



Monitoring report form (Version 03.1)

Monitoring report

Title of the project activity	Bagepalli CDM Biogas Programme
Reference number of the project activity	0121
Version number of the monitoring report	1
Completion date of the monitoring report	05/11/2013
Registration date of the project activity	10/12/2005
Monitoring period number and duration of this monitoring period	Monitoring Period Number – 4 Duration of Monitoring Period - First and last days included (01/08/2011 - 31/08/2013)
Project participant(s)	1. Agricultural Development and Training Society, India 2. Velcan Energy, France 3. Velcan Energy, Switzerland 4. Atmosfair gGmbH, Germany
Host Party(ies)	INDIA
Sectoral scope(s) and applied methodology(ies)	Sectoral Scope I; TYPE I - RENEWABLE ENERGY PROJECTS AMS-I.C. Version 5; Thermal energy for the user
Estimated amount of GHG emission reductions or net anthropogenic GHG removals by sinks for this monitoring period in the registered PDD	40,820 tCO ₂
Actual GHG emission reductions or net anthropogenic GHG removals by sinks achieved in this monitoring period	30,571 tCO₂

SECTION A. Description of project activity**A.1. Purpose and general description of project activity**

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a) Purpose of the project activity and the measures taken for greenhouse gas emission reductions

The purpose of the project activity is to build 5,500 biogas plants (digesters) of 2 m³ capacities each. Each household uses the dung of cattle to feed the biogas digester for the production of biogas for cooking purpose and hot water bath. The aim of the project is to replace the commonly used inefficient wood fired mud stoves technology, with clean, sustainable and efficient biogas fed devices.

About 75.6% of biomass used for cooking and heating water in Kolar District is non-renewable which means that 75.6 % of the fuel wood cannot be considered a renewable source of energy. By burning this firewood, the users were causing the emission of greenhouse gases in the baseline. In the project activity, fuel wood was replaced with renewable biogas, thus avoiding greenhouse gas emissions in the baseline.

Each family was using 2.85 t of wood/year of which 2.15 t was non-renewable. Also, per year, 31.2 liters of kerosene was used as additional cooking fuel. The CO₂ emission reduction from avoidance of non-renewable wood usage and kerosene was estimated *ex-ante* at 3.56 tCO₂/family/year. Thus, the number of CERs generated through the project in one year is basically calculated by multiplying the number of unit operating by the ratio of 3.56.

b) Brief description of the installed technology and equipments

The biogas plant (Deenbandhu Model) consists of a digester with a fixed, non-movable gas space. Families load cattle dung through the inlet into the fixed dome made of bricks and cement, located outside the kitchen. Biogas is produced through anaerobic digestion of the dung and stored in the upper part of the digester before being piped to the biogas stove in the kitchen. Users prepare batches of slurry in the mixing tank, before allowing the final mixture to flow into the digester for methane formation phase. The recovered gas is combusted and used for cooking and water heating. The gas pressure displaces the digested slurry into the compensating tank, ready to be used as manure.

c) Relevant dates for the project activity (e.g. construction, commissioning, continued operation periods, etc.).

The project was registered on 10th December 2005 and the start date of the project activity/ crediting period is 1st September 2006.

This is the fourth monitoring report for the project activity. The details of the earlier monitoring and verification for the project activity are as follows:

Monitoring Report and Verification	Monitoring Period	Biogas Units Commissioned (Nos)	Net Emission Reductions (tCO ₂)	Status
I	1 st Sept 2006 to 31 st August 2007	4,399	11,761	Issued
II	1 st Sept 2007 to 31 st July 2009	5,485	35,872	Issued
III	1 st August 2009 to 31 st July 2011	5,485	33,087	Issued

This is the fourth monitoring period for the period 1st August 2011 to 31st August 2013 till the end of the first crediting period (inclusive of both days). As of 31st August 2013, 5,485 biogas units were constructed and commissioned. (See *Bagepalli_ER_Calculations 2001-13.xlsx*). Thus of the 5,500 units which were taken up as the CDM project, only 5,485 units were built. The construction status of the project as on 1st August 2011 (first date of this monitoring period) is as follows:

Taluk	Units Commissioned	Number of Villages
Bagepalli	2,617	125
Chickballapur	647	48
Chintamani	1,001	78

Siddalaghatta	840	58
Gudibanda	380	27
Total	5,485	336

No further units were built and only repair and maintenance of constructed units were done during this monitoring period. Of the constructed units, 283 units became dysfunctional. Hence by the end of the crediting period i.e. 31st August 2013, only 5,202 (5,485-283) units were functional or operational. The monitoring report has been established following the revised monitoring plan submitted and approved by the EB, UNFCCC (PRC-0121-001) on 27th September 2012¹.

The operational domestic biogas units are in continuous operation after installation. The dates of installation for each of the unit is recorded and included in the excel ER calculations sheet (see *Bagepalli_ER_Calculations 2011-13.xlsx*). In between, due to repair and maintenance, some of the biogas units may not be in operation. The days not operational is recorded for each of the unit. This information is included in the excel ER calculations sheet (see *Bagepalli_ER_Calculations 2011-13.xls*). The dates on which the problem occurred and the problem was fixed is recorded in the village level monitoring sheets and then entered into the online monitoring solution, which is the basis for emission reduction calculations for operational days of the installed units.

d) Total emission reductions achieved in this monitoring period.

Summary of the Project Activity and ERs Generated for the Monitoring Period	
Start date of fourth monitoring period	1-August-11
Carbon credits claimed up to	31-August-13
Emission reduction/unit/yr	3.56
Total Biogas Units Commissioned till 31 st August 2013	5,485
Total ERs generated for operational biogas units (after subtracting for non-operational days and non-operational units) for 1st August 2011 to 31st August 2013 (tCO₂)	30,571

A.2. Location of project activity

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- a) **Host Party(ies):** Non-Annex 1 country: India
- b) **Region/ State/Province, etc:** Karnataka State, India.
- c) **City/Town/Community, etc:** Five Taluks of Chickballapur District namely Bagepalli, Chickballapur, Chintamani, Gudibanda and Siddalaghatta.
- d) **Physical/ Geographical Location:**

