**Project design document form for small-scale CDM project activities**

**(Version 06.0)**

*Complete this form in accordance with the Attachment "Instructions for filling out the project design document form for small-scale CDM project activities" at the end of this form.*

| PROJECT DESIGN DOCUMENT (PDD) | |
|---|---|
| **Title of the project activity** | Ramanagara Biogas Project, version 02; 10th November 2010 |
| **Version number of the PDD** | Version 08.1 |
| **Completion date of the PDD** | 14-04-2016 |
| **Project participant(s)** | SKG Sangha |
| **Host Party** | India |
| **Sectoral scope and selected methodology(ies), and where applicable, selected standardized baseline(s)** | Sectoral Scope 01 (Energy industries (renewable - / non-renewable sources)<br>AMSI.E: "Switch from Non-Renewable Biomass for Thermal Applications by the User"<br>Sectoral Scope 13 (Waste handling and disposal)<br>AMS III.R: "Methane recovery in agricultural activities at household/small farm level" |
| **Estimated amount of annual average GHG emission reductions** | 50,444 t $CO_2e$ |

## SECTION A. Description of project activity

### A.1. Purpose and general description of project activity

The proposed project will provide biogas units to households in rural areas of Ramanagara, Channapatna, Magadi and Kanakapura taluks in Ramanagara District of Karnataka State in India. The project will reduce the amount of fuel wood and kerosene used for cooking and heating water and will replace inefficient traditional cooking stoves with cleaner biogas stoves. The project will also reduce methane emissions from cattle manure and will contribute strongly to the sustainable development of the rural households involved in the project.

The biogas technology is tried and tested in rural India. SKG Sangha, a non-governmental organisation (NGO), will implement the project. SKG Sangha has already successfully implemented over 70,000 biogas units in India. Many of these biogas units were implemented with the help of government subsidies but the availability of these subsidies has reduced drastically in recent years from around 21,500 units per year to around 10,000 units per year for the entire state. As there are over 27 districts in the state, this equates to at best only few hundreds of biogas units per district and even smaller number at a Taluk level. Similarly, charity or donor financing has contributed in a small way to biogas units in the past but such financing is not able to cover the vast need for improving the energy supply to rural households in India. SKG Sangha therefore looking at the Clean Development Mechanism to provide biogas systems to rural households.

With the new EB guidelines for microscale project activity enforced into place, the project is projected to take under the microscale guidelines. Thus, now the project encompasses 7,620 households in all 4 Taluks – Kanakapura, Ramanagara, Channapatna, and Magadi in Ramanagara District in Karnataka State.

In each of the 7,620 households covered by the proposed project a family size biogas unit will be installed. The biogas unit will be of either $2m^3$ or $3m^3$ capacity depending on the number and type of cattle owned by the household and the number of people in the household. At least two heads of cattle are required for a household to be eligible for a $2m^3$ biogas unit and at least 3 heads of cattle are required for a household to be eligible for a $3m^3$ biogas unit. Overall it is planned to install 3,810 units of 3 $m^3$ capacity and 3,810 units of 2 $m^3$ capacity.

The capacity of the unit to be installed during implementation in the household will be decided based on the number of members and the number of the cattle they own. If the family is big and they are having less number of cattle, then a small size unit will be installed. If the family is small and they own large number of cattle then also a small size unit will be installed. If the family is big and they own more than 3 cattle then a large size unit will be installed. This project is meant for creating sustainable energy supply to the households for their energy needs. In some cases, where the family is small and having more than 3 cattle and have to cook for the labourers a big size unit will be installed. In the baseline survey we have calculated the wood use meant for the family members only.

The project will result in greenhouse gas (GHG) emission savings in the following ways:

- The biogas will displace GHG emissions from kerosene and fuel wood that are currently used for cooking and water heating. The biogas produced from cattle manure is a renewable source of energy as the $CO_2$ that is absorbed during the growth of the organic matter in the dung equals to the $CO_2$ emitted when the biogas is burnt (see the introduction in chapter 10.1, Volume 4 of the Revised IPCC Guidelines 2006). In accordance with methodology AMS-I.E, emission reductions are calculated for the non-renewable part of the fuel wood that would be used for cooking and water heating without the proposed project activity.

- The biogas will displace GHG emissions from cattle manure that is currently dumped in pits near the household. The cattle manure is dumped along with other waste such as straw and

animal urine from the cow shed, some kitchen waste, crop residues and other organic matter and liquids in the pit. This organic waste is never dry and does not get mixed therefore animal waste is decaying anaerobically and emitting methane. When cattle manure is fed to the bio-reactor, the emissions from the amount of manure that is added to the bioreactor will be avoided.

## A.2. Location of project activity

The proposed project activity will be implemented in rural areas in 4 taluks, namely, Ramanagara, Kanakapura, Magadi and Channapatna of Ramanagara District, Karnataka State, India.

### A.2.1. Host Party

India

### A.2.2. Region/State/Province etc.

Karnataka State

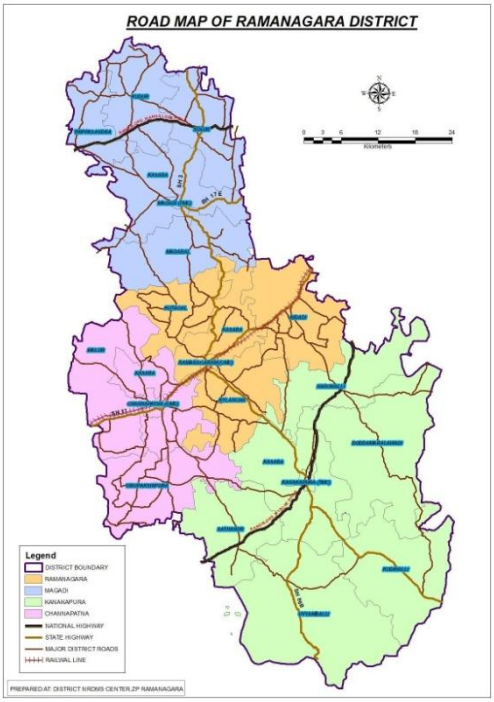
### A.2.3. City/Town/Community etc.

The 7,620households of Ramanagara District (Kanakapura, Ramanagara, Channapatna and Magadi Taluks)

### A.2.4. Physical/Geographical location

The map to the left shows the approximate location of the project on a large scale map of India. The actual project boundaries will be the outer boundaries of Ramanagara District. Ramanagara District encompasses four Taluks: Kanakapura, Ramanagara, Channapatna and Magadi.

The map below provides the four taluks in Ramanagara District




As the proposed project activity is going to be implemented in 7,620 households distributed over an area, it is impractical to give geographic coordinates of 7,620 points. Instead, ranges of geographic coordinates are provided for the taluks where the project will be implemented (see table below).

During the project implementation, SKG Sangha will keep records of every single biogas unit installed. Each unit will have an identification number (which will be visible on the biodigester inlet tank itself and will be written in records), and records will include name of the beneficiary, spouse or father's name, name of the village, name of the Panchayath to which the village belongs and name of the taluk. Once biogas units are installed, the list of units and their locations will be available for verification.

| Geographical coordinates for the project area taluks: | | |
|---|---|---|
| **Area** | **Latitude, º N** | **Longitude, º E** |
| | | |
| Ramnagara Taluk | $77^0$ 08' 23"<br>$77^0$ 29' 03" | $12^0$ 35' 08"<br>$12^0$ 52' 44" |
| Kanakapura Taluk | $77^0$ 14' 47"<br>$77^0$ 38' 16" | $12^0$ 14' 24"<br>$12^0$ 48' 01" |
| MagadiTaluk | $77^0$ 10' 04"<br>$77^0$ 19' 52" | $12^0$ 49' 57"<br>$13^0$ 11' 44" |
| Channapatna Taluk | $77^0$ 19' 29"<br>$77^0$ 04' 11" | $12^0$ 27' 45"<br>$12^0$ 48' 20" |

### A.3. Technologies and/or measures

The project falls into the following categories of small-scale project activities:

I.E - "Switch from Non-Renewable Biomass for Thermal Applications by the User"
III.R -"Methane recovery in agricultural activities at household/small farm level"

The project will involve using cattle dung for the production of biogas (category III.R), which will displace non-renewable biomass (category I.E) for household cooking and water heating purposes.

