_{default}$
Unit	kg dm/animal/day
Description	Default value for the volatile solid excretion rate per day on a dry-matter basis for a defined livestock population
Source of data	IPCC default values
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	IPCC default values
Purpose of data	Used for calculating site adjusted volatile solids of manure waste
Additional comment	

Data / Parameter	nd_y
Unit	Days
Description	Number of days in year *y* where the animal manure management system is operational
Source of data	CPA records
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	CPA records
Purpose of data	Used for calculating site adjusted volatile solids of manure waste
Additional comment	

Data / Parameter	$N_{da,y}$
Unit	Number
Description	Number of days in year *y* where the animal manure management system is operational
Source of data	CPA monthly records
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	CPA-PDD should describe the system for monitoring the number of livestock population. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed
Purpose of data	Used for calculating annual average number of animals
Additional comment	

Data / Parameter	$N_{p,y}$
Unit	Number
Description	Number of animals produced annually of type *LT* for the year *y* (numbers)
Source of data	CPA monthly records
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	CPA-PDD should describe the system for monitoring the number of livestock population. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed
Purpose of data	Used for calculating baseline/project emissions
Additional comment	

Data / Parameter	$Q_{manure,\,j,\,LT,\,y}$
Unit	Tonnes DM/year
Description	Quantity of manure treated from livestock type LT at animal manure management system j
Source of data	1. Based on daily measurement and monthly aggregation
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Manure weight shall be directly measured or alternatively manure volume can be measured together with the density determined from representative sample (90/10 precision). The quantity of animal manure from different farms and different animal types shall be recorded separately for crosscheck. Recording of the baseline animal manure management system where the animal manure would have been treated anaerobically is also required
Purpose of data	Used to calculate baseline/project emissions
Additional comment	

Data / Parameter	$SVS_{j,LT,y}$
Unit	tonnes DM/year, dry basis
Description	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y*
Source of data	CPA monthly records
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	In case animal manure is treated in a centralized plant, as the case in option (2), testing shall be performed according to the guideline in annex 2 of AM0073. It can be on sample basis by following General guidelines for sampling and surveys for SSC project activities , with a maximum margin of error of 10% at a 90% confidence level
Purpose of data	Used for calculating baseline/project emissions
Additional comment	

Data / Parameter	MCF_j
Unit	Fraction
Description	Annual methane conversion factor (*MCF*) for the baseline animal manure management system *j*
Source of data	National MCF values or IPCC default values
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Where available country-specific *MCF* values that reflect the specific management systems used in particular countries or regions shall be used. Alternatively, the IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used. The site annual average temperature is taken from official data at the nearest meteorological station, or from data available from historical on site observations
Purpose of data	Used for calculating Baseline/project emissions
Additional comment	

Data / Parameter	$B_{0,LT}$
Unit	m^3 CH_4/kg dm
Description	Maximum methane producing potential of the volatile solid generated for animal type *LT*
Source of data	National values or IPCC default values
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Use data from country-specific published sources, measured with a standardised method (B_o shall be based on total as-excreted *VS*). These values shall be compared to IPCC default values and any significant differences shall be explained. If country specific B_o values are not available, default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 can be used, provided that the project participants assess the suitability of those data to the specific situation of the treatment site
Purpose of data	Used for calculating Baseline/project emissions
Additional comment	

B.6.3. Ex-ante calculations of emission reductions

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Data / Parameter	AI_l
Unit	Days
Description	Annual average interval between manure collection and delivery for treatment at a given storage device *l*
Source of data	based on monthly records
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Monthly records
Purpose of data	It is to be used to calculate possible project emissions due the storage of animal manure
Additional comment	

Data / Parameter	$VS_{LT,y}$
Unit	kg VS/head/d
Description	Amount of volatile solid production by type of animal *LT* in a day
Source of data	National publication or IPCC default values
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Use data from nationally published sources or IPCC default value from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9
Purpose of data	Used for calculating project emissions
Additional comment	Only required when data from national published source are not available or IPCC default value from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A-4 to 10 A-9 are not used.

Data / Parameter	$MS\%_l$
Unit	%
Description	Fraction of volatile solids handled by storage device *l*
Source of data	Daily measurement and monthly aggregation
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	In case animal manure is treated in different treatment systems manure weight delivered to each system shall be directly measured or alternatively manure volume can be measured together with the density determined from representative sample (90/10 precision). The quantity of animal manure from different farms and different animal types shall be recorded separately for cross-check. Recording of the baseline animal manure management system where the animal manure would have been treated anaerobically is also required
Purpose of data	Used for calculating Baseline/project emissions
Additional comment	

Data / Parameter	*k*
Unit	number
Description	Degradation rate constant
Source of data	IPCC Default value AMS III.D version 18
Value(s) applied	0.069
Choice of data or Measurement methods and procedures	IPCC Default value AMS III.D version 18
Purpose of data	Used for calculating project emissions
Additional comment	

