CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
Version 03 - in effect as of: 22 December 2006

CONTENTS

Annexes

Revision history of this document

Version Number	Date	Description and reason of revision
01	21 January 2003	Initial adoption
02	8 July 2005	•The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document. •As a consequence, the guidelines for completing CDM SSC PDD have been revised accordingly to version 2. The latest version can be found at <http://cdm.unfccc.int/Reference/Documents>.
03	22 December 2006	•The Board agreed to revise the CDM project design document for small-scale activities (CDM-SSC-PDD), taking into account CDM-PDD and CDM-NM.

SECTION A. General description of the small-scale project activity

A.1 Title of the small-scale project activity:

Title : Installation of Biogas Plants by INSEDA Members & Partners
Version: 03
Date : 07 September 2011

A.2. Description of the small-scale project activity:

The main objective of the project activity is to increase the penetration rate of household biodigesters and increasing the functionality rate of the biogas plants by bundling household anaerobic biodigesters installed in the rural areas of Kerala and Madhya Pradesh. Biogas generated from the biodigesters will be replacing firewood used for domestic cooking purposes. Project activity will contribute towards sustainable development by replacing firewood with biogas generated from the biodigesters.

Each household participating in the project activity (the list of 4265 household participated in the project activity will be given to the DoE) will feed animal dung and other organic wastes (herein after referred as "feed") in the anaerobic biodigesters. Biogas generated from anaerobic biodigesters will be used for domestic cooking purposes. This leads to reduction of greenhouse gas emissions by displacing conventionally used non renewable biomass with renewable biogas. In addition, the hygienic conditions in the rural areas will be improved by an appropriate disposal of waste. Further, residue from the bio digesters can be used as organic fertilizer and will improve soil conditions in rural areas.

Project Scenario
The project activity is located in rural areas of the states of Kerala and Madhya Pradesh. The consumption of non renewable biomass firewood for household purposes in the rural areas is the main cause of deforestation in the surrounding areas of Kerala and Madhya Pradesh. The project includes bundling of 4265 households in various districts of Kerala and Madhya Pradesh installed between June 2006 and December 2008.
The size of the biodigesters varies, depending on the number of people and number of cattles available per household. A detailed breakdown of the plants with the respective installed capacity is given below in Table 1.

Table 1. Breakdown of the plants with the respective installed capacity

Sr. No	Capacity (m^3)	Number of plants
1	1	154
2	2	1829
3	3	1842
4	4	338
5	6	102
Total:		**4265**

Role of Integrated Sustainable Energy and Ecological Development Association (INSEDA)

INSEDA is a national organization, formed by grass root NGOs that have been involved in the promotion of renewable energy programmes with special focus on the implementation of anaerobic biodigesters in rural areas of India. The anaerobic biodigesters in the project activity are implemented by INSEDA and its member organizations which are given below:

1. SDA Rural Service partners of Association for Social Action and Development (ASAD) in Kerala
2. Aadivasi khadi Avom krishi Pariskchan Sansthan (AKKPS),Madhya Pradesh
3. Gramodyog Mandal (GM) in Madhya Pradesh

Both AKKPS and Gramudyog Mandal work on common areas and are guided by few common board members.

INSEDA has an agreement with its member organizations and in addition, the member organizations have an agreement with the farmers. All the carbon credits related rights are with INSEDA and INSEDA will be the concerned authority for all modalities and procedure with respect to Gold Standard VER project activity.
The ownership of VERs will be with INSEDA but shared between INSEDA, the member organizations and farmers.
INSEDA (project participant) will act as bundling agency for the subject project activity, to bundle 4265 anaerobic biodigesters installed in rural areas of Kerala and Madhya Pradesh[1].

Project Contributes the Sustainable Development
Project implementation in rural areas will improve the socio- economic condition of the rural population and reduce GHG emissions. It is expected that this project will contribute to the improvement of the living standard of the population. A detailed Sustainable Development description of the project activity is given in the Gold Standard passport.

The advantages of the projects are given in brief below:

Environmental well being

- The project utilizes biomass residues and cow dung which in the absence of the project activity would be left to decay and thus leading to substantial methane emissions from anaerobic processes.
- Utilizing biogas as an energy resource contributes to clean environment.
- Transformation of organic wastes into high quality fertilizer.
- Due to the anaerobic processes, the final sludge of the biodigesters has a very high degree of purity, i.e. it contains no parasites. This reduces the danger of parasitic infestations in people and animals
- During fermentation, part of the nitrogen content is changed into the form of ammonium, more easily absorbed by plants. In the direct spreading of unfermented manure, this process takes place in the soil and requires more time. Thus fermented liquid manure can be applied during the growth period of the plants (top dressing): This direct absorption by plants means that the danger of nitrogen seepage is reduced.

[1] Districts included in the project activity are given in Sec A.4.1.3

- Improvement of hygienic conditions through reduction of pathogens by utilizing the animal and other organic wastes in the bio digesters.
- Contribute to the global environment improvement by reducing deforestation and improving biodiversity.
- It will lead to improvement in soil condition by providing high quality manure.

Social – Economic well being

- It leads to improve the economic level of the local community by employing local people during construction of the biogas plant.
- The project will reduce the cooking time, thus providing women to take up other activities. It improves the overall health situation by reducing smoke in the kitchen, thus eliminating health hazards from indoor air pollution.

Technology well being:

- Better biogas digester models, thus improving biogas yield.

A.3. Project participants:

Name of Party involved (*) ((Host) indicates a host Party)	Private and/or public entity (ies) project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant
India	Integrated Sustainable Energy and Ecological Development Association	No
Germany	First Climate AG	No

A.4. Technical description of the small-scale project activity:

A.4.1. Location of the small-scale project activity:

A.4.1.1. Host Party(ies):

India

A.4.1.2. Region/State/Province etc.:

Kerala and Madhya Pradesh

A.4.1.3. City/Town/Community etc:

The project activity is located in various districts of Kerala and Madhya Pradesh. Various districts are given below

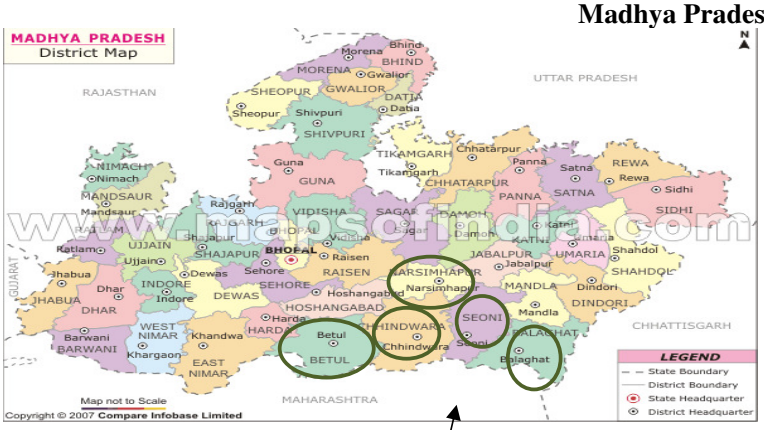
Table 2: Project location

Districts in Kerala	Geo coordinates	Districts in Madhya Pradesh	Geo coordinates
Alappuzha	09°30'N & 76°28'E	Balaghat	21° 48' N& 80° 15' E
Ernakulum	10° 00' N &76° 15 E	Betul	21° 88' N&77° 98' E
Idukki	9° 15'- 10° 21'N &76° 37'- 77° 25'E	Chhindwara	22° 03' N& 78° 59' E
Kannur	11° 52' N & 75° 25 E	Seoni	22° 06' N& 79° 35' E
Kasargodu	12° 30' N&75° 00 E	Narsinhpur	22°26' N- 23° 8' N & 78°22' E- 79° 22' E
Kottayam	9° 36' N &76° 34 E		
Kozhikode	11° 15' N & 75° 49 E		
Malapuram	10^0-12^0 N& 75°-77°E		
Palakkadu	10° 46' N&76° 39' E		
Pathanamthitta	9°3' N & 76°30' E		
Thrissur	10° 31'N- 76° 13'E		
Wayanad	11° 28'- 15°34'N& 75°28' - 70°16' E		

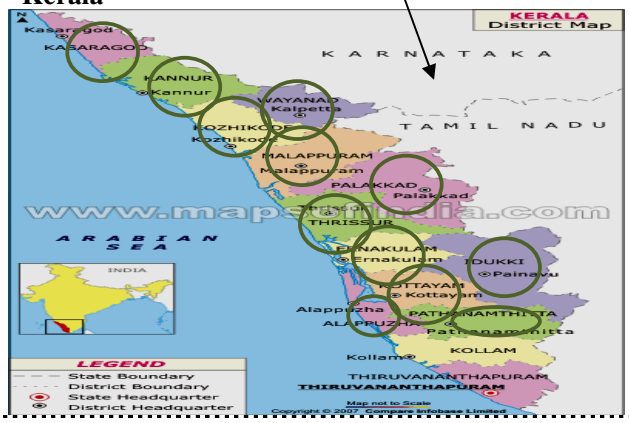
A.4.1.4. Details of physical location, including information allowing the unique identification of this small-scale project activity:

The project activity is located in Kerala, which lies between $10^0$00' N to $76^0$25' E it is bound by south-western part of India and Madhya Pradesh state lies between 23^0 30'N to 80^0 00' E on North Western part of India.

Madhya Pradesh



Kerala



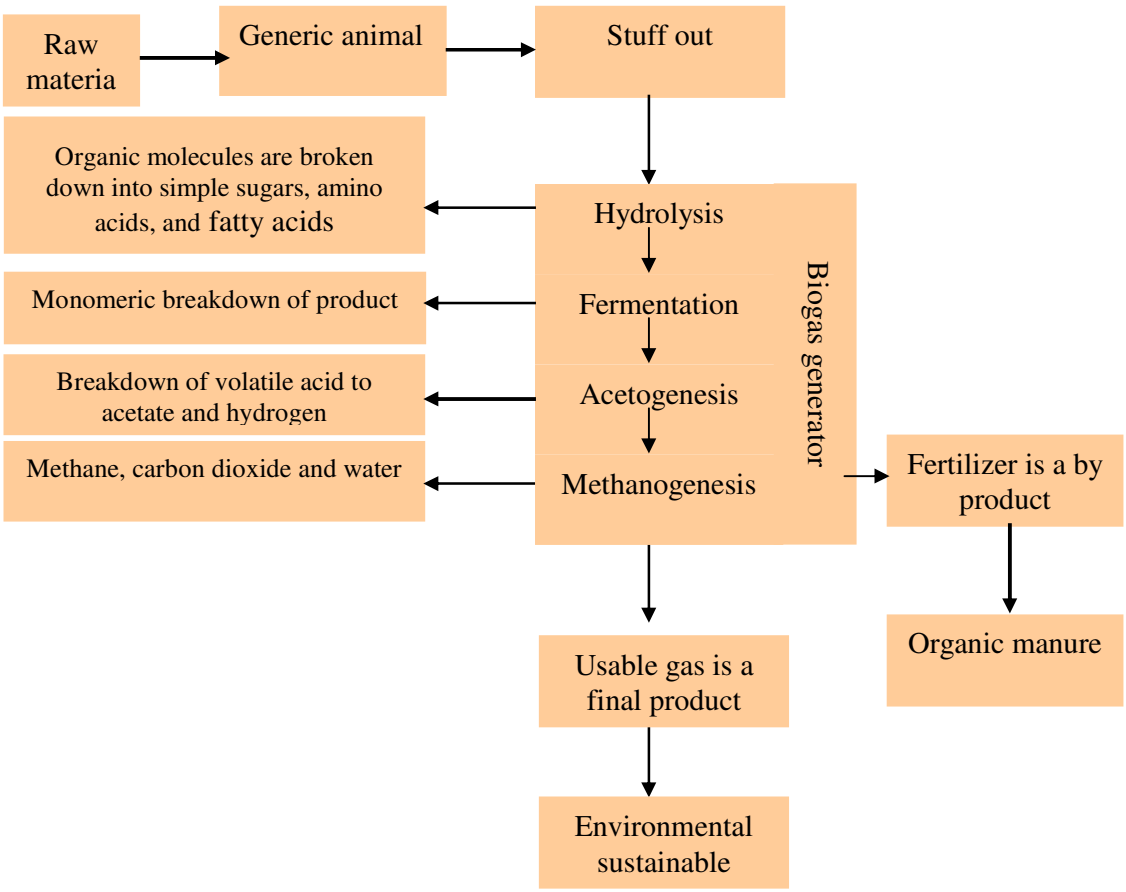
A.4.2. Type and category (ies) and technology/measure of the small-scale project activity:

The project activity is developed under small scale category of Gold Standard (GS). GS VER methodology ***"Indicative programme, baseline, and monitoring methodology for Small Scale Biodigesters Voluntary Gold Standard"*** is be applicable for the project activity.

Technology

As described above project activity involves bundling of household bio-digesters with Fixed –Dome Digester technology installed in rural areas of Kerala and Madhya Pradesh. The "feed" is fed into the digester via the inlet pipe and undergoes digestion in the digestion chamber. Anaerobic digestion takes place in the biodigesters in which microorganisms break down biodegradable material in the absence of oxygen. This process produces methane (CH_4) rich biogas, which serves as a substitute of non-renewable biomass for cooking applications. In addition, the nutrient rich solids left in the digester can be used as fertilizer which enriches soil with essential nutrients.