The project conforms to these small-scale categories because:

- Introduced renewable energy technologies – biogas systems – have an aggregate capacity less than *45* MWth or 15MWe [(see EB61, Annex 21 – general guidelines to SSC CDM methodologies (version 17) para 4 sub section (c)]: the average capacity of the units that will be installed under the proposed project activity is 0.4158 kWe ( for the $3m^3$ unit) and 0.2772 kW (for the 2m3 unit), so the aggregate capacity of the systems is in the order of 2.646 MWe (see justification below); and

- Recovery and destruction of methane from manure and agricultural wastes in all systems (all households) results in emission savings of less than 60Kt $CO_2e$ annually and the emission savings from the manure management per unit per year is 2.803t $CO_2e$ and from all the systems is 21,363t $CO_2e$ which is less than stipulated amount of savings 5 t $CO_2e$ for each unit per year and 60,000 t $CO_2e$ for all the units, respectively.

- The total number of units will not exceed 7620 in number i.e. 3810 of $3m^3$ and 3810 unit of $2m^3$ biodigestor units.

**Justification of installed capacity**

| Parameter | Value | Value | Unit | Source |
|---|---|---|---|---|
| Unit conversion rate | 0.28 | 0.28 | kWh/MJ | http://www.unitconversion.org/energy/megajoules-to-kilowatt-hours-conversion.html |
| Calorific value of biogas in a digester | 21.6 | 21.6 | $MJ/m^3$ | Nijaguna B.T, Biogas Technology (New Age International (P) Ltd. 4835/24 Ansari Road, Daryaganj, New Delhi – 110 002, 2002 |
| Digester capacity/day | 3 | 2 | $m^3$ | unit sizes |

| | | | | |
|---|---|---|---|---|
| Installed Digester electrical capacity /day | 18.144 | 12.096 | kWh | Calorific value of biogas (21.6MJ) x digester capacity x unit conversion value (0.28) |
| Hours per day | 24 | 24 | hours | |
| Installed digester electrical capacity / hour | 0.756 | 0.504 | kW | Installed project unit electrical capacity per day / hours in a day (24) |
| Stove efficiency | 55 | 55 | % | Nijaguna BT |
| Net installed electrical capacity of the project unit | 0.4158 | 0.2772 | kW | Installed digester electrical capacity x stove efficiency (55%) |
| Kilowatts for each megawatt | 1000 | 1000 | kW/MW | |
| Total Project units 3810 (each) installed capacity | 1.584 | 1.056 | MW | Net installed electrical capacity of the unit x number of units of $2m^3$ and $3m^3$in the project (3810) / kilowatt to megawatt conversion value (1000) |
| Total installed capacity for 7620 units | 2.64 | | MW | Net installed electrical capacity of the total 7620 biodigester units of the project. |

**Technology**

In each household, a family-size biodigester together, Deenabandhu type, with a biogas-based cooking stove unit will be installed. The biogas units will be installed using bricks, sand, cement, pipes, pipe fittings, metal clips, wire and gas burners. Each bioreactor will be a mesophilic fixed dome. The capacity of the biodigester will be either $2m^3$ or $3m^3$ of biogas per day. The biogas unit size for a particular household will be chosen based on the number and type of cattle owned by the household and the number of people in the household. SKG Sangha will build the systems with the help of people from the households. Cattle dung and wastewater will be fed into the biodigester daily. Cattle dung and kitchen wastewater will be added to a mixing tank above ground which has an inlet pipe to the digester chamber which is below ground. The dung and wastewater slurry remains in the chamber for approximately 40 days and breaks down anaerobically producing biogas. This biogas builds up above the slurry and remains in the chamber until it is released through the gas outlet pipe at the top of the dome when the gas burner in the household is turned on (the pipe at the top of the biodigester leads to the cooking stove in the household). The biodigester also produces slurry which is pushed into the outlet tank cum displacement chamber as the biogas builds up in the digester and finally exits through the slurry discharge hole. The technology has been tested and widely used in India.

### A.4. Parties and project participants

| Party involved<br>(host) indicates host Party | Private and/or public entity(ies) project participants<br>(as applicable) | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| Party (host)<br>India | Private entity: SKG Sangha | No |

### A.5. Public funding of project activity

The project does not include public funding. The participating households will make a small in kind contribution of materials and labour but otherwise no other funding or assistance will be available to implement the project. The project will be funded solely from the sale of the offsets created from the project's GHG emission reductions. Because of uncertainty in CDM mechanism and unstable rate of CERs many of the CER buyers are not coming forward to give the proper price for CERs and upfront payment. The project proponents may approach the Ministry of New and Renewable Energy, Government of India for additional support in the form of subsidy for the project unit eligible under the ministries policy.

### A.6. Debundling for project activity

This proposed small-scale project activity is not a debundled component of a large project activity as there is no registered small-scale CDM 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 closest point.

SKG Sangha is implementing another two biogas projects 'Hassan Biogas Project' and 'Kolar Biogas Project,' which takes place in the same state (Karnataka State) but in other, districts – Hassan, Mandya, Mysore and Kolar – which do not border with the proposed Ramanagara Biogas Project location. The areas of the two proposed project activities are separated by Bangalore Urban District and Taluks of Mandya District. The present project is having a minimum distance of about 68 kilometers from the closest point of the other two projects.

## SECTION B. Application of selected approved baseline and monitoring methodology and standardized baseline

### B.1. Reference of methodology and standardized baseline

The following approved small scale baseline and monitoring methodologies are applied to the Ramanagara Biogas Project:

(i) Version 4 of AMS-I.E "Switch from non-renewable biomass for thermal applications by the user"

(ii) Version 2 of AMS-III.R "Methane recovery in agricultural activities at the household/small farm level"

### B.2. Project activity eligibility

(i) AMS-I.E "Switch from non-renewable biomass for thermal applications by the user", version 4

| Criteria for the applicability of the methodology | Justification why the methodology is suitable for the proposed project activity |
|---|---|
| This category comprises activities to displace the use of non-renewable biomass by introducing renewable energy technologies. Examples of these technologies include but are not limited to biogas stoves, solar cookers, passive solar homes, renewable energy based drinking water treatment technologies (e.g. sand filters followed by solar water disinfection; water boiling using renewable biomass). | The proposed project will introduce small, family-size biogas systems (bioreactors and stoves) that supply thermal energy for household cooking needs. In the area of the proposed Ramanagara Biogas Project, 95.53% of fuel wood used for cooking is considered non-renewable biomass (see section B.4 below for information on how the fraction was estimated). For households participating in this project, their fuel wood use will be replaced with the use of biogas generated in small biogas reactors (renewable energy derived from cattle dung). |
| The use/diversion of non-renewable woody biomass saved under the project activity by non-project households/users that previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project households/users, that is attributable to the project activity, then $B_y$ is adjusted to account for the quantified leakage. Alternatively, $B_y$ is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required. | A similar activity, 'Hassan Biogas Project' and 'Kolar Biogas Project' has been proposed for registration under the CDM, which is located in the same state but separated from the proposed Ramanagara Biogas Project by Mandya and Bangalore Urban Districts. The closest distance between the borders of the two project areas is about 68 km. This is far above the distance travelled by project participants to collect fuel wood. The baseline survey described in section B.4 below showed that the average distance for collecting fire wood is 0.15 km, and the maximum distance mentioned was 5 km.<br><br>$B_y$ is multiplied by a net to grass adjustment factor of 0.95 to account for leakage. Hence the surveys are not required to collect the data on biomass use. This simplifies the monitoring and much concentration can be done on other aspect of the project by the project personnel. |
| Project participants are able to show that non-renewable biomass has been used since 31 December 1989, using survey methods | A number of studies on bio resource use in Karnataka show that non-renewable biomass has been used since 31 December 1989. In particular, Ramachandra et al in "Bioresource Status in Karnataka" (2004 – see reference 2 in Annex 5) noted that the share of fuel wood in cooking in rural areas increased from 56% in 1989/90 to nearly 62% in 1994/95. This increased demand could not have been met by renewable supplies of fuel wood in Eastern Dry agro climatic Zone due to the serious bio resource shortages in this Zone, to which the project area falls. A number of studies have shown that Ramanagara is a bio resource deficient zone meaning that not only is there insufficient fuel wood to meet cooking and water heating demands, there is also a shortage of other possible bio resource substitutes like animal, |

| | |
|---|---|
| | crop and horticultural residues. With more than 70% of the population in rural areas, Ramachandra et al (2004 – see reference 2 in Annex 5) note that there is tremendous demand on resources such as fuel wood and agricultural residues to meet people's daily fuel needs. More recent studies on non renewable biomass use in Kolar District including Ramachandra and Rao in "Inventorying, Mapping and Monitoring of Bio-resources Using GIS and Remote Sensing" (2005 – see reference 3 in Annex 5) have noted the high level of non renewable biomass use in Kolar District so the pattern that was established from 1989/90 has continued in more recent years due to the sustained demand on bio resources to meet rural energy needs. This is supported by the baseline survey of a sample of households in the region (see B4 below and Annex 3 for further details) which confirmed that the time for collecting fuel woodand the price for purchasing fuel wood has been increasing, which shows persistent and growing non renewable biomass use. See Annex 3, C. Calculations for proof and quantity of NRB. |
| Project boundary | The project boundary will be boundary consisting of renewable energy generation unit, Biogas plant and the place where the traditional cooking and water heating is replaced with the biogas stove. |
| It is assumes in the absence of the project activity the baseline scenario would be the use of fossil fuel | In the project area few households are using fossil fuels like kerosene, LPG for their cooking and water heating needs. There is no specific fossil fuel that will replace the present biomass use. For calculation purposes the default value provided it the methodology is used for calculating the emission savings of the NRB |
| Emission reductions would be calculated using the prescribed formula | The formula (1) provide in the methodology is used to calculate the emissions |
| $B_y$ is determined by using the prescribed formula (2) | $B_y$ is calculated using the formula (2) provided in the methodology. Para 6 (a) and (b) were applied for calculation purpose |