¹ <http://cdm.unfccc.int/PRCContainer/DB/prcp8155416/view>

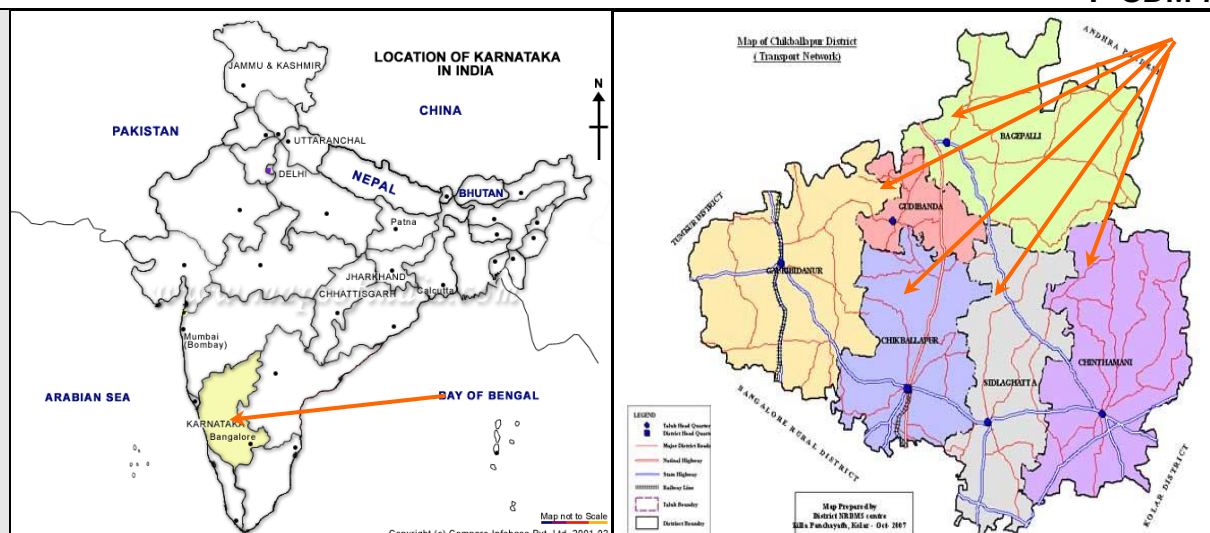


Fig 1: Map showing Karnataka State and the 5 taluks in Chickballapur² district where the project is being implemented.

Taluks	Coordinates
Bagepalli	13° 47' 5" North, 77° 47' 35" East
Chickballapur	13° 26' 3" North, 77° 43' 27" East
Chintamani	13° 24' 0" North, 78° 4' 0" East
Gudibanda	13° 40' 10" North, 77° 41' 54" East
Siddalaghatta	13° 23' 17" North, 77° 51' 46" East

The above table gives the GPS co-ordinates of the Taluks where project is being implemented.

A.3. Parties and project participant(s)

Party involved ((host) indicates a host Party)	Private and/or public entity(ies) project participants (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	Private Entity: Agricultural Development and Training Society (ADATS)	No
France (Annex 1 country)	Private Entity: Velcan Energy	No
Switzerland (Annex 1 country)	Private Entity: Velcan Energy	No
Germany (Annex 1 Country)	Private Entity: Atmosfair gGmbH	No

A.4. Reference of applied methodology

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Sectoral Scope : I; Energy industries (renewable - / non-renewable sources)
Methodology : AMS-I.C. Thermal energy for the user
Version : 5

A.5. Crediting period of project activity

² 6 taluks of former Kolar district have been separately carved out on 23rd August 2007 to form a new district and named Chickballapur district (http://chikballapur.nic.in/district_profile.html). The 6 taluks includes Gowribidanur, Gudibanda, Bagepalli, Chintamani, Siddalaghatta and Chickballapur taluks. Thus the project site is now in Chickballapur district.

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- a) **Type** : Renewable Crediting Period
- b) **Start date of the crediting period**: 01/09/2006
- c) **Length of the crediting period**: 7 years - 0 months (from 01/09/2006 – 31/08/2013)

SECTION B. Implementation of project activity

B.1. Description of implemented registered project activity

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a) Description of the installed technology, technical process and equipment

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

The individual plant consists of a mixing chamber where waste water and cow dung are mixed, an inlet pipe to feed the slurry into the reactor, the main biogas reactor/digester where methane formation/recovery takes place, a slurry outlet pipe, an outlet chamber, and a slurry platform. The outlet pipe and tank are provided to remove the digested/treated sludge or fermentation residue and the slurry platform is provided to maintain the treated slurry in clean condition. A pipe leading from the top of the dome to the stove is provided to supply biogas to a 2-ring stove inside the house. The cross-section of a biogas unit is as shown in Fig 2.