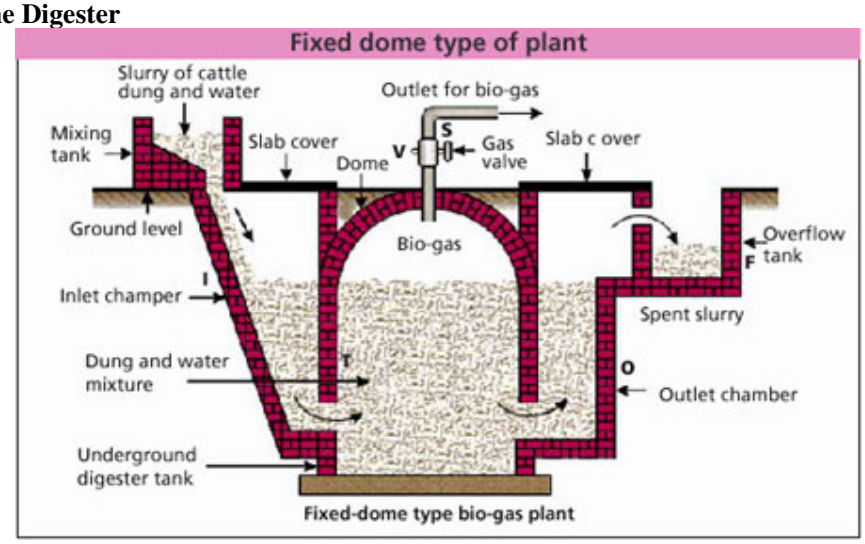
Stages of Anaerobic Digestion



Design of Biogas Digesters

The project activity involves the installation of Fixed-Dome digesters. Fixed-Dome biodigesters consists of one lower segment (digester) and a hemisphere over it (gas holder). The mixing tank is connected to the digester by cement pipe. Through the outlet hole provided in the digester, the slurry is pushed into the outlet tank.

Fixed Dome Digester



A.4.3 Estimated amount of emission reductions over the chosen crediting period:

Year	Annual estimation of emission reductions in tonnes of CO_2e
September 2009- August 2010*	24170
September 2010- August 2011	24170
September 2011- August 2012	24170
September 2012- August 2013	24170
September 2013- August 2014	24170
September 2014- August 2015	24170
September 2015- August 2016	24170
September 2016- August 2017	24170
September 2017- August 2018	24170
September 2018- August 2019	24170
Total emission reductions (tonnes of CO_2 e)	**241700**
Total number of crediting years	10
Annual average over the crediting period of estimated reductions (tonnes of CO_2e)	**24170**

*Since project activity is retroactive, as per Gold Standard Rules and Procedures Updates and Clarifications dated December 17th 2007, Retroactive crediting for all projects submitting documentation (GS Validation report) after October 31st 2007 is only possible for a maximum of two years prior to the date of registration to the Gold Standard

A.4.4. Public funding of the small-scale project activity:

No public funding of any kind is applicable for the project activity.

A.4.5. Confirmation that the small-scale project activity is not a debundled component of a large scale project activity:

This proposed small-scale project activity is not a de-bundled component of a large project activity as there is no registered small-scale GS VER project activity or a request for registration by another small scale project activity:

- By the same project participants;
- In the same project category and technology/measure; and
- Registered within the previous 2 years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closet point

Project activity cannot be considered as a de bundled component of large project activity as this is the first GS VER project activity by the project participant before this project activity project participant project participant has not registered any other CDM /VER project activity[2]. So none of the parameters given above is applicable to the project activity hence cannot be considered as de bundled component.

[2] Undertaking given by Project Participant

SECTION B. Application of a baseline and monitoring methodology

B.1. Title and reference of the approved baseline and monitoring methodology applied to the small-scale project activity:

Gold standard VER methodology "***Indicative programme, baseline, and monitoring methodology for Small Scale Biodigesters Voluntary Gold Standard***" will be applicable for the project activity Version 1

B.2 Justification of the choice of the project category:

Justification for the choice of methodology is given below table:

Criterion	Conditions	Applicability
1	This methodology is applicable to the project involving the implementation of biodigesters in households within the project's boundaries.	Project activity involves installation of biodigesters in the rural households of Kerala and Madhya Pradesh.
2	The project activity is implemented by a project coordinator who acts as the project participant. The individual households will not act as project participants.	INSEDA (project participant) will act as bundling agency and will bundle all the household biogas plants. Individual households have signed an agreement with the respective state NGOs and will not act as project participant.
3	The biodigesters programme promotes the wide-scale use of biogas as substitute for wood, agricultural residues, animal dung and fossil fuels that are presently used for the cooking, space heating and lighting needs of most rural households.	As per survey in both the states firewood was utilized to suffice domestic needs. In the project activity installation of bio-digesters in rural areas will replace firewood [3]which would have been utilized in the absence of the project activity.
4	The methodology applies to project with biodigesters with a maximum total biodigester volume of 20 m^3	As per the detailed list of plants of 4265 plants in Kerala and Madhya Pradesh, size of the biodigesters installed are 1m^3 , 2 m^3, 3 m^3, 4 m^3 and 6 m^3, I[4]n both the states there is no biodigester installation more than 20 m^3.
5	The biodigesters in the programme are not included in another CDM or voluntary market project, (i.e. no double counting takes place).	INSEDA has an agreement with its state NGO and state NGOs have an agreement with farmers where by farmers have transferred their rights to state NGOs for claiming carbon credits. Therefore bio digesters installed in the project activity

[3] As per survey conducted in both states

[4] As per the database of 4265 plants in which capacities varies from 1m^3 to 6m^3

		are/will not include in another CDM or voluntary market project[5].
6	If more than one climate zone is included in the project, the project should make a distinction per climate zone.	Kerala has equatorial tropic climate also known as tropical rainforest climate[6] Madhya Pradesh has sub tropical climate[7]. Since there are two climatic zone involved in the project activity, emission reductions and monitoring will be done separately for each climate zone

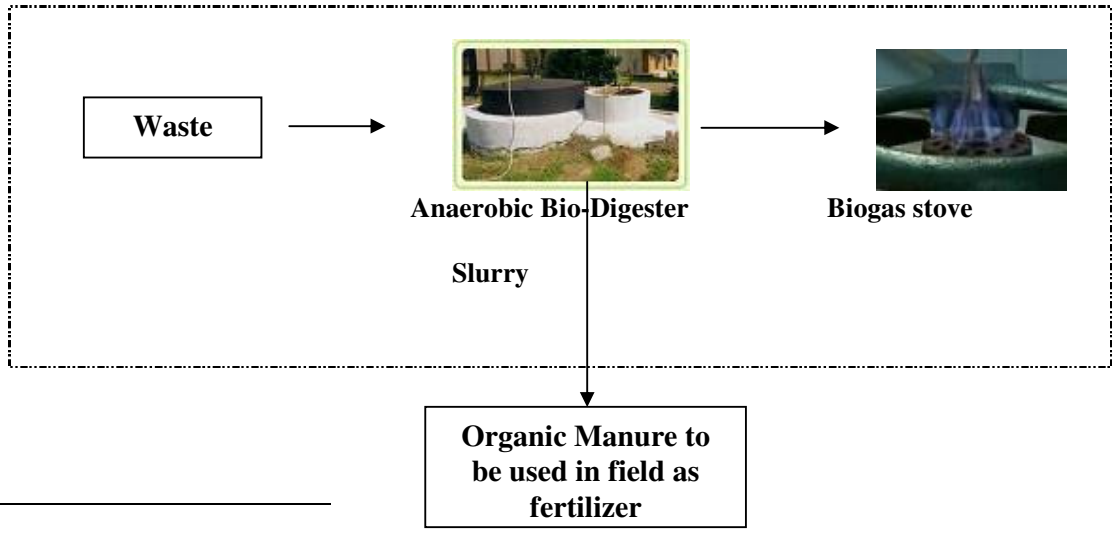
B.3. Description of the project boundary:

As per ***"Indicative programme, baseline, and monitoring methodology for Small Scale Biodigesters Voluntary Gold Standard"*** methodology the project boundary is:

The physical, geographical site of the renewable energy generation delineates the project boundary.

Therefore, the project boundary encompasses the sum of all the 4265 physical geographical sites of all individual biogas plants (digester system, pipe leading to the stove and the stove itself) realized by the project activity. The project boundary also includes the animal waste handling and storage. However, the baseline emissions from this source have been excluded to be conservative.

Boundary Diagram



[5] As per the undertaking given by the farmers

[6] http://en.wikipedia.org/wiki/Kerala

[7] http://en.wikipedia.org/wiki/Madhya_Pradesh

The greenhouse gases included in or excluded from the project boundary are shown in table below:

	Source	Gas	Included?	Justification / Explanation
Baseline	Thermal energy need	CO_2	Yes	The major source of emissions in the baseline due to burning of firewood
		CH_4	No	Excluded for simplification, this is conservative.
		N_2O	No	Not applicable for the project activity
	Animal waste handling and storage	CO_2	No	Not Availed, as baseline emissions from "feed" are not considered
		CH_4	No	Not Availed, as baseline emissions from "feed" are not considered
		N_2O	No	Not Availed, as baseline emissions from "feed" are not considered
Project activity	Direct emissions from the biodigester	CO_2	No	Excluded as CO_2 emissions from biogas incineration are CO_2 neutral
		CH_4	Yes	Emissions from physical leakage and incomplete combustion of biogas
		N_2O	No	Excluded for simplification

B.4. Description of baseline and its development:

As per ***Indicative programme, baseline, and monitoring methodology for Small Scale Biodigesters Voluntary Gold Standard***

The baseline scenario option: ***"The situation before implementation of the biodigesters (i.e. pre-project situation)"***

The proposed project activity involves the installation of anaerobic biodigesters for the production of biogas which will replace non renewable biomass, used as a fuel for household cooking purposes. Baseline emissions will be determined with the help of formula given below:

$BE_h = BE_{th,h} + BE_{aw,h}$

Where:

BE_h = Baseline emissions of household h (tCO_2e/yr)
$BE_{th,h}$ = Baseline emissions from fuel consumption for thermal energy needs of household h (tCO_2e/yr)
$BE_{aw,h}$ = Baseline emissions from animal waste handling of household h (tCO_2e/yr)

In the subject project activity, baseline emissions from "feed" are not considered therefore emissions from replacement of non-renewable biomass will be taken into account. As per section 4.1 of Gold standard methodology, ***Baseline emissions from fuel consumption for thermal energy demand*** can

be determined by collecting questionnaires from households participated in project activity to determine pre project situation.
The following steps are followed to determine baseline emissions from thermal energy demand:

1. Determine baseline emissions from fuel consumption
2. Adjust baseline emissions for the share of non-renewable biomass

Fossil fuel and biomass use was determined through surveys at the household, which were held in the sample of total population. In Kerala, survey was done in Ernakulum, Kottayam and Kasargod as these districts were having, size of plants ranging from 1 m^3 to 6 m^3. Similarly in Madhya Pradesh, survey was done in Balaghat, Betul and Chinndwara as these districts having, size of plants from 2 m^3 to 6 m^3.

To calculate the baseline emissions the mean and standard deviation of household project CO_2 emissions from fuel consumption will be calculated with the help of formulae given below:

$$BE_{th,h,option1} = \Sigma\left(\left(F_{i,bl,h}\right) NCV_i \cdot EF_{CO2i}\right)$$

Where:

$BE_{th,h,\ option1}$ = The baseline emissions used to meet the thermal energy need of one household

$F_{i,bl,h}$ = The total amount of fuel i in the baseline situation (mass or volume) of one household

NCV_i = The net calorific value (energy content) per mass or volume unit of a fuel i

$EF_{CO2,i}$ = The CO_2 emission factor per unit of energy of the fuel i

The mean of household baseline CO_2 emission is calculated as follows:

$$\mu BE = \frac{\sum BE_h}{n_{bl}}$$

Where:

μBE = Mean of CO_2 emission of households included in the baseline sample group

BE_h = The amount of CO_2 emission in household h included in the baseline sample group in the baseline situation

nbl = Total number of households included in the baseline sample group

The standard deviation of CO_2 emission in the baseline situation is calculated as follows:

$$\sigma_{BE,th} = \sqrt{\frac{\sum \left(BE_{th,h} - \mu BE_{th}\right)^2}{n_{bl} - 1}}$$

Where:

$\sigma_{BE,th}$ = Standard deviation of CO_2 emission in the baseline situation

μBE_{th} = Mean of CO_2 emission of households included in the baseline sample group

$BE_{th,h}$ = The amount of CO_2 emission in household h included in the baseline sample

group in the baseline situation

The total CO_2 emission in the pre-project situation can then be calculated as follows:

$$BE = n_{hh,y}\left(\mu_{BE} - z \cdot \frac{\sigma_{BE}}{\sqrt{n_{bl}}}\right)$$

Where:

BE	=	The total amount of CO_2 emission in the pre-project situation
$n_{hh,y}$	=	Total number of households participating in the program for the monitoring interval y
σ_{BE}	=	Standard deviation of CO_2 emission in the baseline situation
μ_{BE}	=	Mean of CO_2 emission of households included in the baseline sample group
n_{bl}	=	Total number of households included in the baseline sample group
z	=	Standard normal for a confidence level of 95% (1.96)

Project Emissions:

The project emissions involve emission from household fuel consumption after installation of the biodigester and emission from the biodigester in the statistically significant sampling group. Emission from the biodigester includes physical leakage of the biodigester and incomplete combustion of biogas, which are both calculated as a percentage of the produced methane.

$$PE_{y,h} = PE_{th,h,y} + PE_{biodigester,h,y}$$

Where:

$PE_{,y,h}$	=	Project emissions per household h in year y (tCO_2e/yr).
$PE_{,th,y,h}$	=	Project emissions from fuels used to meet the thermal energy need per household h in year y (tCO_2e/yr).
$PE_{,biodigester,h,y}$	=	Project emission from the biodigester per household h in year y (tCO_2e/yr).

During monitoring period amount of fossil fuel usage will be monitored and accordingly project emissions will be adjusted..
The physical leakage from anaerobic digesters is 5% of total methane production will be considered.

Apart from leakage, emission reductions will be considered from incomplete combustion of methane. This is accounted by the inclusion of the combustion efficiency ($\eta_{biogastove}$) of the biogas stove as 98%.

B.5. Description of how the anthropogenic emissions of GHG by sources are reduced below those that would have occurred in the absence of the registered small-scale CDM project activity:

A small-scale VER offset project activity is additional if the anthropogenic emissions of GHG by sources are reduced below those that would occur in the absence of the registered VER project activity and the project activity facing one or more barriers. Several barriers related to investment and technologies are described below and hinder development of the proposed VER activity.