(ii) AMS-III.R "Methane recovery in agricultural activities at the household/small farm level", version: 02

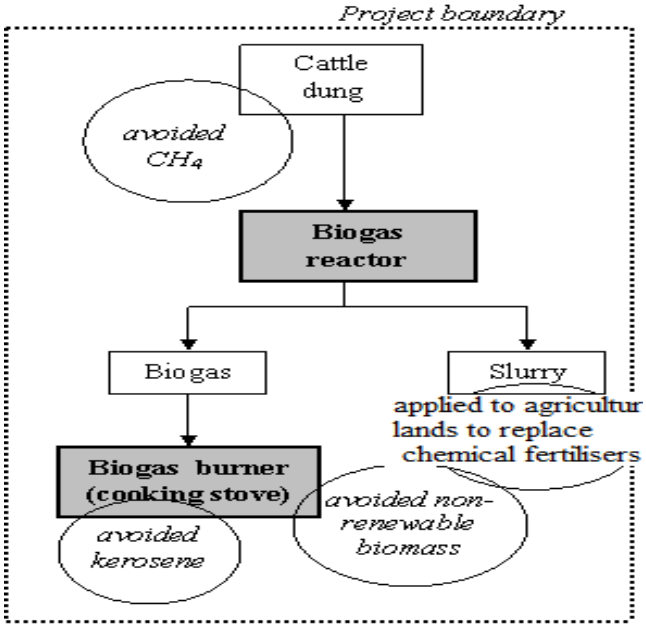
| **Criteria for the applicability of the methodology** | **Justification why the methodology is suitable for the proposed project activity** |
|---|---|
| This project category comprises recovery and destruction of methane from manure and wastes from agricultural activities that would be decaying anaerobically emitting methane to the atmosphere in the absence of the project activity. Methane emissions are prevented by:<br>(a) Installing methane recovery and combustion system to an existing source of methane emissions, or<br>(b) Changing the management practice of a biogenic waste or raw material in order to achieve the controlled anaerobic digestion equipped with methane recovery and combustion | In the proposed project activity, animal manure is currently dumped in pits. Each household has a pit in the ground which is at least 1 m deep, where waste from the cattle shed – cow dung, straw, green fodder and urine – is dumped. Waste from the cattle shed is dumped in the pit along with some crop waste, any food waste, and sometimes toilet waste. The waste is not turned or mixed during the year. Cow urine, wastewater from the kitchen and other liquids are added; this keeps the mass in the pits wet or liquid. During the rainy season the pits also get filled with rainwater. The animal waste is decaying anaerobically in the pit and emits methane. The pits are cleaned out once a year.<br>After introducing a biogas unit, the amount of animal manure fed into biodigesters will not be left to decay |

| | |
|---|---|
| system. | anaerobically in the pit. Instead the manure that is fed into the biodigester will break down anaerobically in the biodigester. The biogas that is produced will be held in the biodigester until it is combusted in the biogas burners and used for cooking and heating water. The project scenario conforms to the (b) situation described in the methodology. |
| The category is limited to measures at individual households or small farms (e.g. installation of a domestic biogas digester). Methane recovery systems that achieve an annual emission reduction of less than or equal to 5 tonnes of CO2e per system are included in this category. | Biogas digesters will be installed in individual households in rural areas.<br>A single biogas system avoids annually an average of 2.803t$CO_2$e due to this methane recovery (see below for calculations) i.e. less than the 5 t $CO_2$e maximum annual amount from methane recovery permitted under this methodology. |
| This project category is only applicable in combination with AMS-I.C "Thermal energy production with or without electricity" and/or AMS-I.I "Biogas/biomass thermal applications for households/small users" and/or AMS-I.E "Switch from non-renewable biomass for thermal applications by the user". | The methodology AMS-I-E is applied for the use of methane for thermal energy (cooking and heating water). |
| The project activity shall satisfy the following conditions:<br>(a) The sludge must be handled aerobically. In case of soil application of the final sludge the proper conditions and procedures that ensure that there are no methane emissions must be ensured.<br><br>(b) Measures shall be used (e.g. combusted or burnt in a biogas burner for cooking needs) to ensure that all the methane collected by the recovery system is destroyed. | The sludge from the biodigesters will be used as a fertilizer either directly or after making a Vermicompost using sludge and earth worms. Training for biogas system users will include training on the proper handling of sludge.<br><br>The methane that builds up in the biodigester is regularly destroyed by burning it in cooking and water heating stove for meeting household energy needs. |
| Aggregated annual emission reductions of all systems included shall be less than or equal to 60 kt CO2 equivalent. | Aggregate annual emission reductions from avoided methane of all 7,620 households included will be 21,363, t $CO_2$e which is less than the 60,000t CO2e limit that applies to this methodology. The calculations are based on a projection that 50% of the units will be $3m^3$ capacity units and that the remaining 50% of the units will be $2m^3$ capacity units. The installed capacity of all the units put together is 2.64 MWe. Hence the project is below the limits prescribed by all the methodologies and conforms to general guidelines for SSC projects. |
| The proper soil application (not resulting in methane emissions) of the final sludge verified on a sampling basis. | (a) The sludge will be collected in a sludge collecting pit, about 50 centimeters deep every day. This sludge either will be dried on the ground or used to generate vermicompost or |

| | |
|---|---|
| | mixed with other organic waste like fodder waste and agricultural residues to be fermented in aerobic condition or applied directly on the agricultural soils as a thin layer. Every beneficiary will be trained not only on biogas unit maintenance but also on proper handling of the sludge to avoid any kind of emissions.<br><br>(b) There is a parameter in the monitoring sheet, "Describe application of the slurry from biodigester: where is it used, how, when". In this parameter all the above scenarios will be questioned and answers will be derived. More over the motivator or the local level supervisor regularly visits the plants will guide the farmers in proper handling of the sludge so that it will not emit any emissions. |

## B.3. Project boundary

The project boundary is defined by the physical, geographical site of biogas digesters and biogas cookers. The diagram below shows a schematic representation of the project and its boundary:




Sources and gases included in the project boundary:

| | Source | Gas | Included? | Justification/explanation |
|---|---|---|---|---|
| Baseline | Thermal energy need –non-renewable biomass share of the fuel wood use | $CO_2$ | Yes | Major source of emissions |
| | | $CH_4$ | No | Excluded for simplification |
| | | $N_2O$ | No | Excluded for simplification |
| | Animal waste | $CO_2$ | No | Excluded as emissions from animal waste are $CO_2$-neutral |
| | | $CH_4$ | Yes | Major source of emissions |
| | | $N_2O$ | No | Excluded for simplification |
| P r | Direct emissions | $CO_2$ | No | Excluded as emissions from biogas are $CO_2$ |

| | | | | |
|---|---|---|---|---|
| | from the biodigester (physical leakage) | | | neutral |
| | | $CH_4$ | Yes | Main source of project emissions |
| | | $N_2O$ | No | Excluded for simplification |
| | Leakage | $CO_2$ | No | Any possible leakage is more than compensated for by unclaimed (a) avoided $N_2O$ emissions from cattle manure that goes into the biodigester, (b) avoided $CO_2$ emissions from avoided application of chemical fertilizer due to improved fertilizer from the biogas slurry, and (c) avoided emissions of products of incomplete combustion of fuel wood. (d) Avoided emissions by replacing kerosene use in cooking. |
| | | $CH_4$ | No | |
| | | $N_2O$ | No | |

## B.4. Establishment and description of baseline scenario

The baseline parameters were identified using a survey of a sample of 600 target households. The survey was carried out in:

- 144 households in Ramanagara Taluk
- 151 households in Channapatna Taluk
- 151 households in Magadi Taluk
- 154 households in Kanakapura Taluk

The survey results show that a typical household has on average 4.38 persons, an annual income of 21,714 rupees (ca. € 362), and 3.5 heads of cattle (ca. 2.231 dairy cows, 0.248 buffalo and 1.028 non-dairy cow). The table with the main baseline survey results is given in Annex 3.