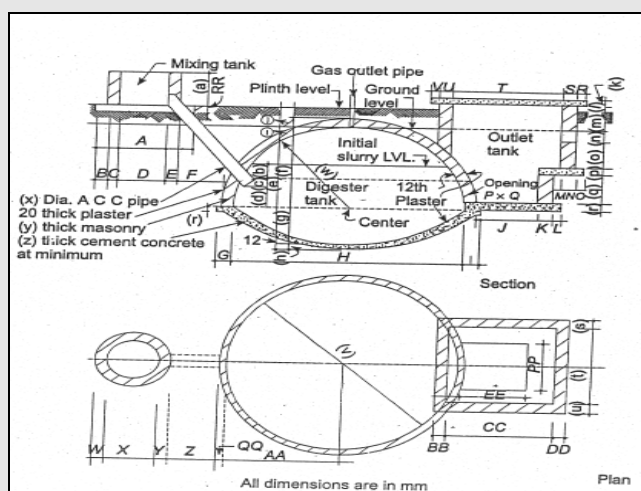
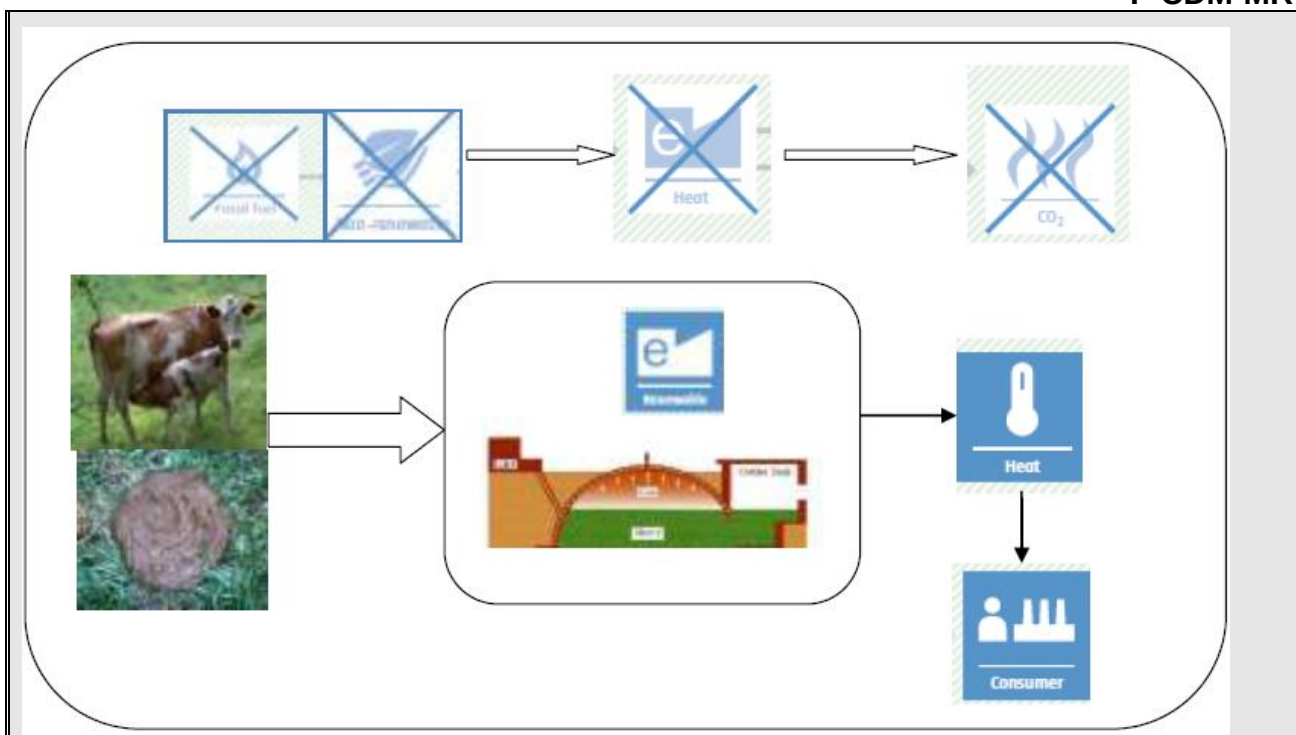


Fig 2: Diagram of a cross-section of the Deenabandhu 2 m³ biogas model

Technical process and equipment of biogas unit



Deenabandhu Biogas Unit in construction



Biogas Stove used for Cooking

B1.2 Implementation Status of the Project Activity

The Bagepalli Biogas CDM project is implemented by ADATS, a 36 year old rural development NGO, for small and poor peasant families in over 336 villages from 5 taluks i.e. Bagepalli, Chickballapur, Chintamani, Gudibanda and Siddalaghatta of Chickballapur District² (formerly Kolar District), Karnataka, India.

The project activity is construction of 5,500 biogas plants in the project area. Of these, 5,485 were built during I and II monitoring periods during 2006-2009. The units were commissioned between 05-Jan 2006 – 05 Feb 2009. The biogas project involves implementation of the technology, maintenance and monitoring the emission reductions. All the tasks and activities were carried out in 16 designated "Areas"³ comprising of 336 villages. Each Area Team consists of a Field Worker, Case Worker and Mahila Trainers (The organization chart of ADATS can be seen at <http://www.adats.com/misc/Organogram.pdf>). Each Area Team is "in-charge" of the processes in their respective villages.

The construction of biogas plants was done in a phased manner. The details of the units

³ Area comprises of a group of villages being overlooked by the Area Team

commissioned and operational are as follows:

Taluk	2006	2007	2008	2009	Total
Bagepalli	1,411	1,108	97	01	2,617
Chickballapur	352	293	02	00	647
Chintamani	657	317	27	00	1,001
Siddalaghatta	377	324	139	00	840
Gudibanda	203	165	12	00	380
Total	3,000	2,207	277	01	5,485

The list of beneficiaries, their unique user ID, village, and other details is provided in the enclosed excel file (*Bagepalli_ER_Calculations 2011-13.xlsx*). The dates of commission of all the 5,485 biogas plants is listed in the excel sheet. The project activity of 5,485 biogas units was implemented in 336 villages of 5 Taluks, Chickballapur district. The status of the project as on 1st August 2011 (first date of this monitoring period) is as follows:

Taluk	Units Commissioned	Number of Villages
Bagepalli	2,617	125
Chickballapur	647	48
Chintamani	1,001	78
Siddalaghatta	840	58
Gudibanda	380	27
Total	5,485	336

No further units were built and only repair and maintenance of constructed units were done during this monitoring period. During this monitoring period, of the constructed units, 283 units became dysfunctional at various times. Hence by the end of the crediting period i.e. 31st August 2013, only 5,202 (5,485-283) units were operational.

The operational domestic biogas units are in continuous use after installation. In between, due to repair and maintenance, some of the biogas units were not be in operation for different durations of time. For each of the unit, the days not operational, is recorded. This information is included in the excel ER calculations sheet (see *Bagepalli_ER_Calculations 2011-13.xlsx*). The date on which the problem occurred and the problem was fixed is recorded in the village level monitoring sheets and then entered into the online monitoring solution, which is the basis for emission reduction calculations for only the operational units and operational days of installed units. The various reasons and days lost due to repairs and maintenance are as follows:

Reason For Breakdown/ Non-Usage	Non-operational biogas days ⁴ for the monitoring period (1st August 2011-31st August 2013)
Empty and Replaster Dome	467514
No Gobar	222544
Unit Dysfunctional	190322
Repair/Replace Gas Pipe	92514
Repair Stove	20938
Repair Inlet Tank	18320
(blank)	14235
Replace Stove	5865
Change Nozzle	4055
Kitchen not Used	3699
Gobar Too Watery	1862

⁴ This is the total number of days in the monitoring period for all the biogas units which were under repair and not operational. Thus for a month of 30 days, the total biogas days are 5,485 x 30 days = 164,550

Gobar Dried	1380
Drain Water in Gas Pipe	762
Repair Outlet Tank	701
Rain Water in Dome	223
Nozzle Blocked	142
Replace Gate Valve	122
Grand Total	10,45,198

The various reasons for non-usage of biogas units are: various unit parts such as stove/stove parts, nozzle, gas pipe was under repair or needed replacement, repair of dome/inlet/outlet tank; the unit are no more operational; watery dung to produce enough biogas, kitchen not used/did not cook, etc. When the users were not aware of the actual reason of non-function, it was recorded as such, later the problem identified, and repaired. The units were repaired as soon as it is informed to the case workers.