Project additionality is demonstrated through use of the "Tool for the demonstration and assessment of additionality" version 05.2, as proposed in the EB 39.

Step1: Identification of alternatives to the project activity consistent with current laws and regulation

Sub-step Ia. Define alternatives to the project activity

Alternative	*Baseline Scenario*	*Justification*
1.	Firewood as fuel for Cooking Applications	In rural India, 75% of households continue to depend on firewood and chips for cooking[8]. According to "NSS Report No 527: Household Consumer Expenditure in India, 2006-07, page # 28", dependence on firewood and wood chips for cooking is high in Kerala, followed by Chhattisgarh and Madhya Pradesh. Utilization of fire wood has no additional investment for cooking. The use of traditional wood stoves represents the baseline situation in the local area[8] which requires no running cost. Also utilization of firewood[9] is cheap and available easily in the region. As per the survey report conducted in Kerala and Madhya Pradesh, the demand for firewood was partially met from the local forests and partially from buying on the local market.
2.	Kerosene as fuel for Cooking Applications	Kerosene is another alternative for cooking purposes in the rural household. Around 0.43 liters would be needed per day,[10] thus it is not feasible for the targeted users in this project activity to use kerosene. Kerosene can be used as a fuel for cooking but the cost of kerosene is around INR 9.5/litre[11] in Kerala & INR 8.86 – 9.97/litre[12] in Madhya Pradesh in the ration shop (subsidized by the government) and around Rs.20.00/litre in the open market. Each family requires at least minimum 0.43 litre[13] of kerosene per day and two litres of kerosene is provided to one family per month at subsidized rate. The additional kerosene will be purchased from the open market which is not affordable by the targeted families in the project activity.

[8] http://www.indiaenvironmentportal.org.in/files/527_final.pdf(report#511)

[8] As per the survey conducted in households of Kerala and M.P

[9] Fire wood contains 90% of non renewable biomass in Kerala & 86% of non renewable biomass in M.P.

[10] Household Fuel and Energy Use In Developing Countries- A Multi country Study by Rasmus Heltberg Oil and Gas Policy Division, The World Bank, page #23

[11] http://www.kerala.gov.in/dept_civilsupplies/details.htm

[12] http://www.mp.gov.in/mpfood/Pra-Prativeden-2006-07_add.pdf

[13] Household Fuel and Energy Use In Developing Countries- A Multi country Study by Rasmus Heltberg Oil and Gas Policy Division, The World Bank, page #23

		Being costlier, it still remains far from the reach of rural households with basic per day cost is around INR 16.6 & 28.33[14] in Kerala and M.P. respectively. Thus it is not feasible for the target users in this project activity to use kerosene. Hence, technically kerosene is removed as one of baseline scenario alternatives.
3.	Liquid Petroleum Gas (LPG) as fuel for Cooking Applications	LPG is another alternative which can be used as a fuel for domestic purposes but this is more expensive compare to firewood and kerosene. LPG cylinder having capacity 11.3 kg usually last for one month [15]when it is used for cooking only. At present situation the running cost of per cylinder is around Rs.258.62[16], which is not affordable for local people. Being costlier, it still remains far from the reach of rural households with basic per day revenue is around INR 16.6& 28.33[17] in Kerala and M.P. respectively.
4.	Proposed Project activity without considering CDM revenue	Since monthly income of the farmers is very low[18]. It is not possible for the farmers to build and maintain household biogas plant.

From the above three alternatives, it can concluded alternative 1 *(continuation of firewood for cooking applications)* is the viable baseline scenario for the subject project activity.

Sub-step I b. Enforcement of application laws and regulations
There is legal / regulatory requirement from the local state government level bodies, for biogas plants implementation. Also there is no regulation prohibit the non renewable biomass utilization.

Step 2: According to the tool, *Step 2 and/or Step 3 of the latest approved version of the "Tool for demonstration and assessment of additionality" shall be used to assess which of these alternatives should be excluded from further consideration (e.g. alternatives facing prohibitive barriers or those clearly economically unattractive).*

[14] Monthly income is INR 500/month as per ration card of the local person (in Kerala) and INR 850/month (in MP.) as per survey results.

[15] http://www.iei-asia.org/IEIBLR-LPG-IndianhomesReport.pdf(page#17)

[16] Based on monthly requirement and Purchase receipt of Indane gas INR 258.62 is required.

[17] Monthly income is INR 500/month as per ration card of the local person (in Kerala) and INR 850/month (in MP.) as per survey results.

[18] Monthly income is INR 500/month as per ration card of the local person (in Kerala) and INR 850/month (in MP.) as per survey results.

As the project activity was installed, barrier analysis was applied for addtionality justification.

Step3: Barrier Analysis
Implementation and operation of biogas based cooking systems without carbon revenue faces significant barriers. Below sections explains the in details with respect to technical barriers, investment barriers and institutional barriers.

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity:
Hereafter the relevant key factors are discussed and described below indicates how it influences the baseline development and GHG emissions at project activity level.

Investment Barrier
The proposed project activity is having high investments compared to alternatives and baseline scenarios. Cost of biogas plant construction is having high investment costs compared to LPG connection / kerosene utilization for cooking.

Sr. No	Type of Application	Cost / Installation
1.	Biogas Thermal Systems (Average cost of a 2 cum capacity Deenbandhu biogas plant on 2006)	Rs. 9,650 (Capital cost). Afterwards negligible operation costs[19]
2.	LPG Stove (Average cost is as on June 2006)	Rs, 1250 (Capital cost) and then Rs.258.62 as monthly filling of cylinder[20]
3.	Kerosene Stove (Average cost is as on July 2006)	Rs, 480[21] (Capital cost) and then Rs. 220 as monthly cost of kerosene
4.	Wood Stove (Average cost is as on July 2006)	0

Biogas based thermal energy generation is clean than other alternatives. The targeted families did not have access to the capital cost and moreover banks are not ready to provide loans for this type of project activities. This can be proven by the lower penetration of family type biogas plants in India[22]. The cost of different biogas plants is mentioned below:

[19]INSEDA provides free operation& maintenance cost to the farmers

[20] IOCL report& Based on monthly requirement and Purchase receipt of Indane gas INR 258.62 is required.

[21] Purchase receipt of Kerosene stove

[22]http://www.ecology.kee.hu/pdf/0604_015027.pdf

Sr. No	Model	Size of bio gas plants	Estimated cost of bio digester[23]
1	Deenbandhu Model	$2m^3$	Rs. 9,650
2	Deenbandhu Model	$3m^3$	Rs. 11,600
3	Deenbandhu Model	$4m^3$	Rs. 13,850
4	Deenbandhu Model	$6m^3$	Rs. 16,500

The cost of family type biogas plant is comparatively higher than the available alternatives and the same is not affordable to the target population. The target population is having a huge number of farmers with limited monthly income. Local NGOs financed the construction of the biogas plants with certain amount of sharing from the farmers[19].

In addition to the initial investment to make plant functional proper operation and maintenance is required. INSEDA and its member organizations will provide free of charge operation and maintenance including end user training to the biogas plant owners. There are nine biogas training centres across the country. These centres conduct four types of training programmes for masons, turnkey workers, staff engaged in biogas development and the users but a major chunk of the amount, over two third, goes towards salary and contingency of staff engaged in biogas activities and with a little amount left for training and R&D, the training centers find it difficult to make it successful[24].
There are several problems for which training is required. These aspects are described in the technological barrier section below:

Technology Barrier

In the baseline, households are handling normal *"chulahs" or wood stove chulahs* in which no maintenance is required. However for the subject project activity, trained persons are required for the proper operation and maintenance of the anaerobic biodigesters.

As per Evaluation study on National Project on Biogas Development, the main reasons for plants becoming non-functional are structural and operational problems, easy availability of other convenient fuels, chocking of inlet/outlet, corrosion/leakage in pipeline, scum formation in digester slurry and water accumulation in gas pipe. Some of the problems can be rectified by the beneficiaries themselves, provided they are trained properly about preventive maintenance.

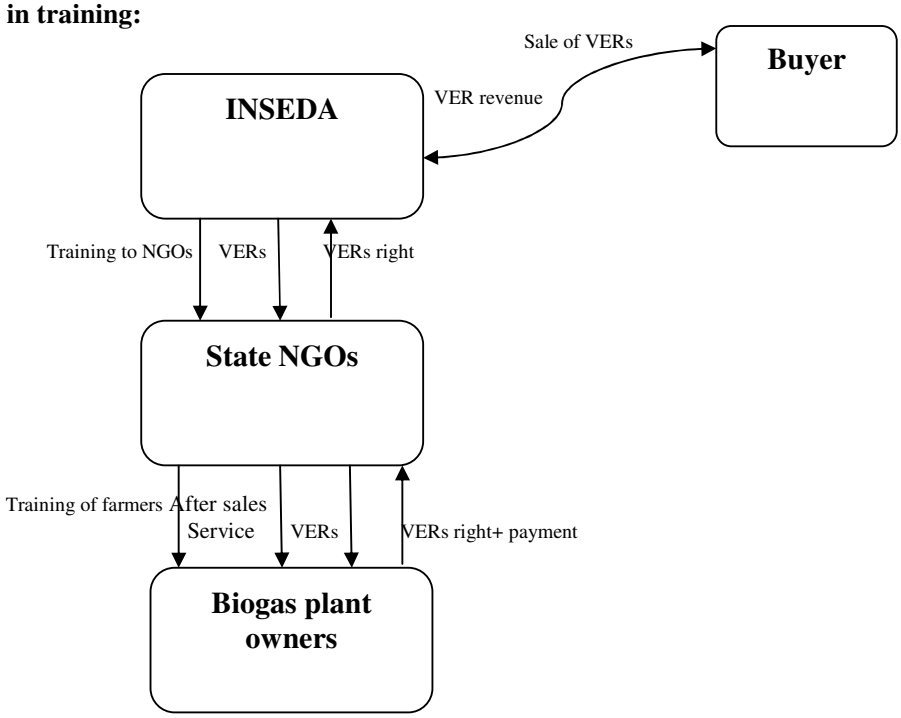
Considering all above points it can be concluded that training is an integral part of the successful operation of the anaerobic biodigesters. Since local people have no prior experience to operate and maintain the anaerobic biodigesters this involves a huge risk in the successful operation of the plant.

[23] As per audit report of the AKKPS ,2006

[19] Letter from Zila panchayat seoni stating AKKPS has provided financial aid to famers during construction of biogas plant.

[24] Evaluation study on National Project on Biogas Development, 2002(page #8)

Role of INSEDA in training:



Outcome of Step 3a: Identified barriers that may prevent one or more alternative scenarios to occur.

All the identified barriers will prevent the project activity without additional revenue through Carbon Credits. End users training & after sales service is an integral part in successful operation of the plant but due to limited number of training centre & funds the penetration of biogas plants in India is still very low. Considering low income of the farmers as stated above regular operation & maintenance of plant is difficult. Therefore, carbon revenue will act as support and catalyst for sustained operation of the plant and increasing penetration of the technology in the rural India. INSEDA will conduct various training programmes for masons, local technical staff in state NGOs and will be engaged in setting up of service centre at state level to provide free of cost service to the end users of biogas plant throughout the crediting period. Biogas plant owners will also get additional sharing from the sale of carbon credits. Summary of the outcome is represented in tabular form below:

Barrier Identified	Reasons	Purpose of Carbon revenue
Investment Barrier	• Project activity is having high investments compared to alternatives and baseline scenarios • Cost of biogas plant is very high as compared to mud stone chullah which does not include any cost • The targeted families did not have access to the capital cost • In addition to the initial investment to make plant functional proper operation and	Considering low income of the farmers as stated in above sections regular operation & maintenance of plant is difficult. Therefore, carbon revenue will act as support and catalyst for sustained operation of the plant.

	maintenance is required	
Technology barrier	• Trained persons are required for the proper operation and maintenance of the anaerobic biodigesters. • There are various reasons for plants becoming non-functional such as structural and operational problems, chocking of inlet/outlet, corrosion/leakage in pipeline, scum formation in digester slurry and water accumulation in gas pipe along with many others. Therefore, training becomes integral part of the successful operation of the anaerobic biodigesters	End users training & after sales service is an integral part in successful operation of the plant but due to limited number of training centre & funds the penetration of biogas plants in India is still very low. Therefore, INSEDA will conduct various training programmes for masons, local technical staff in state NGOs and will be engaged in setting up of service centre at state level to provide free of cost service to the end users of biogas plant throughout the crediting period. Thus, increasing penetration of the technology in the rural India

Sub-step 3 b: Show that the identified barriers would not prevent the implementation of at least one of the alternatives (except the proposed project activity):

Continuing usage of firewood will not be prevented by any barrier discussed above. Utilization of firewood as a fuel will not be hindered as it is economically attractive. Also, the cost of biodigesters is expensive and target populations were reluctant to install household anaerobic biodigesters because of high capex costs.

Step 4: Common practice analysis

Sub-step 4a: Analyze other activities similar to the proposed project activity:

The National Project on Biogas Development (NPBD) of the Ministry of Non-Conventional Energy Sources (MNES) was started in 1981-82 for the promotion of family type anaerobic biodigesters. The implicit objective of the programme was to reduce the use of non-renewable fuels and fuel wood and help poor and the disadvantaged who cannot own and operate family type anaerobic biodigesters. The project does not seem to have significant impact as only 7% households in the sample villages were found to be using biogas, often as a supplementary source of fuel[25]

India has got potential of 12 million biogas plants[26] but the total number of family size biogas plants installed is 3.44 million[27] or 7.5% are operational. Since firewood is obtained practically free of cost, there is no inducement to shift the energy source. Thus their dependence on firewood is likely to continue. Rural households belonging to the lower MPCE (Monthly Per Capita Expenditure) classes used more firewood & chips[28]

[25] Evaluation Study on National Project on Biogas Development, 2002;(page#9&12)

[26] Evaluation Study on National Project on Biogas Development, 2002;(page#10)

[27] Integrated EnergyPolicy Report, GoI planning commission Aug,2006, p-38

[28] http://www.mospi.gov.in/nsso_4aug2008/web/nsso/sdrd/findings%5C61R_1.0.pdf (report no.511:Energy Sources of Indian Households for Cooking)

Sub-step 4b: Discuss any similar Options that are occurring:

There are no similar options occurring.