According to the Methodology and SSC projects guidelines for sample size determination 90/10 precision is needed. With this precision the sample size will be 58 for a population of more than on lakh. The PP has surveyed more than the maximum limit of households to be surveyed to get more precise data from all the four taluks of the project area. Moreover, the values for calculations were taken with 95% confidence precision.

*(i) Non-renewable biomass component*

According to AMS-I.E: "Switch from non-renewable biomass for thermal applications by the user", Version 4:

"It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs."In the proposed project activity, the average participating household uses 5.3 tonnes of fuel wood per year for cooking and water heating according to the baseline survey results. Studies at the Karnataka State level have shown that taluks of Ramanagara District is in a bio resource deficit zone, Eastern Dry Zone where the demand for fuel wood and other bio resources far exceeds supply. For example, in the study "*Bioresource Statusin Karnataka*" (Ramachandra et al, 2004 – see reference 2 in Annex 5) Taluks of Ramanagara District were included in the Eastern Dry Agro Climatic Zone which was identified as having a bio resource availability to demand ratio of 0.39 i.e. only 39% of the bio resources that were used could be considered to be renewable. Similar comments were made in the study "*Bio resource Potential of Karnataka: Technical Report No. 109*" (Ramachandra and Kamakshi, 2005 – see reference 4 Sin Annex 5). These state level studies support the results of specific studies on bio resource use in Eastern Dry agro climatic zone as the project area is.
The households will switch to biogas systems which are able to meet all their cooking and water heating needs. All fuel wood that is used for cooking and water heating will therefore be replaced once a household has a biogas unit. For the households in the project area, fossil fuels generally are too expensive and/or need expensive equipment for their use for cooking purposes (for more details see the section B.5 on additionality). There is no clear projected fossil fuel to which such families

would switch, as the gap between current income and the income needed to afford fossil fuel use for cooking purposes is large.

The default value provided by the methodology for the projected fossil fuel 81600 kg $CO_2$/TJ is used to calculate baseline emissions for NRB of 5.904 t/year (95.53% of 5.3153 t wood used for cooking and water heating purposes. (Please refer Annex 3, C. Calculations section to know how this NRB rate has been derived).

*(ii) Cattle manure component*

According to AMS-III.R "Methane recovery in agricultural activities at the household/small farm level", version 2:

> "The baseline scenario is the situation where, in the absence of the project activity, biomass and other organic matter are left to decay anaerobically within the project boundary and methane is emitted to the atmosphere. Baseline emissions (***BEy***) are calculated ex ante using the amount of the waste or raw material that would decay anaerobically in the absence of the project activity, with the most recent IPCC tier 2 approach (chapter 'Emissions from Livestock and Manure Management' under the volume 'Agriculture, Forestry and other Land use' of the 2006 IPCC Guidelines for National Greenhouse Gas Inventories). Country/regional-specific values shall be used if available."

"The amount of waste or raw materials that would decay anaerobically in the absence of the project activity is determined by survey of a sample group of households/small farms with a 90% confidence interval and 10% margin of error. The survey should determine the baseline animal manure management practices applied. This small-scale methodology is only applicable to the portion of the manure, which would decay anaerobically in the absence of the project activity established by the survey".

The general pattern of manure and waste management was defined during preliminary visits to potentially participating households, and then clarified during the baseline survey. In a typical household that will participate in the proposed project activity, animal manure is currently dumped in pits. Households collect animal manure produced when cattle is kept in a shed. Each household has a pit in the ground, which is on average 1.218 m deep, where waste from the cattle shed – cow dung, straw, green fodder and urine – is dumped. Waste from the cattle shed is dumped in the pit along with some crop waste and any food waste. The waste in the pit is not turned or mixed during the year. During the rainy season the pits get filled with water. In other times of the year, in order to keep the material in the pit wet or liquid, kitchen waste water is also poured into the pits. The animal waste is therefore decaying anaerobically in the pit and emits methane. The pits are cleaned out once a year and the material is applied in the fields as a fertiliser. Such manure and pit management is also described in the study carried out by the Regional Biogas Development and Training Centre, University of Agriculture Sciences, Bangalore (ref. 1 in Annex 5).

Questions were included in the baseline survey on how long the material in the pits corresponds to (i) an uncovered slurry, (ii) drier cover on top but slurry below the crust, (iii) solid wet material, and (iv) solid dry material. The survey categories correspond to the following manure management systems given in Table 10.18, Chapter 10.4, and Volume 4 of the IPCC 2006 Guidelines: (i) liquid/slurry manure management system, (ii) liquid/slurry with crust cover manure management system and (iii) solid storage manure management system. The survey results are backed up by the University of Agriculture Sciences study as referred above.

The survey results have shown that manure is handled in a liquid/slurry manure management system for 4.964 months, in a liquid/slurry with crust cover manure management system for 4.125 months and in a solid storage manure management system for 2.213 months. In the remaining 0.535 months the material is solid and dry.

Animal manure is collected primarily when the animals are kept in the sheds that are attached to or close by the house. All the manure from the shed is put into the pit. When animals are grazing outside, dung is only rarely collected and put into the pit. A check of the amount of manure going into the pit was incorporated in the survey by measuring the approximate total manure production per day and the amount of manure that is collected and dumped in the pit. Animals are kept in the sheds on average for 20.352 hours per day i.e. 87% of the total time. Accordingly, 86% of the total manure produced by the cattle is collected from the sheds and put into the pit as described above. Although some manure that is excreted in the fields is also collected and put into the pit, this manure has not been included in the baseline calculations for the sake of conservativeness. Estimation of the total amount of manure collected and put into pit is considered to be less accurate than estimation of the time per day when animals are kept in the shed; therefore the share identified according to the time the cattle are kept in the shed (i.e. 87%) is used for calculating the baseline.
The following table summarises how the shares of manure handled in different manure management systems have been defined:

| **Survey question** (For how many months does the material in the pit look…) | **Corresponding manure management system according to IPCC definitions** | **Survey result** (months) | **Share of collected manure from total manure produced** | **Share of manure handled in different manure management systems (MS)** |
|---|---|---|---|---|
| | | A | B | = A /12 * B |
| … like an uncovered slurry | Liquid/slurry[1] | 4.964 | 0.87 | 0.36 |
| … like a slurry with a crust cover | Liquid/slurry with crust cover[2] | 4.125 | 0.87 | 0.30 |
| … solid but wet | Solid storage[3] | 2.213 | 0.87 | 0.16 |
| … solid but dry | Solid storage | 0.535 | 0.87 | 0.04 |

After the installation of a biogas system, all the manure collected by an average surveyed household will be fed into the $3m^3$ biogas units. For the $2m^3$ units, the household will have fewer cattle than the $3m^3$ biogas units but in the same proportion of different cattle types. Although the survey results are indicative of an average number of cattle aggregated for both types of households – i.e. those eligible for a 3 $m^3$ unit and those eligible for a 2 $m^3$ unit – in ex-ante calculations for the sake of conservativeness it is assumed that only 2/3 of the collected manure of an average surveyed household will be fed into the $2m^3$ units (as the $2m^3$ units only have 2/3 the capacity of the $3m^3$ units). The methane will be captured and used for cooking.

## B.5. Demonstration of additionality

The proposed project activity has not been announced yet, only the project idea was presented during stakeholder consultation meetings. The project activity is dependent upon receiving carbon credits and this intention was expressed during stakeholder consultation.

Chronology of Actions related to the Project:

[1]Table 10.18 in the IPCC 2006 Guidelines defines this system as the situation when "manure is stored as excreted or with some minimal addition of water in either tanks or earthen ponds outside the animal housing, usually for periods less than one year".

[2]No separate definition is given for this system in the IPCC 2006 Guidelines compared to the liquid/slurry definition, but the Methane Correction Factor is different when the material has a crust cover.