B.2. Post registration changes

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

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There are no temporary deviations from registered monitoring plan or applied methodology.

B.2.2. Corrections

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

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

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There are permanent changes from the registered monitoring plan, which was approved by EB. The changes to monitoring plan and the revised PDD were approved on 27th September 2012 and the reference number is PRC-0121-001¹. The approved revised PDD with revised monitoring plan is Version 3 of PDD dated 22nd August 2012⁵.

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

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There are no changes to the project design of the project activity.

B.2.5. Changes to start date of crediting period

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Crediting Period: From 1st September 2006 to 31st August 2013

Choice of Crediting Period: Renewable

The earlier crediting period of 18th December 2005 – 17th December 2012 was changed to the above crediting period.

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

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Not Applicable for this project activity.

SECTION C. Description of monitoring system

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This section describes the monitoring system followed stepwise for each of the parameters. This

⁵ <http://cdm.unfccc.int/Projects/DB/DNV-CUK1131002343.1/view>

includes data collection procedures which includes data generation, aggregation, recording, calculation and reporting.

The organizational structure, roles and responsibilities of personnel, and emergency procedures for the monitoring system is also described in the following sections.

A CDM Team from Fair Climate Network (FCN) and ADATS has been formed for monitoring and verification of all the monitoring parameters. Qualified and trained people monitor the parameters and calculate the emission reductions.

C.1. Organization structure

The biogas project involves implementation and maintenance of the technology, monitoring the operation of the units, based on which emission reductions (ER) are calculated. All the tasks and activities are carried out in 16 designated “Areas” comprising of 336 villages. Each Area Team consists of a Field Worker, Case Worker and Mahila Trainers (The organization chart of ADATS can be seen at <http://www.adats.com/misc/Organogram.pdf>). Each Area Team was “in-charge” of the processes in their respective villages. The Area Team transfers as much as this charge to the village level cadre of the Coolie Sangha – i.e. elected Cluster Secretaries, elected Representatives, Village Health Workers and Balakendra Teachers⁶. Such a “transfer of ownership” was markedly visible in the actual selection of participating families and assisting individual families in the actual construction activities. Village level Coolie Sangha Units (CSUs), and especially the Mahila Meetings (Women’s meeting), played a vital role in selecting appropriate sites for the actual construction and pitch in with manual labour to help dig pits. This had led to a second “transfer of ownership”. Village CSUs, in turn, made the participating families the true owners of all the processes affecting the final output. Similarly, it was family labour that voluntarily assisted the skilled masons during actual construction. The women were taught efficient ways of cooking in the Mahila Meetings.

ADATS trained 123 local Masons in the tried and tested construction techniques of biogas plants. Extensive personal information was collected on each Biogas Mason and entered into the computerized database. These provide irrefutable identification and responsibility for each Biogas Unit fixed to a particular Mason.

Monitoring of the parameters mentioned below was conducted jointly by ADATS, FCN, village level Coolie Sangha members’ in-charge and selected biogas users.

C.2. Monitoring and Data Collection Procedures

C.2.1. Monitoring during pre-commission and commission of biogas units

The construction of biogas plants was done in a phased manner. During the first monitoring period, 4,399 units were commissioned. During the second monitoring period, 1,086 units were commissioned and as on 1st August 2011, 5,485 were commissioned. The various processes involved in the implementation of the technology as shown below were monitored for all the units which were commissioned.

1. Selection of participating families
2. Defining Masons
3. Defining Material Suppliers
4. Monitoring Construction Progress
 - Marking
 - Excavation
 - Supplying crushed stone Jelly
 - Supplying Sand
 - Supplying Bricks
 - Supplying Cement
 - Supplying Hardware
 - Concreting
 - Brick work
 - Plastering

⁶ Teachers working at village level who impart informal education to the children.

- Filling Gobar (Dung)
 - Supplying Stove
 - Fixing Pipe & Stove
 - Fixing Safety Grill
5. Commissioning
 6. Generating End User Agreements

These processes were monitored on a day to day basis and database maintained from its initiation to completion dates for each of the biogas unit. Quality Control Supervisors comprising of the Audit team and the case worker of ADATS, the key persons to conduct the overall supervision of installed plants, checked the quality of installed biogas plants to ensure that the required materials were used for the construction of biogas units. All payments for construction of biogas units were made by cheque and suppliers were identified with personal data and digital photographs fed into the computerized databank for verification.

Statutory reports, including Trial Balance, Receipts & Payments statement, Income & Expenditure statement and Balance Sheet, are generated for the project activity. The books of accounts are audited by a certified Chartered Accountant. This financial accounting system gives proof of the construction of these biogas plants under the CDM project activity. Each of the biogas unit has been marked as “ADATS-VELCAN” and the date of construction on the doom, which makes it distinct. The Unit ID numbers are also marked on the biogas units. These evidences validate the construction and commission of the 5,485 biogas plants built in the project area, 4,399 during 2006-07 and another 1,086 subsequently during the second monitoring period.

The list of biogas users are identified by a User ID, the name of the beneficiary, the CSU membership number, the village and taluk, and other details such as family strength, land holding, caste, etc. (See *Bagepalli_ER_Calculations 2011-13.xlsx* for details). Other information includes the start date of construction and the date of commissioning.

All activity processes, including financial transactions for construction of biogas units, were digitally monitored using an online intranet solution that is integrated into ADATS’s intranet based monitoring system InfoNeeds that tracks various Coolie Sangha activities. Open and transparent online reports are used by everyone – ADATS Staff, Coolie Sangha functionaries and all other secondary stakeholders to know exactly where they stand in terms of progress and results. Reports are generated at all levels i.e. Project, Taluk, Area, Cluster, Village and individual Family level. The database is updated on a daily basis, as and when Field Staff return from their respective villages.

The information on the daily operating units is gathered by the village health worker or Balakendra teacher from its users on a day to day basis or during the weekly Mahila meetings⁷ held in every village. The information is updated to the individual biogas user’s monitoring database maintained by ADATS by the case worker on monthly basis. The average operational hours for each of the biogas users have been computed based on sample surveys. The Treasurer of the Coolie Sangha has been entrusted with the task of audit.

An upfront CER amount is used to maintain the biogas units and keep them in good condition, which is a vital prerequisite for Coolie women to generate CERs and continue enjoying smoke-free cooking. All activity processes, including financial transactions for construction of biogas units, are digitally monitored using an online intranet solution that is integrated into intranet based monitoring system InfoNeeds that tracks various tasks that is under this project.