Thus, it can be concluded that the lack of investment funds and operational problems are foremost barriers with biogas projects implementation & operation. In absence of the project activity these barriers would automatically, forced the farmers to continuation of the technology with higher emissions thru sustained utilization of firewood in the baseline scenario.

Chronology of events:

S.No	Event	Date	Reference
1	Board Resolution of AKKPS confirming consideration of carbon revenues for the project	26 December 2005	Copy of Board Resolution
2	Board Resolution of Gramudyog Mandal to confirm that Gramudyog in association with AKKPS will install biodigesters in Madhya Pradesh and will claim carbon revenues	27 December 2005	Copy of Board Resolution
3	Board Resolution of Sustainable Development Agency (SDA) confirming consideration of carbon revenues for installation of biodigesters in Kerala	2 February 2006	Copy of Board Resolution
4	Board Resolution	28th September2007	Copy of Board resolution
5	Discussion with consultant	1st January 2008	Email copy
6	Verified Emission reductions Purchase Agreement (VERPA) discussion with buyer	22nd February 2008	Email copy
7	VERPA signing	2nd May,2008	VERPA copy
8	Submission of PDD and passport to GS for pre feasibility assessment	16th February 2009	Pre feasibility report
9	Feedback from GS on pre feasibility assessment	08th September 2009	Pre feasibility report
10	Stakeholder meeting in Madhya Pradesh	12th October 2009	Local stakeholder consultation report
11	Stakeholder meeting in Kerala	14th October 2009	Local stakeholder consultation report
12	DoE Appointment	10th March 2010	Signed Validation Contract

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

As per GS VER methodology point "4.1.1 Baseline Option 1: baseline emission from thermal energy demand in the pre-project situation" is considered to calculate baseline emissions.

The following steps will be followed to determine baseline emissions from thermal energy demand:

1. Determine baseline emissions from fuel consumption
2. Adjust baseline emissions for the share of non-renewable biomass

Non renewable biomass use is determined through surveys conducted in both the states in sample group of districts, where anaerobic biodigesters are installed.

Determination of $F_{i, bl,h}$:

For Madhya Pradesh:

A third party survey was conducted by Environment and Energy Management Group, Bhopal to quantify the non renewable biomass used by the families. Under the 3rd party survey the quantity of firewood that is used for cooking was assessed in various districts of the project area. The details of the survey from the study are as follows:

Sr. No	District	Capacity in m^3	No of Biogas plants	Average saving of Non-renewable Firewood/ plant per month (kg)	Average saving of Renewable Firewood /plant per month (kg)	Total saving of Non renewable Firewood per month (kg)	Total saving of Renewable Firewood/plant per month (kg)
1	CHHINDWARA 65 Villages in Parasia, Chhindwara, Chorai, Bichhua and Amarwada blocks	6	19	596.6	31.4	11335.4	596.6
		4	51	397.1	20.9	20252.1	1065.9
		3	164	299.25	15.75	49077	2583
		2	95	199.5	10.5	18952.5	997.5
	Total		**329**			**99617**	**5243**
2	BALAGHAT 71 Villages in Baihar, Khairlanji,	6	1	589.95	31.05	589.95	31.05

	Waraseoni, Lalbarra and Balaghat blocks	4	15	397.1	20.9	5956.5	313.5
		3	158	294.5	15.5	46531	2449
		2	33	196.65	10.35	6489.45	341.55
	Total		**207**			**59566.9**	**3135.1**
3	BETUL 62 Villages in Betul, Multai, Shahpura, Chicholi and Ghodadongari blocks	6	5	598.5	31.5	2992.5	157.5
		4	16	398.05	20.95	6368.8	335.2
		3	93	304	16	28272	1488
		2	99	204.25	10.75	20220.75	1064.25
	Total		**213**			**57854.05**	**3044.95**

Based on the above, the resulting overall averages of all the three districts are:

Capacity (m^3)	**Non-renewable biomass(kg/month/plant)**	**Renewable biomass(kg/month/plant)**
2	200.13	10.53
3	299.25	15.75
4	397.41	20.91
6	595.02	31.31

Based on the survey report, non-renewable biomass consumption for other two districts i.e. Narsinghpur and Seoni [29] were also considered for respective capacities.

Hence, the amount of non-renewable biomass replaced by all the five districts is summarized below:

Capacity(m^3)	**Non-renewable biomass(kg/month/plant)**	**No. of Plants**	**Average non renewable biomass replaced (kg/month)**
2	200.13	461	92259.93
3	299.25	1320	395010
4	397.41	283	112467.03
6	595.02	58	34511.16
		Total	**634248.12**

[29] Number of plants for both districts are given in VER calculation sheet

Therefore, total non-renewable firewood replaced by Madhya Pradesh is 7610.9 tonnes/ year.

For Kerala:
Survey was conducted by Department of Bio-energy, Agricultural Engineering College & Research Institute, Tamilnadu Agricultural University to quantify the non -renewable biomass used by the families. The details of the survey from the study are as follows:

Sr. No	District	Capacity (m^3)	No of Biogas plants	Total Firewood Saved/ month	Average Firewood saved (kg/ month/ plant)	Average firewood saved/ m^3 (kg/month)
1	Ernakulum	1	17	2115	124.4118	124.4118
		2	29	7770	267.931	133.9655
		3	70	27975	399.6429	133.2143
		4	3	1540	513.3333	128.3333
		10	1	1210	1210	121
		15	1	1850	1850	123.3333
	Total		**121**	**42460**		
2	Kottayam	1	21	2630	125.2381	125.2381
		2	133	35220	264.812	132.406
		3	34	13605	400.1471	133.3824
		4	7	3625	517.8571	129.4643
		6	28	21410	764.6429	127.4405
		8	1	1000	1000	125
		10	3	3735	1245	124.5
		15	1	1800	1800	120
		20	1	2500	2500	125
	Total		**229**	**85525**		
3	Kasargod	1	1	125	125	125
		2	55	14580	265.0909	132.5455
		3	45	17890	397.5556	132.5185
		4	7	3650	521.4286	130.3571
		6	9	6885	765	127.5
		8	1	950	950	118.75
		12	1	1300	1300	108.3333
		15	10	17835	1783.5	118.9

	Total		**129**	**63215**		

Based on the above, the resulting overall averages of all the three districts are:

Capacity(m^3)	Non-renewable biomass(kg/month/plant)
1	124.87
2	265.29
3	399.12
4	518.52
6	764.72
8*	975
10*	1236.25
12*	1300
15*	1709.41
20*	2500[30]

Based on the survey report, non-renewable biomass consumption for other districts included in the project activity was also considered for respective capacities. Hence, the amount of non-renewable biomass replaced by all the districts is summarized below:

Sr. No	Capacity(m^3)	No. of Plants	Average non renewable biomass replaced (kg/month)
1	1	154	19229.28
2	2	1368	362916.72
3	3	522	208340.64
4	4	55	28518.6
5	6	44	33647.68
Total			**652653**

Therefore, total non-renewable biomass replaced by Kerala is 7831.8 tonnes/ year.

[30] Plants more than $6m^3$ are not considered in this project activity as these are established in commercial institutions

Step 2: Determining *f*NRB, y:

In Kerala:

Renewable Biomass from Forest:

(a) The total area under forests for Kerala is 1,082,000 ha. This area will remain as forests.
(b) These forests are classified as Tropical wet evergreen, Tropical semi evergreen, Tropical moist Deciduous, littoral & swamp, Tropical dry Deciduous, Tropical thorn and Montane wet temperate forest. Undertaking sustainable management practices on these land areas to ensure that there is no systematic decrease of carbon stocks, the sustainable rate of extraction is calculated as an average of all these forest and it is 0.33 t/ha/yr (in Kerala) (Ravindranath et al. 2001).
(c) Thus the renewable biomass component from the project area is Area (ha) x sustainable harvest (t/ha/yr) 1,082,000 x 0.33 = 361,697 t/year.

Renewable Biomass from Plantation:

(a) Misc. Tree crops & groves not included in net area sown
- The total area is 540,869 ha.
- Sustainable extraction rate is 2 t/ha/yr (Ravindranath *et al*, 2001)
- Total sustainable biomass is 652,917 ha x 2 t/ha/yr = 1,081,738 t/yr.

Renewable biomass from Culturable non-forest land:

- The total area is 1,795,131ha.
- The mean annual increment is 2.84% of the standing biomass (Shailaja and Sudha, 1987).
- Average Standing biomass/ha is calculated with the help of formula given below:
Biomass=Growing stock*0.8*100/69[31]. Growing stock values are considered from FSI Kerala, 2009 i.e. 192.77 (m.cum). Therefore, average standing biomass is 0.2235 tonnes.
- Mean annual increment is 0.0063 tonnes/hectare

- Sustainable extraction from trees on CNFA = 1,795,131x 0.0063 = 11,394.49 tonnes

The fuelwood requirement of the taluk is based on the number of rural households and proportion of families dependent on fuelwood. This is based on the survey conducted in both states and Housing Profile, Census of India respectively.
Thus summarizing the above steps, the table below shows the renewable biomass available as fuelwood. Thus the total non-renewable biomass used as fuelwood is 91%.

In Madhya Pradesh:

Renewable Biomass from Forest:

(a) The total area under forests for M.P. is 1,754,800 ha. This area will remain as forests.

[31] http://envfor.nic.in/nfap/appch03.html

(b) These forests are classified as Tropical moist Deciduous, Tropical dry Deciduous, and Tropical thorn forest. Undertaking sustainable management practices on these land areas to ensure that there is no systematic decrease of carbon stocks, the sustainable rate of extraction is calculated as an average of all these forest and it is 0.24 t/ha/yr (in Kerala) (Ravindranath et al. 2001).
(c) Thus the renewable biomass component from the project area is Area (ha) x sustainable harvest (t/ha/yr) 1,754,800 x 0.24 = 427,001 t/year.

Renewable Biomass from Plantation:

(a) Misc. Tree crops & groves not included in net area sown
- The total area is 19,000 ha.
- Sustainable extraction rate is 2 t/ha/yr (Ravindranath *et al*, 2001)
- Total sustainable biomass is 19,000 ha x 2 t/ha/yr = 38,000t/yr.

Renewable biomass from Culturable non-forest land:

- The total area is 2,724,000ha.
- The mean annual increment is 2.84% of the standing biomass (Shailaja and Sudha, 1987).
- Average Standing biomass/ha is calculated with the help of formula given below:
Biomass=Growing stock*0.8*100/69[31]. Growing stock values are considered from FSI M.P., 2009 i.e. 336.15 (m.cum). Therefore, average standing biomass is 0.39 tonnes.
- Mean annual increment is 0.011 tonnes/hectare

- Sustainable extraction from trees on CNFA = 2,724,000 x 0.011 = 30,150.84 tonnes

The fuelwood requirement of the taluk is based on the number of rural households and proportion of families dependent on fuelwood. This is based on the survey conducted in both states and Housing Profile, Census of India respectively.
Thus summarizing the above steps, the table below shows the renewable biomass available as fuelwood. Thus the total non-renewable biomass used as fuelwood is 86%.

Item	Kerala Value	MP Value	Unit	Source	Source
RENEWABLE BIOMASS IN THE PROJECT AREA					
Total Geographical Area	3,418,000	4,497,800	ha	Forest Survey India report,kerala 2009 (area of the districts included in the project activity are considered)	Forest Survey India report,M.P.2009(area of the districts included in the project activity are considered)
I. Renewable biomass from forests					
Forest Land	1,082,000	1,754,800	ha	Forest Survey India report,kerala 2009	Forest Survey India report,M.P.2009

[31] http://envfor.nic.in/nfap/appch03.html

Sustainable rate of fuelwood extraction from Kerala&M.P	0.33	0.24	t/ha/yr	Ravindranath et al. 2001	Ravindranath et al. 2001
Renewable biomass extraction from forests	361,697	427,001	t/yr	Area x sustainable rate of extraction	Area x sustainable rate of extraction
II. Renewable biomass from Plantation					
Total Plantation area including misc tree crops and groves	540,869	19,000	ha	Department of Economics&Statistics, Kerala	Forest Survey India report,M.P.2009
Sustainable extraction rate from plantations	2	2	t/ha/year	Ravindranath et al. 2001	Ravindranath et al. 2001
Sustainable extraction from plantations	1,081,738	38,000	tonnes	calculated	calculated
III. Renewable biomass from Culturable non-forest land					
Total Culturable Non-Forest land	1,795,131	2,724,000	ha	Calculated	Calculated
Mean Annual Increment	2.84%	2.84%	of standing Biomass	Shailaja and Sudha, 1987	Shailaja and Sudha, 1987
Average Standing biomass/ha	0.2235	0.39	tonnes	Calculated	Calculated
Mean Annual Increment	0.0063	0.011	tonnes/ha	Calculated	Calculated
Sustainable extraction from trees on CNFA	11,394.49	30,150.84	tonnes/ yr	Area x sustainable rate of extraction	Area x sustainable rate of extraction
Total Sustainable Biomass Available	1,454,830	495,152	tonnes/year	calculated	calculated
Fuelwood Requirement					
Population	5,373,660	1,329,185	Households	Census of India(http://www.censusindia.gov.in/Tables_Published/Basic_Data_Sheet.aspx)	Census of India

% of households reliant on biomass for cooking	84%	75.9%		Housing Profile,Census of India	Housing Profile,Census of India
Fuelwood requirement per HH for 1 m^3	1.5		tonnes/year	Based on survey conducted	Based on survey conducted
Fuelwood requirement per HH for 2 m^3	3.2	2.4			
Fuelwood requirement per HH for 3 m^3	4.8	3.6			
Fuelwood requirement per HH for 4 m^3	6.2	4.8			
Fuelwood requirement per HH for 6m^3	9.2	7.1			
Weighted Average	**3.7**	**3.6**			
Total fuelwood requirement	16,485,537	3,618,447	tonnes/year	calculated	calculated
Availability ratio	0.088	0.137		calculated	calculated
NRB	**91%**	**86%**		calc	calc

As per above calculations it can be considered that Non renewable biomass percentage in Kerala is 91% and in Madhya Pradesh it is 86%.