[3]Table 10.18 in the IPCC 2006 Guidelines defines this system as "The storage of manure, typically for a period of several months, in unconfined piles or stacks.Manure is able to be stacked due to the presence of a sufficient amount of bedding material or loss of moisture by evaporation".

| Sl.No | Type of Action | Date | | Reference |
|---|---|---|---|---|
| 1 | Area Transect | March -2009 | Area survey to find the feasibility | |
| 2 | Board Resolution | 13-4-2009 | The governing body of the SKG Sangha passed a resolution to take up the Ramanagara biogas Project on CDM lines | Resolution copy provided to DOE |
| 3 | Baseline survey | Oct – 2009 | Survey was conducted | Survey sheets copy provided to the DOE |
| 4 | Preparation of Documents | Oct 2009 to September 2010 | PDD preparation collection of relevant documents etc. | PDD version 1 |
| 5 | Applied for the DNA approval | 10-11-2010 | Documents uploaded to the DNA website | |
| 6 | Contract date with DOE | 7-02-2011 | | Validation contract with DOE |
| 7 | CDM consideration | 21-5-2011 | Document sent to the DNA | Mail sent to DNA |
| 8 | Project webhosted in UNFCCCC website by the DOE for global stakeholder comments | 4-8-2011 | Document uploaded to UNFCCC website by the DOE | Mail from the UNFCCC |
| 7 | Receipt of DNA letter | 02-10-2011 | Received the Host country approval dated: 27-09-2011 | Host country approval letter |

**Additionality**

Additionality has been demonstrated using the latest guidelines by the CDM EB.
According to EB 68th meeting report Annex 27, Guidelines for demonstrating additionality of small scale project activities (version 09.0), the additionality has been demonstrated as under.
Paragraph 2 of the guidelines: "Documentation of barriers, as per paragraph 1 above, is not required for the positive list of technologies and project activity types that are defined as automatically additional for project sizes up to and including the small-scale CDM thresholds (e.g. installed capacity up to 15 MW). The positive list comprises of:"

Sub paragraph (c): "Project activities solely composed of isolated units where the users of the technology/measure are households or communities or Small and Medium Enterprises (SMEs) and where the size* of each unit is no larger than 5% of the small-scale CDM thresholds;"
* That is the size of each unit under 750 kW installed capacity or under 3000 MWh of energy savings per year or3000 tonnes of emission reductions per year.

The project activity is solely composed of isolated units, biogas plants and these units are used by the individual households. The generated biogas is used to fulfill the daily cooking needs of the households spread in a wide area, a district.

**Project activity installed capacity:**

| Parameter | Value | Value | Unit | Source |
|---|---|---|---|---|
| Unit conversion rate | 0.28 | 0.28 | kWh/MJ | http://www.unitconversion.org/energy/megajoules-to-kilowatt-hours-conversion.html |

| | | | | |
|---|---|---|---|---|
| Calorific value of biogas in a digester | 21.6 | 21.6 | $MJ/m^3$ | Nijaguna B.T, Biogas Technology (New Age International (P) Ltd. 4835/24 Ansari Road, Daryaganj, New Delhi – 110 002, 2002 |
| Digester capacity/day | 3 | 2 | $m^3$ | unit sizes |
| Installed Digester electrical capacity /day | 18.144 | 12.096 | kWh | Calorific value of biogas (21.6MJ) x digester capacity x unit conversion value (0.28) |
| Hours per day | 24 | 24 | hours | |
| Installed digester electrical capacity / hour | 0.756 | 0.504 | kW | Installed project unit electrical capacity per day / hours in a day (24) |
| Stove efficiency | 55 | 55 | % | Nijaguna BT |
| Net installed electrical capacity of the project unit | 0.4158 | 0.2772 | kW | Installed digester electrical capacity x stove efficiency (55%) |
| Kilowatts for each meghwatt | 1000 | 1000 | kW/MW | |
| Total Project units 3810 (each) installed capacity | 1.584 | 1.056 | MW | Net installed electrical capacity of the unit x number of units of $2m^3$ and $3m^3$in the project (3810) / kilowatt to megawatt conversion value (1000) |
| Total installed capacity for 7620 units | 2.64 | | MW | Net installed electrical capacity of the total 7620 biodigester units of the project. |

The net installed electrical capacity of the each unit is 0.4158 kW ($3m^3$) and 0.2772 ($2m^3$) which is well under the stipulated limit of 750kW, prescribed under the EB 68 Annex 27, Para 2 sub-para (c) foot note 1.
The emission reductions of the project activity are as follows:

| Year | Average units in operation | NRB (ER y) | Manure CH4 | BE | PE | ER |
|---|---|---|---|---|---|---|
| | For 1 unit | 5.90 | 2.803 | 8.71 | 0.46 | 8.25 |
| 2015 | - | | | | | |
| 2016 | 2,000 | 11,809 | 5,607 | 17,416 | 917 | 16,499 |
| 2017 | 5,810 | 34,304 | 16,288 | 50,593 | 2,664 | 47,929 |
| 2018 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 2019 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2020 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2021 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2022 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2023 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2024 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| | | | | | **Total for 10 Years** | **5,04,448** |
| | | | | | **Annual average** | **50,444** |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Total reductions** | | 3,61,053 | 1,71,434 | 5,32,487 | 28,039 | 5,04,448 |

The maximum gross emission reductions per unit is 8.71 t CO2e which is well below the limit of 3,000 t CO2 e, stipulated by the guidelines of the EB 68.
As the project activity is fulfilling the latest guidelines of the CDM EB, the project is additional.

## B.6. Emission reductions

### B.6.1. Explanation of methodological choices

Emission reductions are calculated as the difference between the baseline emissions of the two components (i) displacement of non-renewable biomass and (ii) the capture and destruction of methane from animal manure and the project emissions.

Baseline emissions for the non-renewable biomass component are calculated based on the use of the biomass (fuel wood) that is replaced, the fraction of the biomass that is non-renewable biomass, and the emissions factor of default value provided in the AMS I E methodology Version 4 as a projected alternative fuel (according to AMS-I.E “Switch from non- renewable biomass for thermal applications by the user”). The quantity of the biomass that is replaced is calculated using option (a) in order to provide a more conservative answer. It is calculated as the product of the number of appliances (biogas units) multiplied by the estimate of average annual consumption of biomass per appliance (i.e. the annual use of fuel wood in an average household) determined based on a survey of a representative sample of households.

$$ER_y = B_y * f_{NRB,y} * NCV_{biomass} * EF_{projected\_fossilfuel} \quad \textbf{(1)}$$

*Where:*

| | |
|---|---|
| $ER_y$ | Emission reductions during the year *y* in $tCO_2e$ |
| $B_y$ | Quantity of woody biomass that is substituted or displaced in tonnes (per unit per year) |
| $f_{NRB,y}$ | Fraction of woody biomass used in the absence of the project activity in year *y* that can be established as non renewable biomass using survey methods |
| $NCV_{biomass}$ | Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tonne) |

| | |
|---|---|
| $EF_{projected\_fossilfuel}$ | Emission factor for the substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO2/TJ[4] |

Baseline emissions for the manure component are calculated based on the amount of manure that would decay anaerobically in the pits, using the Tier 2 approach from the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (according to AMS-III.R "Methane recovery in agricultural activities at the household/small farm level", version 2). Emission factors for manure of different cattle categories (dairy cows, buffalo and other cattle) are calculated based on nationally published (where available) and IPCC default values (where nationally published values are not available) for volatile solid excreted by each animal category, maximum methane producing capacity for manure of each animal category, methane correction factors for liquid/slurry, liquid/slurry with natural crust cover and solid storage dry storage manure management systems in a warm climate with average temperature of 26°C (see reference No, 8 in the Annex 5) and fractions of total manure handled in these manure management systems. The baseline emissions were calculated applying the formulas in the AMS III D methodology as specified in the AMS III R.

$$BE_y = GWP_{CH4} * D_{CH4} * UF_b * \sum_{j,LT} MCF_j * B_{0,LT} * N_{LT,y} * VS_{LT,y} * MS\%_{Bl,j} \quad (2)$$

Where:

| | |
|---|---|
| $BE_y$ | Baseline emissions in year *y* ($tCO_2e$) |
| $GWP_{CH4}$ | Global Warming Potential (GWP) of $CH_4$ (25) |
| $D_{CH4}$ | $CH_4$ density (0.00067 t/m$^3$ at room temperature (20 ºC) and 1 atm pressure) |
| $LT$ | Index for all types of livestock |
| $j$ | Index for animal manure management system |
| $MCF_j$ | Annual methane conversion factor (MCF) for the baseline animal manure management system *j* |
| $B_{0,LT}$ | Maximum methane producing potential of the volatile solid generated for animal type *LT* (m$^3$ $CH_4$/kg dm) |
| $N_{LT,y}$ | Annual average number of animals of type*LT* in year *y* (numbers) |
| $VS_{LT,y}$ | Volatile solids for livestock *LT* entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year) |
| $MS\%_{Bl,j}$ | Fraction of manure handled in baseline animal manure management system *j* |
| $UF_b$ | Model correction factor to account for model uncertainties (0.94)[5] |

**Project Activity Emissions**

[4] This value represents the emission factor of the substitution fuels likely to be used by similar users, on a weighted average basis. It is assumed that the mix of present and future fuels used would consist of a solid fossil fuel (lowest in the ladder of fuel choices), a liquid fossil fuel (represents a progression over solid fuel in the ladder of fuel use choices) and a gaseous fuel (represents a progression over liquid fuel in the ladder of fuel use choices). Thus a 50% weight is assigned to coal as the alternative solid fossil fuel (96 $tCO_2$/TJ) and a 25% weight is assigned to both liquid and gaseous fuels (71.5 $tCO_2$/TJ for kerosene and 63.0 $tCO_2$/TJ for Liquefied Petroleum Gas (LPG).