⁷ These Mahila meetings have been held regularly since many years to discuss all issues of coolie sangha

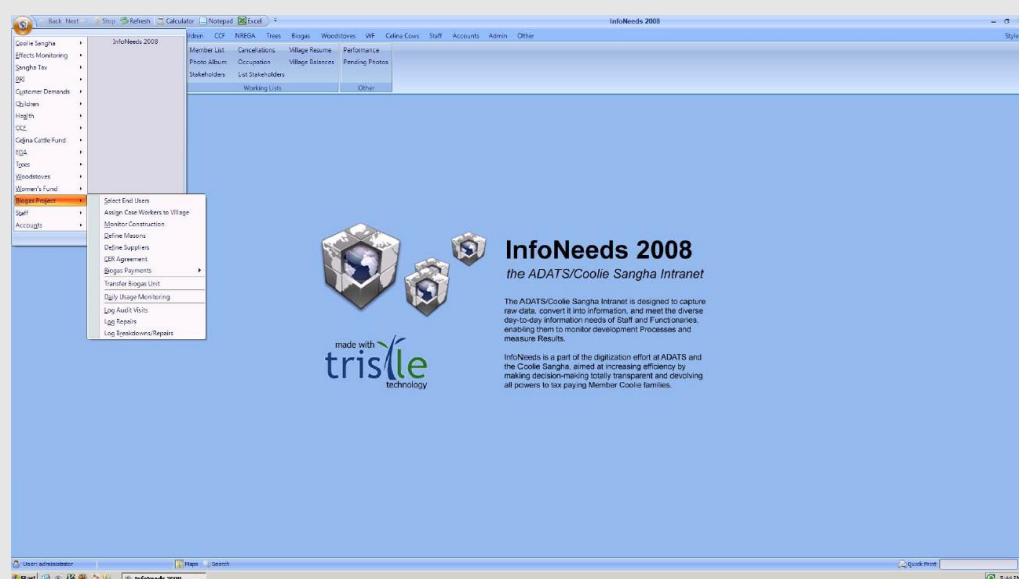
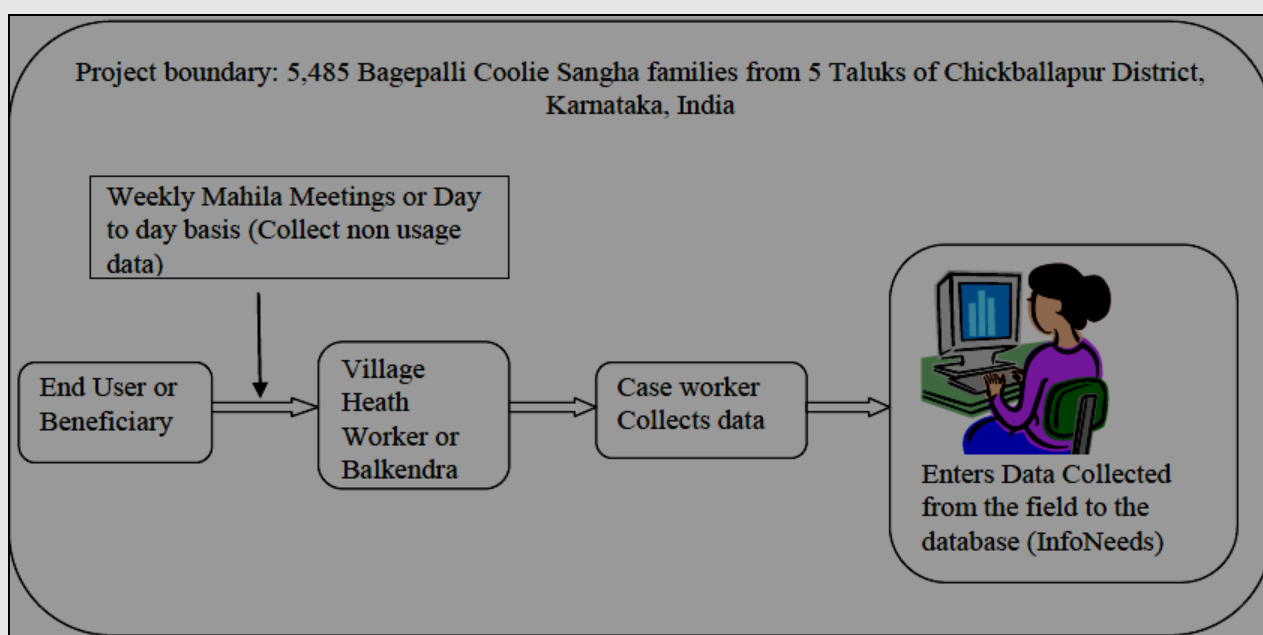


Fig 3: Screenshot of Digital Monitoring System, InfoNeeds.

Open and transparent online reports are used by everyone – Staff and all other secondary stakeholders to know exactly their progress and results. Reports are generated at all levels i.e. Project, Taluk, Area, Cluster, Village and individual Family level. The database is updated regularly as and when Field Staff return from their respective villages.

C2.2 Non-Usage Days:

After commission of biogas plants, the staffs also log-in the repairs required and the dates from when the units were not operational. The day the unit is repaired, the person attending to it and date is logged-in. These in between days are the non-operational days for the units. The information on biogas non-usage days are recorded either by the Balakendra or Village Health worker from its users on a day to day basis or during the weekly Mahila meetings⁸ held in every village. The information is updated to the individual biogas user's data base InfoNeeds by the case worker on regular basis. The end users also communicate through mobile phones to the Balakendra or Village Health workers. Thus there is a continuous database maintained of all the biogas units.



The above diagram describes the arrangement of monitoring the project activity and how the

⁸ These Mahila meetings have been held regularly since many years to discuss all issues of coolie sangha

monitored data flows from end user to the system database.

SECTION D. Data and parameters

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

Data / Parameter:	Baseline emission per household/year
Unit:	tCO ₂
Description:	Baseline emissions per household with a 2 cum biogas system that replaces fuel wood and kerosene in the baseline
Source of data:	Registered PDD
Value(s) applied:	3.56
Purpose of data:	Calculations of baseline emissions. To estimate emission reductions per household/year. This is based on baseline calculations and fixed throughout the crediting period
Additional comment:	As described in the PDD, the emission reduction is calculated using a ratio of 3.56 tCO ₂ /unit operating/year.