Data / Parameter	*d*
Unit	number
Description	Days for which cumulative methane emissions are calculated; d can vary from 1 to 45 and to be run from 1 up to AI_l
Source of data	CPA records
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	CPA records
Purpose of data	Used for calculating project emissions
Additional comment	

Data / Parameter	MCF_l
Unit	Fraction
Description	Annual methane conversion factor for the project manure storage device l from
Source of data	Table 10.17, Chapter 10, Volume 4 AMS III.D. Version 18
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	Where available country-specific *MCF* values that reflect the specific management systems used in particular countries or regions shall be used. Alternatively, the IPCC default values provided in table 10.17 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 can be used. The site annual average temperature is taken from official data at the nearest meteorological station, or from data available from historical on site observations
Purpose of data	Used for calculating project emissions
Additional comment	

Data / Parameter	$BG_{burnt,y}$
Unit	m^3
Description	Biogas volume in year *y*
Source of data	Historical Data and measurement campaign
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	The amount of biogas recovered and fuelled, flared or used gainfully shall be monitored *ex post*, using flow meters. If the biogas flared and fuelled (or utilized) is continuously monitored separately, the two fractions can be added to determine the biogas recovered. In that case, recovered biogas need not be monitored separately. The system should be built and operated to ensure that there is no air ingress into the biogas pipeline. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry)
Purpose of data	Used to determine Methane Captured and destroyed
Additional comment	

Data / Parameter	$w_{CH4,y}$
Unit	%
Description	Methane content in biogas in the year *y*
Source of data	Historical Data and measurement campaign
Value(s) applied	To be determined by each CPA
Choice of data or Measurement methods and procedures	The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level by following General guidelines for sampling and surveys for SSC project activities or, alternatively a default value of 60% 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 a biogas flow measurement takes place
Purpose of data	Used to determine Methane Captured and destroyed
Additional comment	

Data / Parameter	*FE*
Unit	fraction
Description	Flare efficiency in year *y*
Source of data	If the biogas is combusted for gainful purposes, e.g. fed to an engine, an efficiency of 100% may be applied
Value(s) applied	To be determined by CPA
Choice of data or Measurement methods and procedures	
Purpose of data	
Additional comment	

For an adopted fixed period of 10 years, the table below shows the estimated annual emission reductions for each CPA.

	Year	Emission Reductions
1	20xx	XX XXX
2	20xx	XX XXX
3	20xx	XX XXX
4	20xx	XX XXX
5	20xx	XX XXX
6	20xx	XX XXX
7	20xx	XX XXX
8	20xx	XX XXX
9	20xx	XX XXX
10	20xx	XX XXX
Total estimated Reductions (tonnes CO2)e		XXX XXX
Total number of Crediting years		10
Annual average of the estimated reductions over the crediting period		XX XXX

B.7. Application of the monitoring methodology and description of the monitoring plan
B.7.1. Data and parameters to be monitored by each generic CPA
(Copy this table for each data and parameter)

Data / Parameter	$VS_{LT,y}$
Unit	kg dm/animal/year
Description	Volatile solids for livestock *LT* entering the animal manure management system in year *y*
Source of data	National publication or IPCC default values
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	Use data from nationally published sources. These values shall be compared with IPCC default values and any significant differences shall be explained. If data from nationally published sources are not available, country-specific *VS* excretion rates will be estimated from feed intake levels, via the enhanced characterisation method (tier 2) described in section 10.2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10. If country specific VS values are not available IPCC default values from 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 chapter 10 table 10 A 4 to 10 A 9 will be used.
Monitoring frequency	Annually
QA/QC procedures	Use national Publications of IPCC default values
Purpose of data	Used for calculating Baseline emissions
Additional comments	

Data / Parameter	$N_{da,y}$
Unit	Number
Description	Number of days in year *y* where the animal manure management system is operational
Source of data	CPA monthly records
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	CPA-PDD should describe the system for monitoring the number of livestock population. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed
Monitoring frequency	B.7.1.1.1.1.1. Annually, based on monthly records
QA/QC procedures	The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed
Purpose of data	Used for calculating annual average number of animals
Additional comments	

Data / Parameter	$N_{p,y}$
Unit	Number
Description	Number of animals produced annually of type *LT* for the year *y* (numbers)
Source of data	CPA monthly records
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	CPA-PDD should describe the system for monitoring the number of livestock population. The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed
Monitoring frequency	Annually, based on monthly records
QA/QC procedures	The consistency between the value and indirect information (records of sales, records of food purchases) should be assessed
Purpose of data	Used for calculating baseline emissions
Additional comments	