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

"Project emissions consist of $CO_2$ emissions from use of fossil fuels or electricity for the operation of the system and the physical leakages of methane from the recovery system" - Para 7 o f the AMS III R.

There will not be any electricity or fossil used for the regular operation of the biogas plants. The households will collect the animal dung from the cow shed and waste water of the kitchen and feed the plant. The biogas will flow to the burner with the pressure created in the digester.

"Project emissions due to physical leakage of biogas digester is estimated using one of the two options using the method indicated in paragraph 13 of AMS-III.D "Methane recovery in animal manure management systems" – Para 8 of the AMS III R

AMS III D – Para 13:

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

(a) 10% of the maximum methane producing potential of the manure fed into the management systems implemented by the project activity:[6]

(i) In case option in paragraph 9(a) is chosen, it is determined as:

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

Where:

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

If the project activity involves sequential manure management systems, the procedure specified in paragraph 10 (e) shall be used to estimate the project emissions due to physical leakage of biogas in each stage.

(ii) In case option in paragraph 9 (b) is chosen, it is determined as:

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

(b) Optionally a default value of 0.05 m³ biogas leaked/m³ biogas produced may be used for both options in paragraph 9 (a) and (b) as an alternative to calculations per equation 6 and equation 7."

The project emissions are calculated based on the option b)

Leakage As defined in AMS I E methodology Version 4:
"Leakage related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The following potential source of leakage shall be considered:
The use/diversion of non-renewable woody biomass saved under the project activity by non-project households/users that previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project households/users that is attributable to the project activity, then y B is adjusted to account for the quantified leakage. "

[6] 2006 IPCC Guidelines for National Greenhouse Gas Inventories Volume 4 Chapter 10 guidelines specify a default value of 10% of the maximum methane producing potential (Bo) for the physical leakages from anaerobic digesters.

"Alternatively, By is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required."

The net NRB emission reductions were calculated multiplying with the above net to gross emission factor of 0.95 to simplify the monitoring of woody biomass use in the project and non-project households. Please see the table below:

**Non-renewable biomass component**

*Methodology: AMS-I.E. "Switch from non-renewable biomass for thermal applications by the user", version 4*

$$ER_y = B_y * f_{NRB,y} * NCV_{biomass} * EF_{projected\_fossilfuel}$$

| Parameter | Abbr. | Value | Unit |
|---|---|---|---|
| Number of households | N | 7620 | |
| Quantity of biomass substituted or displaced in tonnes (per unit per year) | $B_y$ | 5.3153 | t |
| Fraction of biomass that is non renewable | $f_{NRB,y}$ | 0.9553 | |
| Net calorific value of biomass | $NCV_{biomass}$ | 0.015 | TJ/t |
| Default emissions factor | $EF_{projected\_fossilfuel}$ | 81600 | kgCO2/TJ |
| Factor to convert units | | 1.00E-03 | |
| | | | |
| **BE annual** | $ER_y$ | **47,359** | t CO2e |
| **Net to gross adjustment factor** | | **0.95** | **Factor** |
| BE annual for 1 unit | | 5.904 | Net ERs |

### B.6.2. Data and parameters fixed ex ante

| Data / Parameter | **$B_y$** |
|---|---|
| Unit | T |
| Description | Quantity of biomass that is substituted or displaced in tonnes (per unit per year) |
| Source of data | Baseline survey |
| Value(s) applied | 5.3153 |
| Choice of data or Measurement methods and procedures | The value is defined based on a survey of a representative sample of households. The survey is described in Annex 3. |
| Purpose of data | Determination of baseline emissions |
| Additional comment | |

| Data / Parameter | **$f_{NRB}$** |
|---|---|
| Unit | Dimensionless |
| Description | Fraction of biomass used in the absence of project activity that can be established as non-renewable biomass using survey methods |
| Source of data | State of the Forest Report – 2011, Government of India |
| Value(s) applied | 0.9553 |
| Choice of data or Measurement methods and procedures | The value is provided by the Government of India for the State of Karnataka to where the project belongs. Details were provided in Annex 3. |

| | |
|---|---|
| Purpose of data | Determination of baseline emissions |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | **$GWP\_CH_4$** |
| Unit | t $CO_2$ / t $CH_4$ |
| Description | Global warming potential for methane |
| Source of data | IPCC |
| Value(s) applied | 25 |
| Choice of data or Measurement methods and procedures | Default value suggested by IPCC |
| Purpose of data | Determination of baseline emissions |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | **$N_{(T)}$** |
| Unit | Dimensionless (number) |
| Description | Number of heads per cattle species/category in an average household |
| Source of data | Baseline survey |
| Value(s) applied | 2.230 for dairy cows, 0.248 for buffalos, 1.027 for other cattle |
| Choice of data or Measurement methods and procedures | The values are defined based on a survey of a representative sample of households. The survey is described in Annex 3 |
| Purpose of data | Determination of baseline emissions |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | **$VS_{(T)}$** |
| Unit | kg dry matter / (head * day) |
| Description | Daily volatile solid excreted for livestock category T |
| Source of data | Tables 10A-4 to 10A-6 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Biogas Technology by B.T. Nijaguna (see reference 5 in Annex 5), Table 2.12 p29. |
| Value(s) applied | 3.8 for dairy cow, 3.1 for buffalo, 1.4 for other cattle |
| Choice of data or Measurement methods and procedures | India specific value taken for dairy cows from Biogas Technology by B.T. Nijaguna (see reference 5 in Annex 5). As nationally published values are not available for other cattle and buffalo, IPCC default Indian subcontinent values are used for buffalo and other cattle. |
| Purpose of data | Determination of baseline emissions |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | **$B_{o(T)}$** |
| Unit | $m^3$ $CH_4$/kg VS |
| Description | Maximum methane producing capacity for manure produced by livestock category T |
| Source of data | Tables 10A-4 to 10A-6 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories |

| | |
|---|---|
| Value(s) applied | 0.13 for dairy cattle, 0.1 for buffalo and other cattle |
| Choice of data or Measurement methods and procedures | Default values suggested by IPCC |
| Purpose of data | Determination of baseline emissions |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | **$MCF_{manure}$ ($MCF_{liquid}$, $MCF_{liquid\ with\ crust}$, $MCF_{solid}$)** |
| Unit | % |
| Description | Methane correction factor for cattle manure for each manure management system S by climate region k |
| Source of data | Table 10.17 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories |
| Value(s) applied | 78 for liquid/slurry manure management system ($MCF_{liquid}$), 48 for liquid/slurry manure management system with natural crust cover ($MCF_{liquid\ with\ crust}$), 5 for solid storage manure management system ($MCF_{solid}$) and 2 for dry storage manure management system ($MCF_{dry}$) |
| Choice of data or Measurement methods and procedures | Values corresponding to average annual temperature of 26.3°C are taken for $MCF_{liquid}$, $MCF_{liquid\ with\ crust}$ , $MCF_{solid}$ and $MCF_{dry}$. Temperature data was taken from Indian meteorological Department , Government of India, Bangalore office |
| Purpose of data | Determination of baseline emissions |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | **$MS_{manure}$ ($MS_{liquid}$,$MS_{liquid\ with\ crust}$, $MS_{solid}$, $MS_{dry}$)** |
| Unit | Dimensionless |
| Description | Fraction of livestock category T's manure handled using manure management system S in climate region k (fraction of livestock manure handled using liquid/slurry manure management system, fraction of livestock manure handled using liquid/slurry with natural crust cover, fraction of livestock manure handled using solid storage manure management system and fraction of livestock manure handled using dry storage manure management system)) |
| Source of data | Based on baseline survey |
| Value(s) applied | 0.36 for liquid/slurry manure management system ($MS_{liquid}$), 0.30 for liquid/slurry with crust cover manure management system ($MS_{liquid\ with\ crust}$), 0.16 for solid storage manure management system ($MS_{solid}$) and 0.04 for dry storage system ($MS_{dry}$) |
| Choice of data or Measurement methods and procedures | See manure component in section B.4 for the detailed explanation. |
| Purpose of data | Determination of baseline emissions |
| Additional comment | |