D.2. Data and parameters monitored

Based on the approved revised monitoring plan, the parameters monitored are as follows:

ID	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived? (electronic / paper)	For how long is archived data to be kept?	Comment
1	Number of installed 2 m ³ systems	IS	Units	m	Daily basis	All	e & p	Crediting period plus 2 years	ERs will be calculated only for installed units
2	Number of operating 2 m ³ systems	OS	Units	m	Daily basis	All	e & p	Crediting period plus 2 years	Non usage days will be recorded on daily basis and ERs not calculated for non-operational days
3	2 m ³ system average annual operating time	T	Hours	e	Annually	Random sample	e & p	Crediting period plus 2 years	Not used for calculation of the emission reductions
4	Non-usage days of installed and operational biogas plants		Days	m	Daily basis	All	e & p	Crediting period plus 2 years	ERs will be deducted for non-operational days.

Data/Parameter

Number of installed 2 m³ systems

Unit	Number
Description	Number of biogas units installed under the project activity
Measured/Calculated /Default	Measured
Source of data	Field Data monitored on a daily basis which was entered into the ADATS monitoring solution - InfoNeeds.
Value(s) of monitored parameter	5,485 as on 1 st August 2011
Monitoring equipment	There are no monitoring equipments to measure this parameter. The method to monitor the number of biogas units installed is described in Section C. Construction processes were monitored on a day to day basis and database maintained from its initiation to completion for each of the biogas units.
Measuring/Reading/ Recording frequency	The construction processes was monitored on a day to day basis from pre-commission till commissioning for all the 5,485 biogas units.
Calculation method (if applicable)	Not applicable
QA/QC procedures	After commissioning and satisfactory functioning of the biogas plant for a minimum of 2 weeks, an end user agreement was signed with the beneficiary, which is taken as the day of commissioning of the biogas plant. All activity processes, including financial transactions for construction of biogas units were digitally monitored using the online intranet solution that is integrated into ADATS's intranet based monitoring system InfoNeeds. This provides verification for the construction of biogas units.
Purpose of data	Used to calculate the emission reductions of the project activity.
Additional comment	Emission Reductions are calculated for only the installed and operational biogas units.

Data/Parameter	Number of operating 2 m³ systems
Unit	Number
Description	Number of biogas operating systems under the project activity
Measured/Calculated /Default	Measured
Source of data	Field Data monitored on a daily basis which is entered into the ADATS online monitoring solution, InfoNeeds.
Value(s) of monitored parameter	During the monitoring period, 283 units went dysfunctional on various dates. The number of operational units at the end of the monitoring period is 5,485 – 283 = 5,202.
Monitoring equipment	There are no monitoring equipments to measure this parameter. The method to monitor the number of operating systems is described in Section C. The non-operational days of all the installed units was monitored by Balakendra Teachers or the health workers at village level along with the reason, which was entered into the ADATS database – InfoNeeds. The units which are dysfunctional are reported as "Units Dysfunctional". The remaining units are the operational units.
Measuring/Reading/ Recording frequency	The measurement was done on a day to day basis for all the installed 5,485 biogas units and data entered into the online monitoring solution.
Calculation method (if applicable)	Those units which cannot be repaired are deemed as Units Dysfunctional and the rest of the units are the operational units. For a particular day, the number of operating systems is all the units which were functional. The number of operational days during the monitoring period for each of the system was determined to estimate the emission reductions.

QA/QC procedures	For efficient monitoring, continuous day to day monitoring was done. A user friendly survey sheet for each of the biogas user was maintained at the village level by the village health worker or the Bal Kendra Teacher. Hence continuous monitoring of the operational units was done.
Purpose of data	To calculate emission reductions.
Additional comment	Emission Reductions are not calculated anymore after the Units are dysfunctional. Emission Reductions were deducted or not calculated for non-functional days of operational units.

Data/Parameter	2 m³ system average annual operating time
Unit	Hours
Description	Hours of operation of biogas units/day
Measured/Calculated /Default	Measured
Source of data	Field data monitored annually through stratified random sample survey. As per the revised PDD, the average operating hours need to be monitored only once a year on a random basis. A revised monitoring plan was submitted and approved on 27 th September 2012 ⁵ by the EB. In the revised monitoring plan, the operational hours needs to be monitored yearly once for randomly selected households.
Value(s) of monitored parameter	3.19 hours/day
Monitoring equipment	There are no monitoring equipments to measure this parameter. The operating time of biogas systems was assessed based on annually conducted stratified random sample survey through questionnaire method.
Measuring/Reading/ Recording frequency	Frequency of monitoring is annual.
Calculation method (if applicable)	Average hours of cooking calculated from the annually collected data for the year 2011-12 and 2012-2013.
QA/QC procedures	The sample survey was conducted is statistically determined numbers of households.
Purpose of data	The value is not be used for ER calculations.
Additional comment	It is part of monitoring requirements under methodology I.C.

Data/Parameter	Non-usage days of installed and operational biogas plants
Unit	Number of days
Description	Based on the number of days some of the biogas units did not function due to: repairs, family not in the village or dung not fed into the digester.
Measured/Calculated /Default	Measured
Source of data	Field Data recorded
Value(s) of monitored parameter	The domestic biogas units are in continuous operation after installation. In between, due to repair and maintenance, some of the biogas units were not be in operation. The days not operational is recorded for each of the unit. This information is included in the excel ER calculations sheet (see <i>Bagepalli_ER Calculations 2011-13.xls</i>). The data was entered into the online monitoring solution, which is the basis for emission reduction calculations of operational days of the installed units. The various reasons for non-usage of biogas units are non availability of dung, did not cook at home, biogas stove under repair, nozzle not working, unit demolished and rebuilt, biogas tank under repair, the stove needs to be replaced, watery dung, etc.
Monitoring equipment	There are no monitoring equipments to measure this parameter.

Measuring/Reading/Recording frequency	It was monitored on a day to day basis by the Balakendra Teachers or the health workers at village level, which is entered into the ADATS database – InfoNeeds for all the biogas units.
Calculation method (if applicable)	The operational days in a year for a biogas unit are 365 days minus non-operational days.
QA/QC procedures	As per the methodology, the number of non-operational days of biogas units need not be measured. To be conservative and reduce uncertainty, the ERs are deducted for the days each of the commissioned biogas unit is not functional.
Purpose of data	To calculate emission reductions for only the operational days for each biogas unit.
Additional comment	This information is included in the excel ER calculations sheet (see <i>Bagepalli_ER Calculations 2011-13.xlsx</i>). The main objective of the project is to provide clean energy to rural women, thereby reducing their drudgery of fuel wood collection and provide better indoor air quality without smoke, soot and particulate matter. Hence, all efforts are made to record and repair the biogas units.