Data / Parameter	W_{site}
Unit	kg
Description	Average animal weight of a defined livestock population at the project site
Source of data	Daily measurement and monthly aggregation
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	Daily measurement and or monthly aggregation
Monitoring frequency	Annually
QA/QC procedures	Sampling procedures can be used to estimate this variable as per General guidelines for sampling and surveys for SSC project activities
Purpose of data	Used to calculate site adjusted volatile solids of manure waste
Additional comments	

Data / Parameter	$BG_{burnt,y}$
Unit	m^3
Description	Biogas volume in year *y*
Source of data	Historical Data and measurement campaign
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	The amount of biogas recovered and fuelled, flared or used gainfully shall be monitored *ex post*, using flow meters. If the biogas flared and fuelled (or utilized) is continuously monitored separately, the two fractions can be added to determine the biogas recovered. In that case, recovered biogas need not be monitored separately. The system should be built and operated to ensure that there is no air ingress into the biogas pipeline. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry)
Monitoring frequency	Annually, based on continuous flow measurement with accumulated volume recording (e.g. hourly/daily accumulated reading)
QA/QC procedures	Instruments calibrated by according to manufacturer recommendations. The system should be built and operated to ensure that there is no air ingress into the biogas pipeline. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry)
Purpose of data	Used to determine Methane Captured and destroyed
Additional comments	

Data / Parameter	$w_{CH4,y}$
Unit	%
Description	Methane content in biogas in the year *y*
Source of data	Historical Data and measurement campaign
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level by following General guidelines for sampling and surveys for SSC project activities or, alternatively a default value of 60% 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 CO2 is not permitted. The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place
Monitoring frequency	The fraction of methane in the gas should be measured with a continuous analyser or, alternatively, with periodical measurements at a 90/10 confidence/precision level.
QA/QC procedures	The methane content measurement shall be carried out close to a location in the system where a biogas flow measurement takes place, and on the same basis (wet or dry)
Purpose of data	Used to determine Methane Captured and destroyed
Additional comments	

Data / Parameter	*T*
Unit	^{o}C
Description	Temperature of the biogas
Source of data	Measurement campaign
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas
Monitoring frequency	Shall be measured at the same time when methane content in biogas ($w_{CH4,y}$) is measured
QA/QC procedures	
Purpose of data	The temperature of the gas is required to determine the density of the methane combusted.
Additional comments	

Data / Parameter	*P*
Unit	Pa
Description	Pressure of the biogas
Source of data	Measurement campaign
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	If the biogas flow meter employed measures flow, pressure and temperature and displays or outputs the normalised flow of biogas, then there is no need for separate monitoring of pressure and temperature of the biogas
Monitoring frequency	Shall be measured at the same time when methane content in biogas ($w_{CH4,y}$) is measured
QA/QC procedures	
Purpose of data	The pressure of the gas is required to determine the density of the methane combusted.
Additional comments	

Data / Parameter	FE
Unit	%
Description	The flare efficiency
Source of data	As per the "Tool to determine project emissions from flaring gases containing Methane".
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	As per the "Tool to determine project emissions from flaring gases containing Methane".
Monitoring frequency	
QA/QC procedures	Regular maintenance shall be carried out to ensure optimal operation of flares
Purpose of data	Used to calculate project activity emissions
Additional comments	

Data / Parameter	$Q_{manure,\,j,\,LT,\,y}$
Unit	Tonnes DM/year
Description	Quantity of manure treated from livestock type LT at animal manure management system j
Source of data	Based on daily measurement and monthly aggregation
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	Manure weight shall be directly measured or alternatively manure volume can be measured together with the density determined from representative sample (90/10 precision). The quantity of animal manure from different farms and different animal types shall be recorded separately for crosscheck. Recording of the baseline animal manure management system where the animal manure would have been treated anaerobically is also required
Monitoring frequency	Annually, based on daily measurement and monthly aggregation
QA/QC procedures	Weight shall be directly measured or alternatively manure volume can be measured together with the density determined from representative sample (90/10 precision). The quantity of animal manure from different farms and different animal types shall be recorded separately for crosscheck.
Purpose of data	Used to calculate project activity emissions
Additional comments	

Data / Parameter	$SVS_{j,LT,y}$
Unit	tonnes DM/year, dry basis
Description	Specific volatile solids content of animal manure from livestock type *LT* and animal manure management system *j* in year *y*
Source of data	CPA monthly records
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	In case animal manure is treated in a centralized plant, as the case in option (2), testing shall be performed according to the guideline in annex 2 of AM0073. It can be on sample basis by following General guidelines for sampling and surveys for SSC project activities , with a maximum margin of error of 10% at a 90% confidence level
Monitoring frequency	Annually,
QA/QC procedures	Testing shall be performed according to the guideline in annex 2 of AM0073. It can be on sample basis by following General guidelines for sampling and surveys for SSC project activities, with a maximum margin of error of 10% at a 90% confidence level.
Purpose of data	Used for calculating baseline emissions
Additional comments	