Baseline emissions will be calculated as per the formulae given below:

$$BE_{th,h,option1} = \Sigma\left(\left(F_{i,bl,h}\right) \cdot NCV_i \cdot EF_{CO2i}\right)$$

Where:

$BE_{th,h,option1}$	=	The baseline emissions used to meet the thermal energy need of one household
$F_{i,bl,h}$	=	The total amount of fuel i in the baseline situation (mass or volume) of one household
NCV_i	=	The net calorific value (energy content) per mass or volume unit of a fuel i
$EF_{CO2,i}$	=	The CO_2 emission factor per unit of energy of the fuel

The mean of household baseline CO_2 emission is calculated as follows:

$$\mu BE = \frac{\sum BE_h}{n_{bl}}$$

Where:

µBE	=	Mean of CO_2 emission of households included in the baseline sample group
BEh	=	The amount of CO2 emission in household h included in the baseline sample group in the baseline situation
nbl	=	Total number of households included in the baseline sample group

The standard deviation of CO_2 emission in the baseline situation is calculated as follows:

$$\sigma_{BE,th} = \sqrt{\frac{\sum \left(BE_{th,h} - \mu BE_{th}\right)^2}{n_{bl} - 1}}$$

Where:

$\sigma_{BE,th}$	=	Standard deviation of CO_2 emission in the baseline situation
μBE_{th}	=	Mean of CO_2 emission of households included in the baseline sample group
$BE_{th,}$	=	The amount of CO_2 emission in household h included in the baseline sample group in the baseline situation
n_{bl}	=	The amount of CO_2 emission in household h included in the baseline sample group in the baseline situation

The total CO_2 emission in the pre-project situation can then be calculated as follows:

$$BE = n_{hh,y}\left(\mu_{BE} - z \cdot \frac{\sigma_{BE}}{\sqrt{n_{bl}}}\right)$$ Where:

BE = The total amount of CO_2 emission in the pre-project situation
$n_{hh,y}$ = Total number of households participating in the program for the monitoring interval
σ_{BE} = Standard deviation of CO_2 emission in the baseline situation
μ_{BE} = Mean of CO_2 emission of households included in the baseline sample group
n_{bl} = Total number of households included in the baseline sample group
z = Standard normal for a confidence level of 95% (1.96)

Project Emissions:
As per GS VER biodigester methodology, project emissions will be the emission from household fuel consumption after installation of the biodigester and emission from the biodigester in the statistically significant sampling group. Emission from the biodigester includes physical leakage of the biodigester and incomplete combustion of biogas, which are both calculated as a percentage of the produced methane.

Overall project emissions will be calculated based on the below equation.

$$PE_{y,h} = PE_{th,h,y} + PE_{biodigester,h,y}$$

$PE_{y,h}$ = Project emissions per household h in year y (tCO_2e/yr)
$PE_{th,h,y}$ = Project emissions from fuels used to meet the thermal energy need per household h in
$PE_{biodigester,h,y}$ = Project emission from the biodigester per household h in year y (tCO_2e/yr)

$$PE_{th,h,y} = \Sigma\left(\left(F_{i,pj,y}\right) NCV_i \cdot EF_{CO2i}\right)$$

$PE_{th,h,y}$ = Project emissions from fuels used to meet the thermal energy need per household h in year y (tCO_2e/yr)
$F_{i,pj,y}$ = The total amount of fuel i in the project situation (mass or volume) per household in year y.
NCV_i = The net calorific value (energy content) per mass or volume unit of a fuel *i*
$EFCO_{2,i}$ = The CO_2 emission factor per unit of energy of the fuel *i*

$$PE_{biodigester,y} = \sum (LC_{T,h,y} \cdot EF_T) \cdot PL_y + \sum (LC_{T,h,y} \cdot EF_T) \cdot (1 - \eta_{biogastove})(1 - PL_y)$$

Where:
$LC_{T,h,y}$ = Number of animals of livestock category T in year y in household h.
EF_T = Annual CH_4 emission factor for livestock category *T*, (tCH_4 animal^{-1} yr^{-1}).
PL = Physical Leakage of the biodigester in year y (%).
$\eta_{biogastove}$ = Combustion efficiency of the most commonly used type of biogas stove.

EF_T is estimated using the IPCC TIER 2 approach. Formula (12) of methodology needs to be applied for the situation of the biodigester in the project situation.,

The physical leakage (PL) of the biodigester system has been considered as 5%.

Apart from leakage, also incomplete combustion results in the emission of methane to the atmosphere. This is accounted for by the inclusion of the combustion efficiency (ηbiogastove) of the most commonly used type of biogas stove. This figure can be obtained form literature or a default value of 98% can be applied.

$$EF_{(T)} = VS_{(T)} \cdot 365 \cdot GWP_{CH4} \left[Bo_{(T)} \cdot 0.67 kg/m^3 \cdot \sum_k \frac{MCF_{BL,k}}{100} \cdot MS_{(T,k)} \right]$$

Where:

$EF_{(T)}$ = annual CH_4 emission factor for livestock category *T*, $tCO_2eq\ animal^{-1}\ yr^{-1}$

$VS_{(T)}$ = daily volatile solid excreted for livestock category *T*, kg dry matter $animal^{-1}$ day-1

365 = basis for calculating annual VS production, days yr^{-1}

GWP_{CH4} = Global Warming Potential (GWP) of methane

$Bo_{(T)}$ = maximum methane producing capacity for manure produced by livestock category *T*, $m^3CH_4\ kg^{-1}$of VS excreted

0.00067 = conversion factor of m^3 CH_4 to tonne CH_4

MCF = methane conversion factors for the animal waste handling system in the project situation by climate zone *k*, %

$MS_{(T,S,k)}$ = fraction of livestock category *T*'s manure treated in the animal waste management system, in climate region *k*, dimensionless

If country-specific data are available for only a portion of these variables, project participants must calculate country-specific emission factors, using the data in Tables 10A-4 through 10A-9 from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories to fill gaps

Default methane conversion factors (MCFs) are provided in Table 10.17 from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for different manure management systems and by annual average temperatures.

Leakage

No significant sources of leakage are identified.

Emission reductions:

ERy = BE – PEy

B.6.2. Data and parameters that are available at validation:

Data / Parameter:	**By**
Data unit:	Tonnes/year
Description:	Total amount of biomass substituted
Source of data used:	Survey
Value applied:	15442.77

Justification of the choice of data or description of measurement methods and procedures actually applied :	Survey was conducted in both the States to know the firewood consumption pattern In Kerala, Department of Bio-energy, Agricultural Engineering College & Research Institute, Tamilnadu Agricultural University conducted the survey and submitted the final report on 27th April, 2010. As per the report, total biomass substituted is 7831.8 tonnes/year In Madhya Pradesh, Environment and Energy Management Group, Bhopal and submitted final report on 10th June, 2010. As per the report, total biomass substituted is 7610.9 tonnes/ year
Any comment:	NA

Data / Parameter:	***f*NRB, y**
Data unit:	%
Description:	Fraction of Non Renewable Biomass
Source of data used:	Calculated
Value applied:	Kerala- 91% and Madhya Pradesh-86%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Fraction of Non-renewable biomass was calculated for both the states.[32]
Any comment:	Not Applicable

Data / Parameter:	**NCV_i**
Data unit:	TJ/tonne
Description:	Net Calorific Value of non-renewable biomass
Source of data used:	IPCC
Value applied:	0.0156
Justification of the choice of data or description of measurement methods and procedures actually applied :	Default Value obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories
Any comment:	Not Applicable

Data / Parameter:	**$EF_{CO2,i}$**
Data unit:	tCO_2/TJ
Description:	Emission factor of non-renewable biomass
Source of data used:	IPCC
Value applied:	112
Justification of the choice of data or description of measurement methods	Default Value obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories

[32] Calculation sheet

and procedures actually applied :	
Any comment:	Not Applicable

Data / Parameter:	MCF
Data unit:	%
Description:	Methane conversion factors for the animal waste handling system in the baseline situation by climate zone k
Source of data used:	Table 10.17 from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for different manure management systems and by annual average temperatures.
Value applied:	100%
Justification of the choice of data or description of measurement methods and procedures actually applied :	Most conservative default value obtained from 2006 IPCC Guidelines for National Greenhouse Gas Inventories has been considered for anaerobic biodigesters in project situation and for warm climatic zones since both states of Kerala and Madhya Pradesh fall in warm type of climatic zones. Average Annual Temperature of Kerala: 31.43°C[20] Average Annual Temperature of Madhya Pradesh: 29.1°C[21]
Any comment:	Not Applicable

Data / Parameter:	MS
Data unit:	dimensionless
Description:	Fraction of livestock category T's manure treated in the animal waste management system, in climate region k
Source of data used:	
Value applied:	1
Justification of the choice of data or description of measurement methods and procedures actually applied :	Most conservative value taken considering 100% of waste will be treated in project situation.
Any comment:	Not Applicable

Data / Parameter:	**GWP_{CH4}**
Data unit:	tCO_2e/tCH_4
Description:	Global Warming Potential (GWP) of methane, valid for the relevant commitment period
Source of data used:	Decisions under UNFCCC and the Kyoto Protocol (a value of 21 is to be applied for the first commitment period of the Kyoto Protocol)
Value of data applied:	21
Justification of the choice of data or	Default Value has been considered

[20] http://www.weatherbase.com/weather/weather.php3?s=35334&refer=&cityname=Cochin-India

[21] http://www.weatherbase.com/weather/weather.php3?s=76624&refer=&cityname=Bhopal-India

description of measurement methods and procedures actually applied :	
Any comment:	Not Applicable

Data / Parameter:	PLy
Data unit:	%
Description:	Physical Leakage
Source of data used:	Expert Opinion
Value applied:	5
Justification of the choice of data or description of measurement methods and procedures actually applied :	Considered as 5% as given in expert opinion vide letter from Dr. Virendra Kumar Vijay, IIT Delhi
Any comment:	Not Applicable

Data / Parameter:	$\eta_{biogastove}$
Data unit:	%
Description:	Efficiency of biodigester
Source of data used:	Indicative programme, baseline, and monitoring methodology for Small Scale Biodigester, Voluntary Gold Standard
Value applied:	98
Justification of the choice of data or description of measurement methods and procedures actually applied :	Considered as 98% default value as per the methodology
Any comment:	Not Applicable

B.6.3 Ex-ante calculation of emission reductions:

As per GS methodology point 7- The project implementation and determination of emission reductions involves the following steps:

Step 1: Determination of the project area(s) i

Project area is divided in two climatic zones Kerala has equatorial tropic climate also known as tropical rainforest climate and Madhya Pradesh has sub tropical climate.
Districts involved in both the states are given in table below:

Districts in Kerala	**Districts in Madhya Pradesh**
Alappuzha	Balaghat

Ernakulum	Betul
Idukki	Chhindwara
Kannur	Seoni
Kasargodu	Narsinhpur
Kottayam	
Kozhikod	
Malapuram	
Palakkadu	
Pathanamthitta	
Thrissur	
Wayanad	

Step 2: Establishment of a project activity implementation plan

Project activity involves installation of Deenbandhu fixed dome type of plants with varying capacity from $1m^3$ to 6 m^3 in Kerala and M.P.
INSEDA and its member organizations planned to install 1500 plants each year from 2006 to 2008 in households and commercial institutions. In the project activity, plants built in between June 2006-Dec 2008 in the rural households of Kerala and M.P. is considered. Total plants included in project activity are 4265.
Local staffs of state NGOs hold informal meetings with the local villagers of Kerala and Madhya Pradesh and explained the benefits of biogas plant over firewood and motivated them to install biogas plants in their households. Interest free loan was offered to persuade large number of villagers irrespective of their income.

All the interested villagers approached state NGOs for the installation of biogas plants in their households. Only 10% of the total cost of biodigester was contributed by the biogas plant owners and remaining 90% was invested by State NGOs. Plants owners availed interest free loan for the period of 5 years on monthly installment based on their monthly income.

For monitoring, random sampling will be done with the help of Microsoft excel at 95% confidence level. Therefore, 100 samples will be selected from Kerala and 86 samples will be selected from Madhya Pradesh.

Step 3: Determination of the size of the project sample group

Stratified sampling will be done at 95% confidence level for each climatic zone. Therefore, 100 samples will be selected from Kerala and 86 samples will be selected from Madhya Pradesh.

For baseline emissions:

In Madhya Pradesh:

There are five districts Balaghat, Betul, Chinndwara, Seoni and Narsinghpur. Betul, Balaghat and Chindwara districts were considered randomly for the baseline survey and total population of 749 plants were surveyed. Even if we consider 95% confidence level and 5% margin error 326 household should be surveyed but being conservative 749 plants were surveyed.

In Kerala:

There are total 12 districts included in project activity. Kasargod, Kottayam and Ernakulum were considered for survey as these districts were having all capacities plants. Total 479 plants were surveyed along with plants having capacity more than $6m^3$ but these plants were installed in commercial institutions therefore these are not taken into consideration for emission calculations.

For project emissions:

During monitoring plants will be surveyed for use of fossil fuel considering 95% confidence level and 20% margin error, 100 in Kerala and 86 in M.P total 186 plants will be monitored. Plants will be selected randomly with the help of excel according to each capacity.