D.3. Implementation of sampling plan

D.3.1. Description of implemented sampling design

The data monitored for the project activity is as follows:

- (i) Number of installed 2 m³ systems
- (ii) Number of operating 2 m³ systems and
- (iii) Non-usage days of installed and operational biogas plants
- (iv) 2m³ average annual operating time

The parameters (i) to (iii) were monitored on a day to day basis for all the installed units for the monitoring period. There was no sampling plan as 100% units were monitored for these parameters. Based on the revised monitoring plan, the 2 m³ system average annual operating time is determined based on sample survey.

Objectives and Reliability requirements: The objective of the sampling effort is to determine the average annual operating time.

Target Population: The target population is 5,485 rural households in which biogas were constructed in 5 taluks of Chickballapur.

Sampling Frame: The sampling method chosen for the project area is stratified random sampling, wherein each Taluk is a stratum. It is easy to implement as the sampling framework i.e. household details for which biogas were implemented was collected and stored in the monitoring database. Each of the five Taluks - Bagepalli, Chickballapur, Chintamani, Siddlaghatta and Gudibanda was treated as a stratum. Thus, sampling was done for each of the Taluk to ensure that all the areas were well represented.

Sampling Frame: The sampling frame is the complete listing of all rural households for which biogas was built under the project activity in Bagepalli, Chickballapur, Chintamani, Siddlaghatta and Gudibanda, Chickballapur District, Karnataka State. Each of the household has a unique identification number with all the required details of the family.

Determination of sample size: Determination of sample size is in accordance with Annex 5, EB 69, "Guidelines for sampling and surveys for CDM project activities and programme of activities", which specifies the reliability requirements and describes appropriate sampling methods applicable to small-scale projects. The sample frame is homogeneous, wherein the families are from rural region from similar socio-economic strata and similar cooking habits. Thus, the sample size required to achieve a required level of reliability was calculated based on the following formula:

$$n \geq \frac{1.645^2 N \times p(1-p)}{(N-1) \times 0.1^2 + 1.645^2 p(1-p)}$$

Where:

n Sample size

- N Total number of households (5,485)
 p Our expected proportion (0.85) of biogas units operational. Though, according to the monitoring solution, the value is 95% (5,202 of 5485 operational), to be conservative, 85% is considered for determination of n .
 1.645 Represents the 90% confidence required
 0.1 Represents the 10% relative precision p

Accordingly

$$n \geq \frac{1.645^2 \times 5485 \times 0.85 \times (1 - 0.85)}{(5485 - 1) \times 0.1^2 + 1.645^2 \times 0.85 \times (1 - 0.85)} = 35$$

If we expect the response rate from the sampled households to be only 80%, then the scale up for the survey would be $35/0.8 = 44$ households.

Apportioning to all the Taluks, the number of households to be sampled is as follows:

Mandals	Total Number of Households
Bagepalli	$\frac{2617}{5485} \times 44 = 21$
Chickballapur	$\frac{647}{5485} \times 44 = 5$
Chintamani	$\frac{1001}{5485} \times 44 = 8$
Siddalaghatta	$\frac{840}{5485} \times 44 = 7$
Gudibanda	$\frac{380}{5485} \times 44 = 3$
Total	44

The villages were selected using randomly using random sample selection in Microsoft excel and again random selection of households in each village. The details of the survey and the field studies conducted for the study is as follows:

Taluk-wise details of villages and end-user households sampled

Taluks	2011-12		2012-13	
Taluks	Number of Villages	Total number of households	Number of Villages	Total number of household
Bagepalli	11	39	10	38
Chickballapur	4	15	4	14
Chintamani	6	21	6	21
Gudibanda	3	12	3	11
Siddalaghatta	4	15	4	14
Grand Total	28	102	27	98

The details of the villages visited and the number of households visited for the survey is as follows:

Year wise details of the villages and beneficiary households sampled

Year 2011-12			Year 2012-13	
No of Families Surveyed			No of Families Surveyed	
Taluks	Village	Total	Village	Total
Bagepalli	Boodalapalli	4	Bandolapalli	4

	Chokkampalli	2	Chinnampalli	4
	Devareddipalli	4	Endrakayalapalli	4
	Gundlapalli	4	Karkur	4
	Karkur	3	Kothakota	5
	Kothapalli	4	Kurubarapalli	4
	Kuntlapalli	4	Maraganakunte MV-B	4
	Palyakere MV	4	Paipalya-B	2
	Pillagutta	4	Pesalaparthi HC	3
	Ramasamipalli	4	Thimmakalapalli	4
	Saprampalli	2		
Chickballapur	Bandahalli	4	Angarekanahalli	4
	Kondenahalli	4	Beeraganahalli	2
	Reddigollarahalli	3	Kadiseeganahalli	4
	Yelagalahalli	4	Suddahalli	4
Chintamani	Dodda Katigenahalli HC	4	C. Gundlapalli	3
	Kotagal B	4	Digavakota	4
	Kurumarlapalli	2	Digavapalli	4
	Raguttahalli	4	Muddalahalli	3
	S. Raguttapalli	3	Papathimanahalli MV	3
	Seethahalli	4	Thippanahalli	4
Gudibanda	Ganganapalli	4	Karaganathanahalli	4
	Karaganathanahalli	4	Ramaganahalli	3
	Kondavulapalli	4	Ullodu	4
Siddalaghatta	K.Mukudahalli	3	Gadiminchinahalli	4
	Kadirinayakanahalli	4	Marihalli	2
	Kondarasanahalli	4	Pedda Bandaragatta	4
	Valasahalli	4	Valasahalli	4
Total		102		98

D.3.2. Collected data

The monitoring parameters i.e. (i) Number of installed 2 m³ systems (ii) Number of operating 2 m³ systems and (iii) Non-usage days of installed and operational biogas plants were monitored on a day to day basis and data collected for all the installed units. The data collected was entered into the monitoring solution, which was extracted to Microsoft Excel Sheet for emission reduction calculations.

For the 2 m³ system average annual operating time, field data was collected based on an annual stratified random sample survey through household level questionnaire method.