### B.6.3. Ex ante calculation of emission reductions

**Baseline emissions**

**(i) Avoided non-renewable biomass**

Annual baseline emissions for 1 operating unit:

$BE_y = B_y * f_{NRB} * NCV_{NRB} * EF_{projected\_fossil\ fuel} * 10^{-3}$

The following parameters are used:

| 1. Baseline wood fuel stoves energy generation per day | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Item** | **Factor** | **unit** | **Source** |
| **1** | Traditional cook stove efficiency | 10 | % | AMS I E |
| **2** | Fire wood consumption per day for cooking | 9.706373 | Kg | Baseline survey |
| **3** | Water heating stove efficiency | 20 | % | AMS I E |
| **4** | Fire wood consumption per day for water heating | 4.856004 | | Baseline survey |
| **5** | Calorific value of wood/kg | 15 | MJ | AMS I E |
| **6** | Net energy generation per day in cook stove | 14.55956 | MJ | Calculated |
| **7** | Net energy generation per day in water heating stove | 14.56801 | MJ | Calculated |
| **8** | Net energy generation per day | 29.12757 | MJ | Calculated |
| **9** | Total wood use in the baseline per day | 14.56238 | Kg | Baseline survey |

| 2. Baseline kerosene fuel stove energy generation per day | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Item** | **Factor** | **unit** | **Source** |
| **1** | Cook stove efficiency | 35 | % | BT Nijaguna |
| **2** | Kerosene consumption per year | 19.88 | L | Baseline survey |
| **3** | Density of kerosene | 0.817 | $kg/m^3$ | http://www.simetric.co.uk/si_liquids.htm |
| **4** | Net calorific value of kerosene | 43.8 | MJ/kg | Table 1.2 in 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2, Chapter 1. |
| **5** | Energy generation per | 249.0227 | MJ | Calculated |

| | | | | |
|---|---|---|---|---|
| | year | | | |
| **6** | Energy generation per day | 0.682254 | | Calculated |

**3. Total energy generation in the baseline average household**

| Sl. No. | Item | Factor | unit | Source |
|---|---|---|---|---|
| **1** | Energy generation through wood | 29.12757 | MJ/day | Table 2 above |
| **2** | Energy generation through kerosene | 0.682254 | MJ/day | Table 3 above |
| **3** | **Total energy generation per day** | **29.80982** | **MJ/day** | Calculated |

**4. Energy Generation by the average project unit**

| Sl. No. | Item | Factor | unit | Source |
|---|---|---|---|---|
| 1 | There will be 50% each of 2 and 3 cubic meter biogas generation plants in the project | 2.5 | $m^3$ | Average unit size of the project units. |
| 2 | NCV of biogas | 21.6 | MJ | BT Nijaguna |
| 3 | Biogas Stove thermal efficiency | 55 | % | BT Nijaguna |
| 4 | Net energy generation per day | 29.7 | MJ | Calculated |

**5. Quantity of wood replaced by the project unit**

| Sl. No. | Item | Factor | unit | Source |
|---|---|---|---|---|
| 1 | Net energy generation per day in the project unit | 29.7 | MJ | Table 4 above |
| 2 | Net energy required for cooking | 14.559 | MJ | Table 1 above, Wood replacement is full |
| 3 | Remaining energy to replace wood use in water heating stove | 15.141 | MJ | Point 1-2 |
| 4 | Energy required for water heating | 14.568 | kg/day | Table 1 above, Wood replacement is full |
| 5 | Remaining enrgy generated by the project | 0.573 | kg/day | Point 3-4 |
| 7 | Energy generated | 0.69881 | kg/day | Table 2 above, kerosene |

| | | | | |
|---|---|---|---|---|
| | by kerosene | | | replacement is partial |
| 8 | Yet to be needed energy per day | **-0.12581** | MJ/day | Point 5-6 |

| Parameter | Value | Unit | Source |
|---|---|---|---|
| $B_y$ | 5.3153 | T | Baseline survey |
| $f_{NRB}$ | 0.9553 | Factor | Annex 3, C. Calculations section |
| $NCV_{NRB}$ | 0.015 | TJ/t | IPCC 2006 T.1.2 |
| $EF_{kerosene}$ | 81,600 | kg $CO_2$/TJ | AMS I.E |

$BE_{NRB}$ = 5.3153 t * 0.9553 * 0.015 TJ/t * 81,600kg $CO_2$/TJ * $10^{-3}$ = 6.21 t $CO_2$

Leakage: gross to net adjustment factor described in the methodology is: 0.95

Net $BE_{NRB}$ = gross emission savings ( 6.21 t CO2 e) X adjustment factor (0.95) = 5.8995t $CO_2$

**(ii) Avoided methane from cattle manure**

Annual baseline emissions for 1 operating unit: (formula 1 in Para 10 of AMS III D)

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

| | |
|---|---|
| $BE_y$ | Baseline emissions in year *y* ($tCO_2e$) |
| $GWP_{CH4}$ | Global Warming Potential (GWP) of $CH_4$ (25) |
| $D_{CH4}$ | $CH_4$ density (0.00067 t/m$^3$ at room temperature (20 ºC) and 1 atm pressure) |
| $LT$ | Index for all types of livestock |
| $j$ | Index for animal manure management system |
| $MCF_j$ | Annual methane conversion factor (MCF) for the baseline animal manure management system *j* |
| $B_{0,LT}$ | Maximum methane producing potential of the volatile solid generated for animal type *LT* (m$^3$ $CH_4$/kg dm) |
| $N_{LT,y}$ | Annual average number of animals of type*LT* in year *y* (numbers) |
| $VS_{LT,y}$ | Volatile solids for livestock *LT* entering the animal manure management system in year *y* (on a dry matter weight basis, kg dm/animal/year) |
| $MS\%_{Bl,j}$ | Fraction of manure handled in baseline animal manure management system *j* |
| $UF_b$ | Model correction factor to account for model uncertainties (0.94)[7] |

**BEy Dairy cow** = 25*0.67*0.94*{78/100 ($MCF_{liquid}$/100) * 4.964/12 ($MS_{liquid)}$ + 48/100 ( $MCF_{liquid\ with\ crust}$/100 )* 4.125/12 ($MS_{liquid\ with\ crust}$ )+ 5/100 ($MCF_{solid}$/100) * 2.213/12 ($MS_{solid\ )}$+ 2/100 ($MCF_{dry}$/100) * 0.535/12 ($MS_{dry}$)}*0.13*2.2309*3.8*365*0.867*0.001 = 2.83

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

**BEy Buffalo** = 25*0.67*0.94*{78/100 ($MCF_{liquid}$/100) * 4.964/12 ($MS_{liquid)}$ + 48/100 ( $MCF_{liquid\ with\ crust}$/100 )* 4.125/12 ($MS_{liquid\ with\ crust}$ )+ 5/100 ($MCF_{solid}$/100) * 2.213/12 ($MS_{solid\ )}$+ 2/100 ($MCF_{dry}$/100) * 0.535/12 ($MS_{dry}$)}*0.1*0.248*3.1*365*0.867*0.001 = 0.18

**BEy Other cattle** = 25*0.67*0.94*{78/100 ($MCF_{liquid}$/100) * 4.964/12 ($MS_{liquid)}$ + 48/100 ( $MCF_{liquid\ with\ crust}$/100 )* 4.125/12 ($MS_{liquid\ with\ crust}$ )+ 5/100 ($MCF_{solid}$/100) * 2.213/12 ($MS_{solid\ )}$+ 2/100 ($MCF_{dry}$/100) * 0.535/12 ($MS_{dry}$)}*0.1*1.0279*1.4*365*0.867*0.001 = 0.35

BE manure for one unit of 3 cubic meter size = 2.83 + 0.19 + 0.36 = 3.36 t CO2 e
BE manure for 2 cubic meter unit = 3.36 * 2/3 as 2 cubic meter plant will treat 2/3 capacity of the dung treated in a 3 cubic meter plant = 2.239= 2.24

BE manure for an average unit = There will be equal number of units of both the sizes = (3.36+ 2.24) / 2 = 2.81t CO2e/year