The physical leakage from anaerobic digesters is 5% of total methane production will be considered. Apart from leakage, emission reductions will be considered from incomplete combustion of methane. This is accounted by the inclusion of the combustion efficiency (ηbiogastove) of the biogas stove as 98%.

$$EF_{(T)} = VS_{(T)} \cdot 365 \cdot GWP_{CH4} \left[Bo_{(T)} \cdot 0.67 kg/m^3 \cdot \sum_k \frac{MCF_{BL,k}}{100} \cdot MS_{(T,k)} \right]$$

Parameter	Unit	Value	Reference
Daily volatile solid excreted for livestock category T (VS_T) for Dairy cows for Indian subcontinent	kg dry matter/ animal/ day	2.6	IPCC 2006 Guidelines
GWP_{CH4}	tCO_2/tCH_4	21	Default IPCC value
Maximum methane producing capacity for manure produced by livestock category T (Bo) for Dairy cows for Indian subcontinent	m^3CH_4 /kg of VS excreted	0.13	IPCC 2006 Guidelines
Methane conversion factors for the animal waste handling system in the baseline situation by climate zone k (MCF)	%	1.0	Table 10.17 from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories for different manure management systems and by annual average temperatures.
Fraction of livestock category T's manure treated in the animal waste management system, in climate region k (MS)	dimensionless	1	Most Conservative value has been considered
Emission Factor	tCO2e/animal/yr	1.74	

$$PE_{biodigester,y} = \sum (LC_{T,h,y} \cdot EF_T) \cdot PL_y + \sum (LC_{T,h,y} \cdot EF_T) \cdot (1 - \eta_{biogastove})(1 - PL_y)$$

Number of cows per household ($LC_{T,h,y}$)	2
Annual CH4 emission factor for livestock category T (EF_T)	1.74
Physical Leakage (PL_y)	5%
Efficiency of biodigester (ηbiogastove)	98%
Total number of households	4265
Project Emissions ($PE_{biodigester,y}$)	**1022**

Therefore total project emissions work out to be 1022 tCO_2e.

Step 4: Selection of the households to be included in the project sample group

The households will be selected randomly among the households that are participating in the project activity with the help of Microsoft excel. Plants will be selected randomly from Kerala and Madhya Pradesh separately according to their capacities at 95% confidence level. In Kerala, 100 plants will be selected comprising of all capacities ranging from $1m^3$ to 6 m^3 and in Madhya Pradesh 86 plants will be considered.

Step 5: Establishment of a project database

Database of all the 4265 plants has been established. This database contains all the information related to plant like biogas plant owner name, biogas plant identification number, year in which it was commissioned which as per the GS methodology point 7 page# 13.

Step 6: Collect baseline questionnaire

Survey was done in both the states in Kerala survey was done by Department of Bio-energy, Tamil Nadu Agricultural University, Coimbatore and in Madhya Pradesh Environment and Energy management group; Bhopal conducted the survey through questionnaire. During survey, villagers were asked regarding their pervious fuel consumption, amount of fuel usage etc. sample of questionnaire is given in Annex-5.

Baseline Emissions

The amount of firewood saved due to the project activity will be the baseline for calculating the emission reductions. The annual baseline emissions (ERy) in tCO_2, during each year of the crediting period are expressed as follows:

$$BE_{th,h,option1} = \Sigma\left(\left(F_{i,bl,h}\right) \cdot NCV_i \cdot EF_{CO2i}\right)$$

Where:

$BE_{th,h,}$ = The baseline emissions used to meet the thermal energy need of one household

option1

$F_{i,bl,h}$ = The total amount of fuel i in the baseline situation (mass or volume) of one household

NCV_i = The net calorific value (energy content) per mass or volume unit of a fuel i

$EF_{CO2,i}$ = The CO_2 emission factor per unit of energy of the fuel i.

Size of Biogas plants(m3)	**1**	**2**	**2**	**3**	**3**	**4**	**4**	**6**	**6**
$Fi_{,bl,h}$ (kg/month/plant)	114	242	173	364	258	473	343	697	514
$Fi_{,bl,h}$ (tonnes/annum)	1.37	3	2	4	3	6	4	8	6
NCV_i(TJ/tonnes)	0.0156	0.0156	0.0156	0.0156	0.0156	0.0156	0.0156	0.0156	0.0156
$EF_{CO2i(tCO2/tJ)}$	112	112	112	112	112	112	112	112	112
ERy (per plant)	2.39	5	3.62	8	5	10	7	15	11
Total No.of plants	154	1,368	461	522	1,320	55	283	44	58
$ER_{y\ tCO2}$	368	6,930	1,670	3,981	7,149	546	2,035	643	625
$BE_{th,h}$	**23025**								

Step 7: Perform project questionnaire

Similarly, survey will be done in both the states during monitoring to calculate project emissions.

Step 8: Calculation of the mean and standard deviation of project and baseline emissions

To assess the baseline, survey method was deployed with option (b) 'survey in sample of the total population'. The calculation of baseline emissions is based on the results of the questionnaire. After collecting the questionnaires at all households included in the sample group, the mean and standard deviation of household project CO_2 emissions from fuel consumption is calculated and these variables serves as the inputs for calculating total CO_2 emission from fuel consumption for the total number of households in the baseline scenario.

The calculations are based on the below equations:

Mean of household baseline CO_2 emissions:

$$\mu BE = \frac{\sum BE_h}{n_{bl}}$$

Where:

μBE = Mean of CO_2 emission of households included in the baseline sample group

BEh = The amount of CO_2 emission in household h included in the baseline sample group in the baseline situation

nbl = Total number of households included in the baseline sample group

Kerala:		
Size	**Number of households(n_{bl})**	**BE_h**
1	39	93
2	217	1099
3	149	1136
4	17	169
6	37	541
Total	**459**	**3038**

Therefore, Mean of CO_2 emission is 6.3

Madhya Pradesh:		
Size	**Number of households(nbl)**	**BEh**
2	227	822
3	415	2247
4	82	590
6	25	269
Total	**749**	**3929**

Therefore, Mean of CO_2 emission is 5.04

The standard deviation of CO_2 emission in the baseline situation is calculated as follows:

$$\sigma_{BE,th} = \sqrt{\frac{\sum \left(BE_{th,h} - \mu BE_{th}\right)^2}{n_{bl} - 1}}$$

Where:

$\sigma_{BE,th}$ = Standard deviation of CO_2 emission in the baseline situation

μBE_{th} = Mean of CO_2 emission of households included in the baseline sample group

$BE_{th,h}$ = The amount of CO_2 emission in household h included in the baseline sample group in the baseline situation

n_{bl} = Total number of households included in the baseline sample group

For Kerala:

Parameter	1m3	2m3	3m3	4m3	6m3
$BE_{th,h}$	2.3	5	7	10	14
μBE_{th}	6.3	6.3	6.3	6.3	6.3
n_{bl}-1	458	458	458	458	458
$\sigma_{BE,th}$	**0.458**				

For Madhya Pradesh:

Parameter	2m3	3m3	4m3	6m3
$BE_{th,h}$	3.48	5	7	10
μBE_{th}	5.04	5.04	5.04	5.04
n_{bl}-1	748	748	748.	748.
$\sigma_{BE,th}$	**0.222**			

The total CO_2 emission in the pre-project situation can then be calculated as follows:

$$BE = n_{hh,y}\left(\mu_{BE} - z \cdot \frac{\sigma_{BE}}{\sqrt{n_{bl}}}\right)$$

Where:

BE = The total amount of CO_2 emission in the pre-project situation

$n_{hh,y}$ = Total number of households participating in the program for the monitoring

interval y

σ_{BE} = Standard deviation of CO_2 emission in the baseline situation

μ_{BE} = Mean of CO_2 emission of households included in the baseline sample group

n_{bl} = Total number of households included in the baseline sample group

z = Standard normal for a confidence level of 95% (1.96)

Baseline emissions for Kerala are 14,096tCO_2/yr and for Madhya Pradesh is 11,096tCO_2/yr. Therefore, total baseline emissions are 25192tCO_2/yr

Step 9: Calculation of emission reductions

Hence, baseline emissions are 25192 tCO_2/ annum.
Project emissions are 1022 tCO_2/ yr.
$ER_y = BE_y - PE_y$

Emission reductions for the period September 2009-August 2010 and each year onwards till August 2019 are 24170 tCO_2/ yr

B.6.4 Summary of the ex-ante estimation of emission reductions:

Year	Estimation of project activity emissions (tCO_2 e)	Estimation of baseline emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
September 2009-August 2010	1022	25192	0	24170
September 2010-August 2011	1022	25192	0	24170
September 2011-August 2012	1022	25192	0	24170
September 2012-August 2013	1022	25192	0	24170
September 2013-August 2014	1022	25192	0	24170
September 2014-August 2015	1022	25192	0	24170
September 2015-August 2016	1022	25192	0	24170
September 2015-August 2017	1022	25192	0	24170
September 2017-August 2018	1022	25192	0	24170
September 2017-August 2019	1022	25192	0	24170
Total (tonnes of CO_2e)	**10220**	**251920**	**0**	**241700**

B.7 Application of a monitoring methodology and description of the monitoring plan:

B.7.1 Data and parameters monitored:

Data / Parameter:	ID 1 / $Area_i$
Data unit:	km^2
Description:	Project area
Source of data to be used:	Data regarding project will be collected from official websites of the Seoni, Balaghat, Betul, Chinndwara and Narsinghpur district. For Kerala- Forest Survey India report will be referred
Value of data	Madhya Pradesh-44986.55 Kerala-34180
Description of measurement methods and procedures to be applied:	Data was collected from official website of the Madhya Pradesh districts. Links are as follows: (http://www.chhindwara.nic.in/about.htm http://www.balaghat.nic.in/general%20information.pdf http://www.betul.nic.in/stat.htm http://seoni.nic.in/ http://narsinghpur.nic.in/geography.htm) Forest survey report of Kerala 2009 was referred for the values
QA/QC procedures to be applied:	Data will be monitored either through government published reports if available or through third party survey Monitoring frequency: Annual
Any comment:	

Data / Parameter:	ID 2 / n_{bl}
Data unit:	-
Description:	Number of households in baseline sample group
Source of data to be used:	INSEDA
Value of data	1228
Description of measurement methods and procedures to be applied:	***In Madhya Pradesh:*** There are five districts Balaghat, Betul, Chinndwara, Seoni & Narsinghpur included in the project activity. Betul, Balaghat and Chindwara districts were considered randomly for the baseline survey and total population of 749 plants were surveyed. ***In Kerala:*** There are total 12 districts included in project activity. Kasargod, Kottayam and Ernakulum were considered for survey as these districts were having all capacities plants. Total 479 plants were surveyed along with plants having capacity more than $6m^3$ but these plants were installed in commercial institutions therefore these are not taken into consideration for emission calculations.
QA/QC procedures to be applied:	Annual stratified sampling will be conducted
Any comment:	Considering 95% confidence level and 5% margin error 326 household

	should be surveyed but in both states total number of plants included in three districts were considered for survey and therefore in Kerala 479 plants were surveyed and in M.P. 749.

Data / Parameter:	**ID 3 / n_{pj}**
Data unit:	-
Description:	Number of households in project sample group
Source of data to be used:	INSEDA
Value of data	185
Description of measurement methods and procedures to be applied:	As per stratified sampling with 95% confidence level. In Kerala, 100 households will be sampled which are as follows(please refer annex-4):

Size(m^3)	**Number of samples**
1	21
2	24
3	23
4	17
6	16

Similarly in M.P.86will be sampled which are given below covering three districts of total 5 districts

Size(m^3)	**Number of samples**
2	23
3	24
4	22
6	17

QA/QC procedures to be applied:	Monitoring Frequency: Annual stratified sampling will be conducted.
Any comment:	

Data / Parameter:	**ID 5 / $n_{hh,y}$**
Data unit:	-
Description:	Total number of households participating in the programme in year y
Source of data to be used:	INSEDA
Value of data	4265
Description of measurement methods and procedures to be applied:	All households' details are included in a database and same will be available at the time of verification
QA/QC procedures to be applied:	Data will be monitored through ex post survey Monitoring frequency: Annual
Any comment:	

Data / Parameter:	**ID 6 / $F_{i,bl1}$**
Data unit:	tonnes/annum
Description:	Amount of firewood consumption in the baseline

Source of data to be used:	Survey was conducted in both the states by third party
Value of data	15442.7
Description of measurement methods and procedures to be applied:	Survey was conducted in both the states by third party to calculate amount of firewood consumed in the baseline situation. **In Kerala**, Department of Bio-energy, Agricultural Engineering College & Research Institute, Tamilnadu Agricultural University conducted the survey and submitted the final report on 27th April, 2010. As per the report, total biomass substituted is 7831.8 tonnes/year **In Madhya Pradesh**, Environment and Energy Management Group, Bhopal and submitted final report on 10th June, 2010. As per the report, total biomass substituted is 7610.9 tonnes/ year
QA/QC procedures to be applied:	Data will be monitored through ex post third party survey Monitoring frequency: Annual
Any comment:	

Data / Parameter:	**ID 8 / $F_{i,y,pj}$**
Data unit:	kg
Description:	Amount of fuel I consumption in the project in year y
Source of data to be used:	Obtained from field surveys
Value of data	
Description of measurement methods and procedures to be applied:	Value will be obtained from the survey conducted in each monitoring period in both states. Accordingly emissions reductions will be adjusted.
QA/QC procedures to be applied:	Data will be monitored through ex post third party survey Monitoring frequency: Annual
Any comment:	

Data / Parameter:	**ID 9 / I**
Data unit:	tons/year
Description:	Annual biomass increment on the project area i
Source of data to be used:	Obtained from field surveys
Value of data	Kerala-0.0063 , Madhya Pradesh-0.011
Description of measurement methods and procedures to be applied:	Third party field survey will be conducted in both the states to know the annual biomass increment.
QA/QC procedures to be applied:	Data will be monitored through ex post third party survey Monitoring frequency: Annual
Any comment:	

Data / Parameter:	**ID 10 / H**
Data unit:	tons/year
Description:	Annual biomass harvest on the project area i
Source of data to be used:	Obtained from field surveys