D.3.3. Analysis of the collected data

The data collected was entered into monitoring solution and exported to excel sheet for data analysis and to calculate the emission reductions of the project activity (*Bagepalli_ER Calculations 2011-13.xlsx*).

(i) Number of installed 2 m³ systems: Of the 5,500 units that were to be constructed under the project, 5,485 units were constructed. All the units were constructed during the first and second monitoring period, before August 2011. No units were constructed during this monitoring period.

(ii) Number of operating 2 m³ systems: The analysis of all the operating systems for each day consolidated for the monitoring period is shown in *Bagepalli_ER Calculations 2011-13.xls*. The emission reductions are calculated only of operational units for operational days.

(iii) Non-usage days of installed and operational biogas plants: The non-usage days or non-

operating units were monitored on a day to day basis for all the constructed units. Based on the data, which is collected and entered into the online monitoring system, there were repairs, overhaul and maintenance of constructed biogas units and units not repaired. The reasons for the breakdown and total non-operational biogas days for the monitoring period (1st August 2011-31st August 2013) are as follows:

Reason For Breakdown/ Non-Usage	Non-operational biogas days ⁹ for the monitoring period (1 st August 2011-31 st August 2013)
Empty and Replaster Dome	467514
No Gobar	222544
Unit Dysfunctional	190322
Repair/Replace Gas Pipe	92514
Repair Stove	20938
Repair Inlet Tank	18320
(blank)	14235
Replace Stove	5865
Change Nozzle	4055
Kitchen not Used	3699
Gobar Too Watery	1862
Gobar Dried	1380
Drain Water in Gas Pipe	762
Repair Outlet Tank	701
Rain Water in Dome	223
Nozzle Blocked	142
Replace Gate Valve	122
Grand Total	10,45,198

A detailed breakdown time for each of the biogas unit is shown in excel sheet (*Bagepalli_ER Calculations 2011-13.xlsx*).

There have been no events or situations that occurred during this monitoring period which has impacted the applicability of the methodology.

(iv) 2 m³ system average annual operating time: Based on the data collected from stratified random sample survey the average operating time of a biogas unit for the monitoring period is 3.19 hours/unit/day.

D.3.4. Demonstration on whether the required confidence/precision has been met

The parameters (i) to (iii) were monitored for all the installed biogas units. Thus there results of the data has very high confidence and precision level, with very low uncertainly levels.

With regard to average annual biogas operating hours (parameter iv) of a biogas unit, the mean use is 3.19 hours/day, standard deviation is 0.74 and standard error of the mean is 0.05. The precision of the mean average cooking hours, assuming 90% confidence is calculated as follows:

$$(t\text{-value} \times \text{standard error of mean}) = (1.6559 \times 0.05) = \pm 0.086904$$

$$\text{The ratio of this relative to the mean average cooking hours is } \frac{0.086904}{3.19} = 0.027232$$

So the relative precision is 2.72% which is therefore within the required specification. Thus the required confidence/precision has been met.

⁹ This is the total number of days in a month all the biogas units under repair were not operational. Thus for a month of 30 days, the total biogas days are 5,485 x 30 days = 164,550

SECTION E. Calculation of emission reductions or GHG removals by sinks**E.1. Calculation of baseline emissions or baseline net GHG removals by sinks**

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As described in the PDD and in the revised monitoring plan, the emission reduction was calculated using a ratio of 3.56 tCO₂/unit//year. The emission reduction for a year is calculated as follows:

$$ER_y = \sum_{n=1}^N (OS_y \times \frac{EM_y}{365} \times \text{number.of.operational.days})$$

where:

ER_y : yearly Emission Reductions (tCO₂)

OS_y : 2 m³ operating system in year y.

N : Number of biogas units. In this project 5,485 biogas units installed and monitored. EM_y = 3.56 t CO₂e = Baseline emissions per household with a 2 m³ biogas system. Calculated as the average yearly wood consumption times the emission coefficient for (non-renewable) wood, plus average yearly kerosene consumption times the emission coefficient for kerosene.

Number of Operational days = 365 - Non-usage days of installed biogas.

The total emission reductions for the period 1st August 2011 to 31st August 2013 for the installed and operational 5,485 biogas units are **30,571 tCO₂**. The unit-wise calculations of emission reduction are as enclosed in the excel sheet – *Bagepalli_ER Calculations 2011-13.xlsx*.

The total emission reductions for the period 1st August 2011 to 31st August 2013 for the installed 5,845 biogas units are 30,571 tCO₂.

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

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There are no project emissions in the project activity.

E.3. Calculation of leakage

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There is no leakage due to the project activity. As mentioned in the PDD, leakage is not an issue and need not be monitored for the project activity.

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

Item	Baseline emissions or baseline net GHG removals by sinks (t CO ₂ e)	Project emissions or actual net GHG removals by sinks (t CO ₂ e)	Leakage (t CO ₂ e)	Emission reductions or net anthropogenic GHG removals by sinks (t CO ₂ e)
1 st Aug 2011 to 31 st August 2013	30,571	0	0	30,571
Total	30,571	0	0	30,571

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

estimates in registered PDD

Item	Values estimated in ex-ante calculation of registered PDD	Actual values achieved during this monitoring period
Emission reductions or GHG removals by sinks (t CO ₂ e)	40,820 tCO ₂	30,571 tCO ₂

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

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The emission reductions are lesser than that projected in the PDD as only 5,485 are commissioned. Of the constructed units, 283 have become dysfunctional during the monitoring period, which has also reduced emission reductions. Also, as detailed in section D.2, many units were under repair and maintenance leading to non-operational biogas days during the 2 years of monitoring period. This has led to a decrease of 25.10% of expected emission reductions for the monitoring period.

These factors has accounted for lesser emission reductions to that estimated in the registered PDD.

E.7. Actual emission reductions or net anthropogenic GHG removals by sinks during the first commitment period and the period from 1 January 2013 onwards

Item	Actual values achieved up to 31 December 2012	Actual values achieved from 1 January 2013 onwards
Emission reductions or GHG removals by sinks (t CO ₂ e)	21,119	9,452

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Document information

Version	Date	Description
03.1	2 January 2013	Editorial revision to correct table in section E.5.
03.0	3 December 2012	Revision required to introduce a provision on reporting actual emission reductions or net anthropogenic GHG removals by sinks for the period up to 31 December 2012 and the period from 1 January 2013 onwards (EB70, Annex 11).
02.0	13 March 2012	Revision required to ensure consistency with the "Guidelines for completing the monitoring report form" (EB 66, Annex 20).
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