Data / Parameter	$MS\%_l$
Unit	%
Description	Fraction of volatile solids handled by storage device *l*
Source of data	Daily measurement and monthly aggregation
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	In case animal manure is treated in different treatment systems manure weight delivered to each system shall be directly measured or alternatively manure volume can be measured together with the density determined from representative sample (90/10 precision). The quantity of animal manure from different farms and different animal types shall be recorded separately for cross-check. Recording of the baseline animal manure management system where the animal manure would have been treated anaerobically is also required
Monitoring frequency	Monthly
QA/QC procedures	IPCC Default Values
Purpose of data	Used to calculate possible project emissions due the storage of animal manure.
Additional comments	

Data / Parameter	$B_{0,LT}$
Unit	$m^3 CH_4$/kg dm
Description	Maximum methane producing potential of the volatile solid generated for animal type *LT*
Source of data	National values or IPCC default values
Value(s) applied	To be determined by each CPA
Measurement methods and procedures	Use data from country-specific published sources, measured with a standardised method (B_o shall be based on total as-excreted *VS*). These values shall be compared to IPCC default values and any significant differences shall be explained. If country specific B_o values are not available, default values from tables 10 A-4 to 10 A-9 of 2006 IPCC Guidelines for National Greenhouse Gas Inventories volume 4 Chapter 10 can be used, provided that the project participants assess the suitability of those data to the specific situation of the treatment site
Monitoring frequency	Annually
QA/QC procedures	Could use IPCC default values
Purpose of data	Used for calculating Baseline emissions
Additional comments	

B.7.2. Description of the monitoring plan for a generic CPA
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This Monitoring Plan (MP) provides a standard monitoring plan for all the CPAs covered under this PoA. The managing entity, BPI, will manage the monitoring done by each CPA to ensure its compliance with data collection, processing and reporting required in this PoA. The MP shall comply with all the relevant rules and regulations of the CDM. CPAs shall make reference to this MP to facilitate accurate and consistent monitoring of the PoA's Certified Emission Reductions. This MP shall be followed during the project duration and be used for project verification in quantifying the CERs achieved by each CPA and aims to achieve the following:

- Establishing and maintaining a suitable monitoring system,
- Establishing and maintaining a reliable and accurate monitoring system,
- Guide the implementation of necessary measurement and management operations,
- Guide for meeting CDM requirements for verification and certification.

All the CPAs will be assigned a unique identification number and GPS coordinates of project location for verification and as reference to ensure single counting of the PoA or CPA.

Monitoring Obligations

To facilitate the accurate determination of CERs, each CPA will need to fulfil certain operation and data collection obligations. A CDM Operations and Monitoring Manual will be prepared before the start of the first crediting period. The objective of the manual is to ensure the accurate and transparent calculation and monitoring of CERs for each CPA. The necessary data for baseline and emission reduction determination shall be stipulated in each CPA-DD.

The management entity, BPI, will maintain all monitoring reports for the CPAs in accordance to the records keeping system and shall ensure that monitoring reports are available upon request by the DOE for verification purposes. BPI shall also carryout onsite inspections for each individual farm included in the project boundary where a CPA is implemented for each verification period.

Management and Operational Systems

Each CPA shall have a well-defined management and operational system that meets the specific requirements of the project activities. The system should ensure successful execution of CPA and the credibility and verifiability of the CERs achieved and should include the following:-

Data Handling

- Each CPA will develop, implement and maintain a transparent system for the collection, computation and storage of data, which includes adequate records keeping and data monitoring system fit for independent monitoring auditing and verification.
- BPI as the management entity will oversee and ensure that each CPA will maintain standard records documentation and keep the monitored data in a secure data for the crediting period and up to two years after the crediting period for each CPA.
- Data (soft and hard copy) will be transmitted to BPI who is responsible for the compilation of the monitoring reports and BPI will conduct a data audit and compliance review with the MP atleast bi-annually for each CPA.

Quality Assurance

- Key quality assurance personnel will be assigned for overall project management, operation, monitoring and reporting required by the project activity
- A competent manager responsible and accountable for the generation of CERs including monitoring, records keeping, computation of ERs, audits and verification. The manager will sign off on all GHG Emission worksheets.
- Well defined quality control procedures will be encouraged to enhance data archiving and integrity of ERs.

Training

- Training for new staff will be done to enable them to implement the requirements of this MP. Initial training will be done for all staff involved in the implementation of the MP before the start of the project and generation of CERs.
- Environment, health and safety issues will also be given priority.

The CPA will inform the management entity about the need for any corrective and enhancement measures.

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