Value of data	Average fuel wood requirement in Kerala was 3.7 tonnes and in Madhya Pradesh it was 3.6 tonnes.
Description of measurement methods and procedures to be applied:	Third party field survey will be conducted in both the states to know the annual biomass harvest. Since, project activity involves installation of different types of sizes varying from 1 m^3 to 6 m^3 average of all the size was taken. Similarly, for M.P. average of $2m^3$, $3m^3$, $4m^3$ and $6m^3$ was taken.
QA/QC procedures to be applied:	Data will be monitored through ex post third party survey Monitoring frequency: Annual
Any comment:	

Monitoring of Sustainable Development Indicators

No		1
Indicator		Air Quality
Mitigation measure		-
Chosen parameter		Indoor pollution
Current situation of parameter		After installation of biogas plant level of indoor pollution has been decreased.
Estimation of baseline situation of parameter		Usage of firewood for cooking purpose causes indoor pollution and smoke In addition problems like asthma, lung cancer etc are also prominent.
Future project target for parameter		Proper functioning of biodigester plants will lead to significant reduction in indoor pollution and other health related problems.
Way of monitoring	How	Trained staff of respective state NGO's will check the functioning of biogas plants and will rectify if there is any problem with the working of biogas plant at earliest so as to ensure firewood is not used and level of indoor pollution is maintained.
	When	Once in six months trained staff will inspect the biogas plant. In case of emergency problems will be rectified within 24 hours.
	By who	Trained staff of respective state NGO's and same will be verified during third party survey conducted annually

No	2
Indicator	Livelihood of the poor
Mitigation measure	-
Chosen parameter	Number of population who can access to effective waste management system
Current situation of parameter	Post installation of biogas plants cow dung is effectively utilized.
Estimation of baseline situation of parameter	Before implementation of household biogas plant cow dung was left to decay without proper handling which causes bad odour in the nearby areas.
Future project target for parameter	Cow dung should be managed adequately by each household

Way of monitoring	How	Biogas plant owners will use cow dung in the biodigester to produce biogas. Slurry from biodigester will be used as organic manure and this will also help in reduction in usage of Urea and other chemical fertilizers
	When	Daily
	By who	Biogas plant owners and same will be verified during third party survey conducted annually

No		3
Indicator		Access to clean and affordable energy
Mitigation measure		-
Chosen parameter		Estimation of firewood consumption
Current situation of parameter		Biogas plant owners are not utilizing firewood to suffice their thermal needs.
Estimation of baseline situation of parameter		Firewood was used as primary fuel before installation of biogas plants.
Future project target for parameter		Utilizing biogas as primary fuel and avoiding usage of firewood
Way of monitoring	How	Trained persons will check biogas plants on regular basis. Proper functioning of biogas plant will lead to reduction in firewood significantly
	When	Biannual inspection will take place to ensure proper working of biogas plant and in case of emergency problem will be rectified within 24 hours.
	By who	Trained technical staff of NGOs and same will be verified during third party survey conducted annually

No		4
Indicator		Quantitative employment and income generation
Mitigation measure		-
Chosen parameter		Increase in level of income generation
Current situation of parameter		Implementation of the project activity leads to employment generation for the unemployed local villagers.
Estimation of baseline situation of parameter		Many villagers were unemployed.
Future project target for parameter		Increase in level of employment generation
Way of monitoring	How	Maintaining the household biodigester is an integral part of the project activity. Trained persons will be required to check biogas plants on regular basis. Local youth and unemployed villagers will be hired for proper operation and maintenance of the plant. This will increase level of employment and income generation.
	When	This will be continuous process throughout project activity.
	By who	Technical staff of NGOs will provide training and will be involved in recruitment of local villagers.Same will be verified during third party survey conducted annually

B.7.2 Description of the monitoring plan:

The monitoring of the project activity will be done by the local NGO present in the villages. The NGO members will be trained to maintain the biogas plants. Monitoring of biogas plants will be done as per monitoring plan given below to ensure that real and long term GHG reductions are taking place due to the project activity.

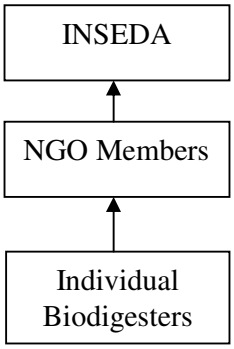
A representative sample of biodigesters will be selected in both Kerala and Madhya Pradesh as per Gold standard methodology step 3 of point 7. Random sampling will be done at 95% confidence level with the help of excel. Sample size will be total 186 plants out of 4265 plants (please refer Annex 4). In Kerala 100 plants will be sampled and in Madhya Pradesh 86 plants.
The selected biodigesters will be continuously monitored by the state NGO members and the compiled reports will be sent to INSEDA office once in six months. This data will be stored in both log books as well as electronically which will be made available to the DoE at the time of verification. If any biodigester is not working the same will be intimated to the NGO and action will be taken. All monitored data required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs, for this project activity, whichever occurs later.

Since emission reductions will be calculated based on questionnaires distributed amongst sampled household, third party survey will be carried out in both states monitoring parameters are given below and results of the survey will be provided to DoE.

Parameters to be monitored are:

1. Working of Biogas plants
2. Usage of fossil fuel along with biogas plant
3. Annual biomass increment
4. Annual biomass harvest
5. Sustainable development indicators as given in Gold standard Passport.

Figure below shows flow of information:



In case of failure:

As stated sample size is 186 plants which is 4% of the total population (4265 plants). Monitoring consist of annual check of 4% (186) plants selected randomly to ensure working of household biogas plants. If plants are found to have failed or are not running satisfactorily, another sample must be

taken of the same size, taken randomly. The sample shall also be checked for continued firewood usage. In case continuous firewood usage is observed for long period, the plant is deemed non-functional. Average of failures will be calculated from both samples and divided by whole population to give the failure rate in entire population. This failure rate shall be applied to the total expected greenhouse gas reductions and the emission reductions for the year reduced accordingly.

B.8	**Date of completion of the application of the baseline and monitoring methodology and the name of the responsible person(s)/entity(ies)**

Date: 1 October 2010
Integrated Sustainable Energy and Ecological Development Association (INSEDA)
First Floor, House No: C-37
Next to Car Life Centre, Jeevan Park, Pankha Road,
Uttam Nagar, New Delhi – 110059
Ph. No +91 92120 14905

SECTION C. Duration of the project activity / crediting period

C.1 Duration of the project activity:

C.1.1. Starting date of the project activity:

1/06/2006 ***(As per Gold standard Rules and Procedure dated December 17th 2007 Retroactive crediting for all projects submitting documentation (GS Validation report) after October 31st 2007 is only possible for a maximum of two years prior to the date of registration to the Gold Standard. The earliest start date for retroactive crediting is January 1st 2006)***

C.1.2. Expected operational lifetime of the project activity:

15 years 0 month

C.2 Choice of the crediting period and related information:

C.2.1. Renewable crediting period

Not Applicable

C.2.1.1. Starting date of the first crediting period:

Not Applicable

C.2.1.2. Length of the first crediting period:

Not Applicable

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

1/09/2009

C.2.2.2. Length:

10 years ***Retroactive crediting for all projects submitting documentation (GS Validation report) after October 31st 2007 is only possible for a maximum of two years prior* to the date of registration to the Gold Standard***

SECTION D. Environmental impacts

D.1. If required by the host Party, documentation on the analysis of the environmental impacts of the project activity:

The project activity does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India, 2006[34].

Hence, it is not required by the host party.

As per Gold standard, project activity should conform to host country requirements therefore EIA is not required for the project activity.

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D.2. If environmental impacts are considered significant by the project participants or the host Party, please provide conclusions and all references to support documentation of an environmental impact assessment undertaken in accordance with the procedures as required by the host Party:

The use of biogas from residential biodigesters has positive effects on the socio-economic and health conditions of the participating households as well as on local environment. There are no additional adverse environmental impacts identified from the project activity.
There is no significant impact identified due to the project activity. Furthermore, per Gold Standard norms an EIA is not required for the project activity since none of the Sustainable Development Indicator scores negative.

[34] http://envfor.nic.in/legis/eia/so1533.pdf;(LIST OF PROJECT OR ACTIVITIES REQUIRING PRIOR ENVIRONMENTAL CLEARANCE)

SECTION E. Stakeholders' comments

E.1. Brief description how comments by local stakeholders have been invited and compiled:

After getting pre-feasibility results, a stakeholder meeting was conducted in both the states Madhya Pradesh and Kerala on 12th October 2009 and 14th October 2009 respectively to intimate the local community about the project activity and the benefits on its implementation and to get their feedback about the proposed project.

The stakeholders were invited through an advertisement in the local news paper of the Seoni district and Kerala as well as personal invitations were sent to the local people.

All the local and international Gold Standard NGO supporters were invited through mails along with local NGOs, Panchayat members and local residents.

INSEDA representatives explained about their project activity and the benefits about the project. It was informed that reduction in emissions by implementing biodigesters will improve the ambient air quality of the houses. As per Gold Standard, a blind sustainable exercise was conducted after circulating a non-technical summary to the stakeholders. A separate questionnaire along with the evaluation form was also circulated to the stakeholders during the meeting.

E.2. Summary of the comments received:

After discussions about the project, the stakeholders were asked to raise their doubts and concerns of the proposed project activity. The comments can be summarized as positive and environmental friendliness due to the installation of biodigesters for thermal energy applications and Socio economic benefits from the project activity had also been appreciated. A more detailed description has been given in the local stakeholder consultation report.

E.3. Report on how due account was taken of any comments received:

No negative comments due to the project activity

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	Integrated Sustainable Energy and Ecological Development Association – INSEDA
Street/P.O.Box:	First Floor, House No: C-37
Building:	Next to Car Life Centre, Jeevan Park, Pankha Road, Uttam Nagar
City:	New Delhi
State/Region:	New Delhi
Postfix/ZIP:	110059
Country:	India
Telephone:	
FAX:	011- 2554 4905
E-Mail:	raymyles@bol.net.in
URL:	www.inseda.org, www.inseda.info
Represented by:	Mr. Raymond Myles
Title:	Secretary General-cum-chief executive
Salutation:	Mr.
Last Name:	Myles
Middle Name:	
First Name:	Raymond
Department:	
Mobile:	09212014905
Direct FAX:	
Direct tel:	011-6450 0730
Personal E-Mail:	ray.myles06@gmail.com

Organization:	First Climate AG
Street/P.O.Box:	Industriestrasse 10
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City:	
State/Region:	
Postfix/ZIP:	
Country:	Gernany
Telephone:	+49 6101 556 58 0
FAX:	+49 6101 556 58 77
E-Mail:	Martin.kruska@firstlcimate.com
URL:	
Represented by:	Mr. Martin Kruska
Title:	
Salutation:	Mr.
Last Name:	Kruska
Middle Name:	
First Name:	Martin
Department:	
Mobile:	

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Direct tel:	+49 6101 556 58 0
Personal E-Mail:	Martin.kruska@firstlcimate.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No Public Funding Involved In the Project Activity

Annex 3

BASELINE INFORMATION

Please refer to Section B. 4

Annex 4

MONITORING INFORMATION

The sampling plan to be followed for monitoring household anaerobic biodigesters is based on the calculation provided below. The sampling size is calculated considering 95% confidence level and 20% margin error[35]:

$$n_{min} = \frac{t^2_{crit,p} * S^2_y}{l^2_t + (S^2_y x \frac{t^2_{crit,p}}{N})}$$

Where,

n_{min}	=	Required minimum sample size
$\overline{y}$	=	the mean value of a variable
l^2_t	=	interval
p	=	designated probability
$t^2_{crit,p}$	=	is the t value corresponding to P
N	=	Number of anaerobic biodigesters
S^2_y	=	denotes the (true) population variance of y

Given values:

$t_{crit, 90\%=}$	=	1.96
cv	=	0.5
l^2_t	=	20%
N	=	Given in the table below

Given below number of samples for different capacities:

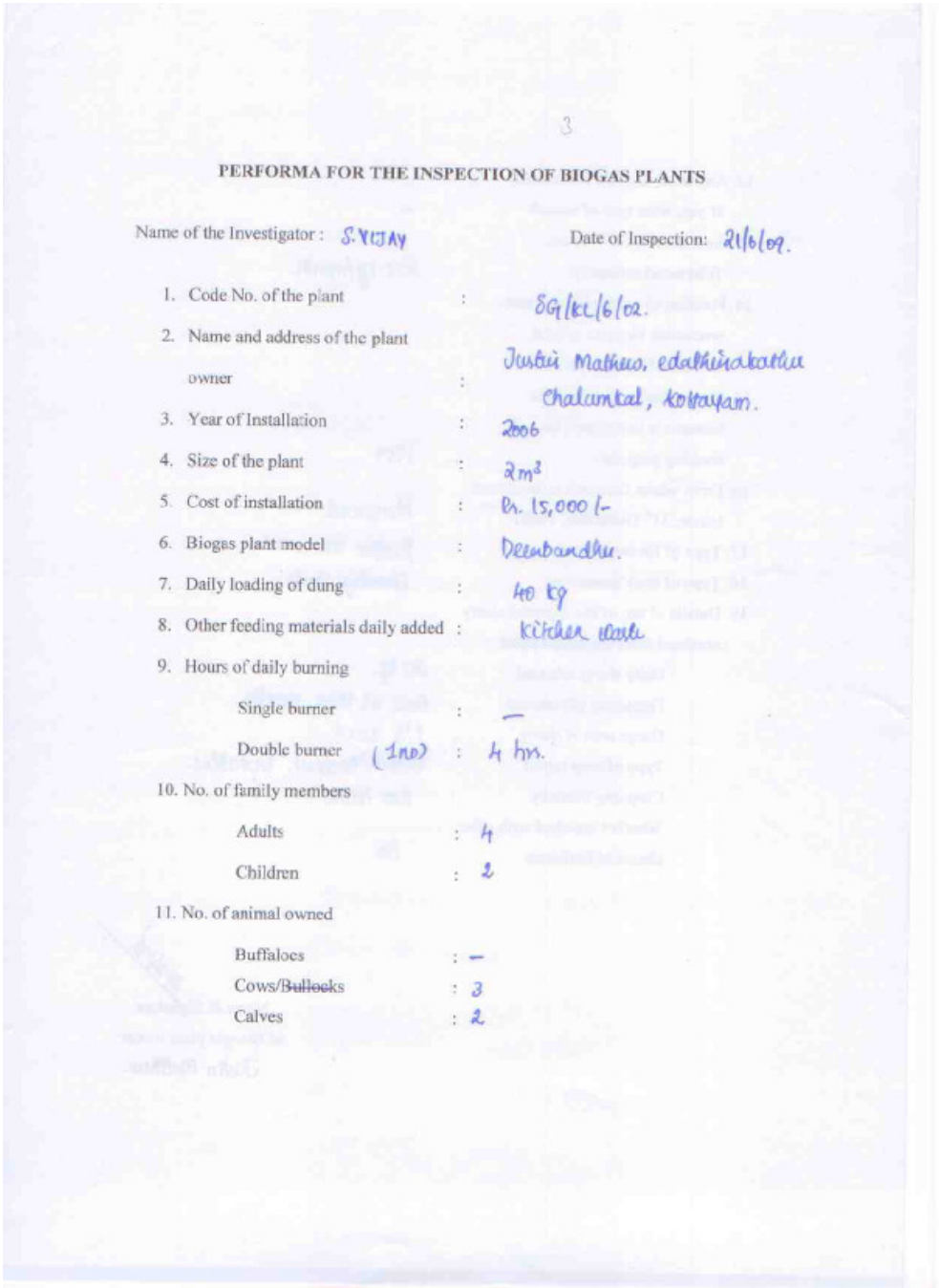
[35] http://cdm.unfccc.int/Panels/ssc_wg/meetings/020/ssc_020_an14.pdf

Sr. No	Capacity (m^3)	Number of plants
1	1	154
2	2	1836
3	3	1858
4	4	348
5	6	124
Total:		**4265**

Domestic Household biogas plants

State	**Kerala**					
Domestic Household biogas plants						
Capacity (m3)	1	2	3	4	6	
Number(N)	154	1368	522	55	44	
Biogas plants to be monitored as per sampling(n)	21	24	23	17	16	**100**
State	**M.P.**					
Domestic Household biogas plants						
Capacity (m3)	2	3	4	6		
Number(N)	461	1320	283	58		
Biogas plants to be monitored as per sampling(n)	23	24	22	17		**86**
Total Sample						**186**

Annex -5



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PERFORMA FOR THE INSPECTION OF BIOGAS PLANTS

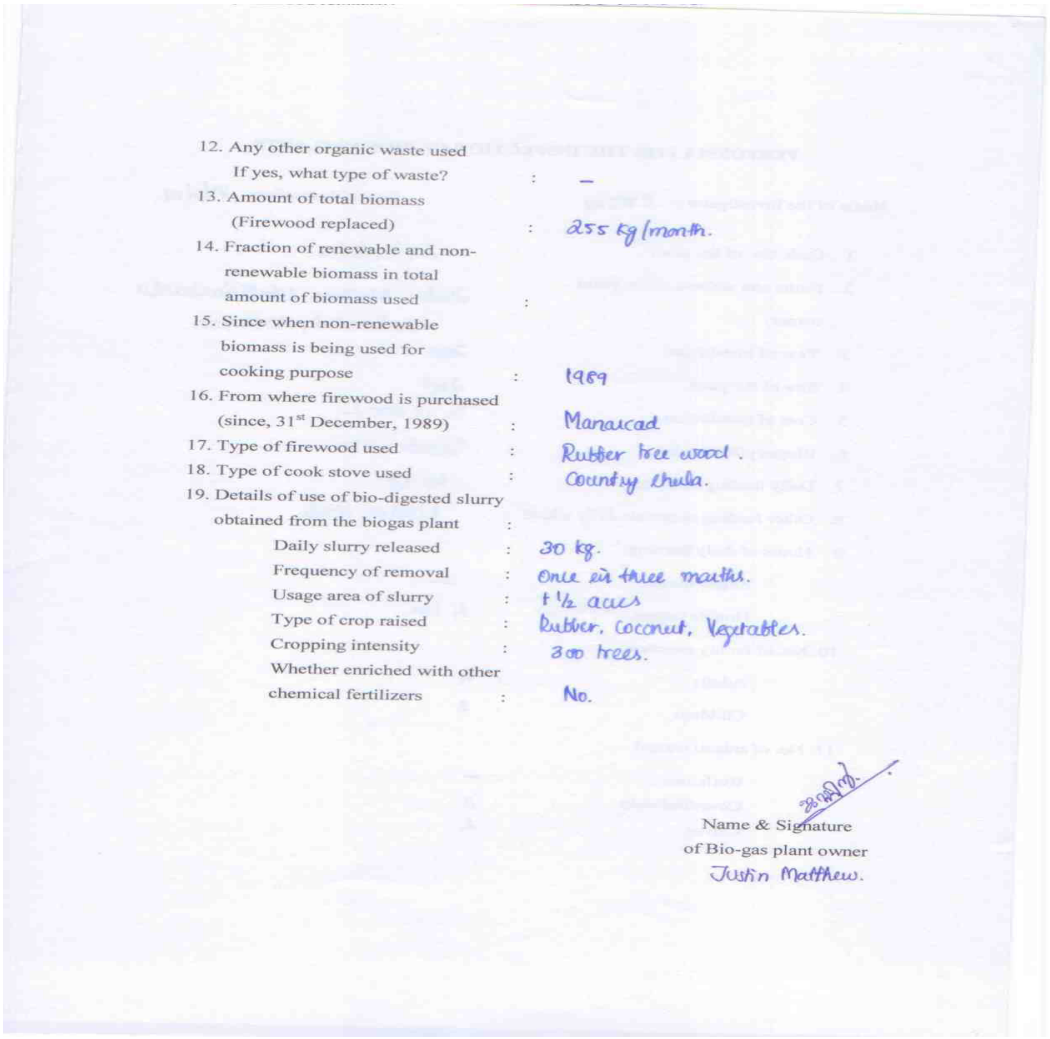
Name of the Investigator : S. VIJAY Date of Inspection: 21/6/09.

1. Code No. of the plant : SG/KL/6/02.
2. Name and address of the plant owner : Justin Mathew, edathiyakattu Chalumtal, Kottayam.
3. Year of Installation : 2006
4. Size of the plant : 2 m³
5. Cost of installation : Rs. 15,000 /-
6. Biogas plant model : Deenbandhu.
7. Daily loading of dung : 40 kg
8. Other feeding materials daily added : kitchen waste
9. Hours of daily burning
   - Single burner : —
   - Double burner (1no) : 4 hrs.
10. No. of family members
    - Adults : 4
    - Children : 2
11. No. of animal owned
    - Buffaloes : —
    - Cows/~~Bullocks~~ : 3
    - Calves : 2

Kerala						
	Domestic Household biogas plants					
Capacity (m3)	1	2	3	4	6	
Number(N)	154	1368	522	55	44	2143

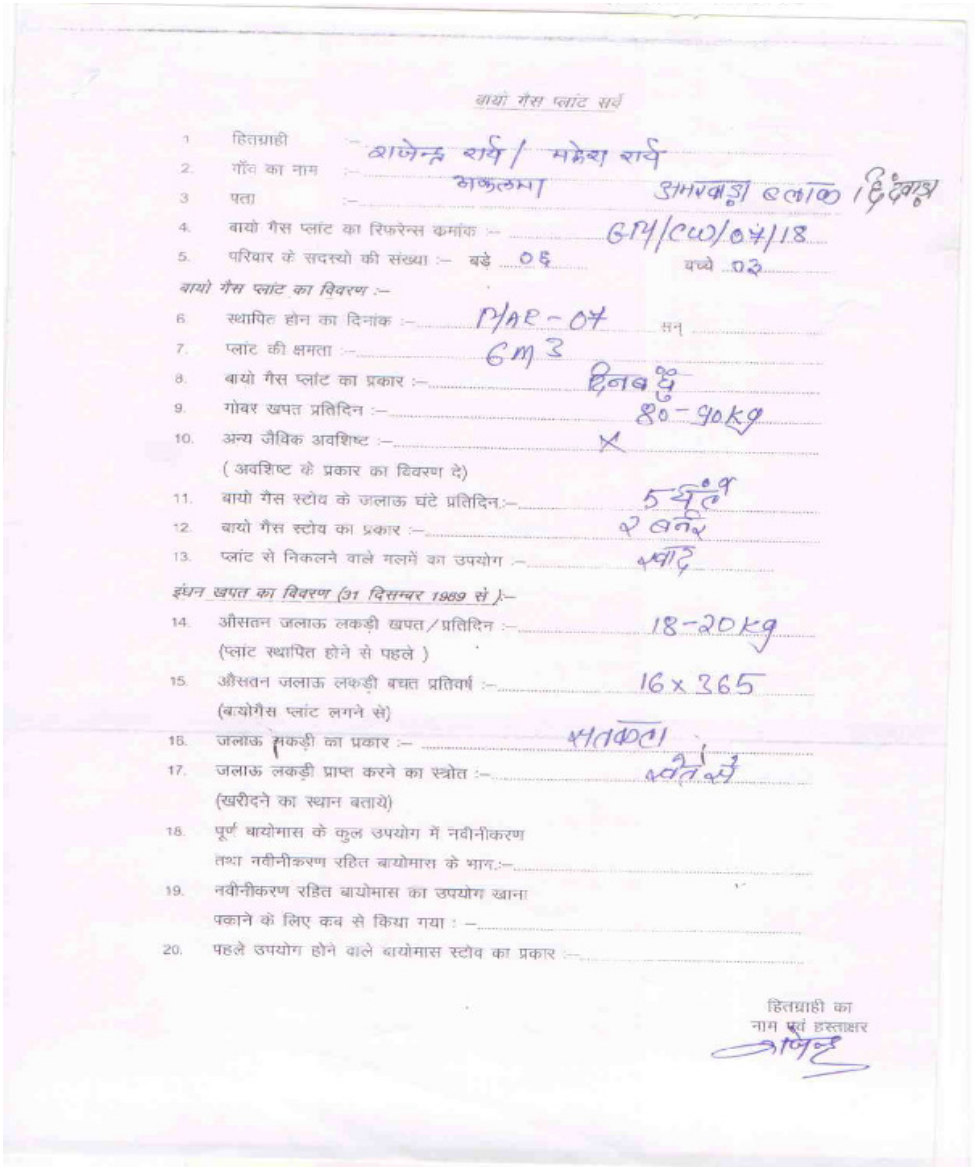
Biogas plants to be monitored as per sampling(n)	47	64	60	30	27	227

M.P.						
	Domestic Household biogas plants					
Capacity (m3)	2	3	4	6		
Number(N)	461	1320	283	58		2122
SWH to be monitored as per sampling(n)	59	64	54	31		208
Total Sample						**435**



12. Any other organic waste used
If yes, what type of waste? : –
13. Amount of total biomass
(Firewood replaced) : 255 Kg/month.
14. Fraction of renewable and non-renewable biomass in total amount of biomass used :
15. Since when non-renewable biomass is being used for cooking purpose : 1989
16. From where firewood is purchased (since, 31st December, 1989) : Manaicad
17. Type of firewood used : Rubber tree wood.
18. Type of cook stove used : Country chula.
19. Details of use of bio-digested slurry obtained from the biogas plant :
Daily slurry released : 30 kg.
Frequency of removal : Once in three months.
Usage area of slurry : 1½ acres
Type of crop raised : Rubber, Coconut, Vegetables.
Cropping intensity : 300 trees.
Whether enriched with other chemical fertilizers : No.

Name & Signature
of Bio-gas plant owner
Justin Matthew.



बायो गैस प्लांट सर्वे

1. हितग्राही :- राजेन्द्र सार्थे / महेश सार्थे
2. गाँव का नाम :- अकलमा
3. पता :- अमरवाड़ा ब्लॉक / छिंदवाड़ा
4. बायो गैस प्लांट का रिफरेन्स क्रमांक :- GH/CW/07/18
5. परिवार के सदस्यो की संख्या :- बड़े 05 बच्चे 02

बायो गैस प्लांट का विवरण :-

6. स्थापित होने का दिनांक :- MAR-07 सन्
7. प्लांट की क्षमता :- 6m3
8. बायो गैस प्लांट का प्रकार :- हिनबुंद
9. गोबर खपत प्रतिदिन :- 80-90kg
10. अन्य जैविक अवशिष्ट :- X
    (अवशिष्ट के प्रकार का विवरण दे)
11. बायो गैस स्टोव के जलाऊ घंटे प्रतिदिन :- 5 घंटे
12. बायो गैस स्टोव का प्रकार :- 2 बर्नर
13. प्लांट से निकलने वाले गलमें का उपयोग :- खाद

इंधन खपत का विवरण (31 दिसम्बर 1999 से):-

14. औसतन जलाऊ लकड़ी खपत / प्रतिदिन :- 18-20kg
    (प्लांट स्थापित होने से पहले)
15. औसतन जलाऊ लकड़ी बचत प्रतिवर्ष :- 16 x 365
    (बायोगैस प्लांट लगने से)
16. जलाऊ लकड़ी का प्रकार :- सतकटा
17. जलाऊ लकड़ी प्राप्त करने का स्त्रोत :- खरीद से
    (खरीदने का स्थान बताये)
18. पूर्ण बायोमास के कुल उपयोग में नवीनीकरण
    तथा नवीनीकरण रहित बायोमास के भाग :-
19. नवीनीकरण रहित बायोमास का उपयोग खाना
    पकाने के लिए कब से किया गया : -
20. पहले उपयोग होने वाले बायोमास स्टोव का प्रकार :-

हितग्राही का
नाम एवं हस्ताक्षर