The following parameters are used:

| Parameter | Value | Unit | Source |
|---|---|---|---|
| $GWP\_CH_4$ | 25 | kg $CO_2$ / kg $CH_4$ | IPCC |
| $MCF_{liquid}$ | 78 | % | IPCC 2006 T. 10A-4 to 10A-6 and 10.17 |
| $MCF_{liquid\ with\ crust}$ | 48 | % | IPCC 2006 T. 10A-4 to 10A-6 and 10.17 |
| $MCF_{solid}$ | 5 | % | IPCC 2006 T. 10A-4 to 10A-6 and 10.17 |
| $MCF_{dry}$ | 2 | % | IPCC 2006 T. 10A-4 to 10A-6 and 10.17 |
| $MS_{liquid}$ | 0. 36 | - | Baseline survey |
| $MS_{liquid\ with\ crust}$ | 0.30 | - | Baseline survey |
| $MS_{solid}$ | 0.16 | | Baseline survey |
| $MS_{dry}$ | 0.04 | | Baseline survey |
| ***Dairy cow*** | | | |
| $N_T$ | 2.2309 | - | Baseline survey |
| $VS_{(T)}$ | 3.8 | kg dry matter/(head*day) | Biogas Technology by B.T. Nijaguna |
| $B_{o(T)}$ | 0.13 | $m^3$ $CH_4$/kg VS | IPCC 2006 T. 10A-4 to 10A-6 |
| ***Buffalo*** | | | |
| $N_T$ | 0.248 | - | Baseline survey |
| $VS_{(T)}$ | 3.1 | kg dry matter/(head*day) | IPCC 2006 T. 10A-4 to 10A-6 |
| $B_{o(T)}$ | 0.1 | $m^3$ $CH_4$/kg VS | IPCC 2006 T. 10A-4 to 10A-6 |
| ***Other Cattle*** | | | |
| $N_T$ | 1.0279 | - | Baseline survey |
| $VS_{(T)}$ | 1.4 | kg dry matter/(head*day) | IPCC 2006 T. 10A-4 to 10A-6 |
| $B_{o(T)}$ | 0.1 | $m^3$ $CH_4$/kg VS | IPCC 2006 T. 10A-4 to 10A-6 |

(iv) Total baseline emissions for one operating unit:

$BE = BE_{NRB} + BE_{manure}$ = 5.90t $CO_2$ + 2.81t $CO_2e$ = 8.71 t $CO_2e$

Project emissions

"Project emissions due to physical leakage of biogas digester is estimated using one of the two options using the method indicated in paragraph 13 of AMS-III.D "Methane recovery in animal manure management systems".

The project emissions are calculated based on the option b) of the Para 13:
So the Project emissions are calculated as below:
PE = Average biogas generation per day in an average unit x days in a year x default leakage value ($0.05m^3/m^3$ of biogas produced) x content of methane in the biogas x specific gravity of methane x GWP of Methane (25) x conversion factor of kg to ton(1000)
PE = 2.5 x 365 x 0.05 x 0.60 x 25 x 0.67 / 1000 = 0.46 tons/year

Emission reductions

Emission reductions for one operating unit:

BE = BE– PE = 8.71 t $CO_2$ – 0.46 t $CO_2$e = 8.25t $CO_2$e

Annual emission reductions for the whole project are calculated by multiplying emission reductions for one operating unit by number of biogas units operating in that year. Schedule for construction and operation of biogas units is provided in the table below:

| **Year** | **Units built** | **Units in Operation** |
|---|---|---|
| 2015* | 0 | 0 |
| 2016 | 4000 | 2000 |
| 2017 | 3620 | 5,810 |
| 2018 | | 7,620 |
| 2019 | | 7,620 |
| 2020 | | 7,620 |
| 2021 | | 7,620 |
| 2022 | | 7,620 |
| 2023 | | 7,620 |
| 2024 | | 7,620 |

* Though crediting period starts on 2015, the actual implementation starts only during 2016 and the emission reduction is estimated based on the same. Also the implementation schedule mentioned here is indicative only and the actual implementation may vary.

### B.6.4. Summary of ex ante estimates of emission reductions

| Year | Average units in operation | NRB (ER y) | Manure CH4 | BE | PE | ER |
|---|---|---|---|---|---|---|
| | For 1 unit | 5.90 | 2.803 | 8.71 | 0.46 | 8.25 |
| 2015 | - | | | | | |
| 2016 | 2,000 | 11,809 | 5,607 | 17,416 | 917 | 16,499 |
| 2017 | 5,810 | 34,304 | 16,288 | 50,593 | 2,664 | 47,929 |
| 2018 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2019 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2020 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2021 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2022 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2023 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| 2024 | 7,620 | 44,991 | 21,363 | 66,354 | 3,494 | 62,860 |
| | | | | | **Total for 10** | **5,04,448** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | **Years** | |
| | | | | | **Annual average** | **50,444** |
| **Total reductions** | | 3,61,053 | 1,71,434 | 5,32,487 | 28,039 | 5,04,448 |

| Year | Baseline emissions (t $CO_2e$) | Project emissions (t $CO_2e$) | Leakage (t $CO_2e$) * | Emission reductions (t $CO_2e$) |
|---|---|---|---|---|
| 2015 | - | - | | - |
| 2016 | 17,416 | 917 | | 16,499 |
| 2017 | 50,593 | 2,664 | | 47,929 |
| 2018 | 66,354 | 3,494 | | 62,860 |
| 2019 | 66,354 | 3,494 | | 62,860 |
| 2020 | 66,354 | 3,494 | | 62,860 |
| 2021 | 66,354 | 3,494 | | 62,860 |
| 2022 | 66,354 | 3,494 | | 62,860 |
| 2023 | 66,354 | 3,494 | | 62,860 |
| 2024 | 66,354 | 3,494 | | 62,860 |
| **Total** | 5,32,497 | 28,039 | | 5,04,448 |
| **Total number of crediting years** | 10 years | | | |
| **Annual average over the crediting period** | **53,249** | **2,803** | | **50,444** |

*Leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project households/users that is attributable to the project activity, then $B_y$ is adjusted to account for the quantified leakage. The gross NRB has been multiplied by 0.95 and the resulted value has been taken as net value to calculate the emission reductions.

## B.7. Monitoring plan

### B.7.1. Data and parameters to be monitored

| Data / Parameter | $N_{operating}$ |
|---|---|
| Unit | - |
| Description | Number of systems (biogas units) operating |
| Source of data | SKG Sangha personnel and yearly surveys by SKG Sangha (taluk level monitoring team) |
| Value(s) applied | 7,620 |

| | |
|---|---|
| Measurement methods and procedures | When SKG Sangha starts biogas unit installation in a village, it trains a local person (the motivator) to be the main contact with SKG Sangha, to maintain and repair biogas systems, and to monitor and report the operation of systems. All biogas unit beneficiaries in the village are introduced to this person. They report any faults to the motivator and normally any faults with the biodigesters are resolved by this person on the same day as the complaint is lodged. The motivator records any periods of non-functioning (in days). In addition, the motivator visits the beneficiaries at least once per month to check whether biodigesters and burners are functioning properly. All records are made by the motivator by hand in two paper copies of a monitoring journal. One copy is sent at the end of the month to the taluk level, and another copy is kept at the village level. |
| Monitoring frequency | Annual |
| QA/QC procedures | The level of uncertainty of recording this parameter is low. The methodology requires recording the number of systems operating annually. In this case, the recording will be done monthly, and any periods of non-functioning will be recorded. Beneficiaries are not likely not to report faults, as any non-functioning means non availability of clean and simple cooking. Normally beneficiaries want to resolve any problems as soon as they appear. Nevertheless, monitoring team from the project level will do random checks to check whether the data recorded by the motivator is correct. |
| Purpose of data | Determination of ER |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | $N_T$ |
| Unit | |
| Description | Annual average animal population in a household (number of heads of dairy cow, buffalo and other cattle). |
| Source of data | Survey of a sample of households by SKG Sangha (taluk level monitoring team). |
| Value(s) applied | 2.2309 for dairy cow, 0.248 for Buffalo and 1.0276 for Other cattle |
| Measurement methods and procedures | Survey of a representative sample (at least 5%) of beneficiaries. The surveys will be carried out once per year by the taluk level monitoring team. Annex 6 contains the survey sheet. The team will count the number of heads of cattle and will clarify with the household people during a discussion whether there were any changes in number of heads throughout a year. |
| Monitoring frequency | Annual |
| QA/QC procedures | Monitoring team from the project level will do random checks to check whether the data recorded by the taluk level team is reasonable and correct. |
| Purpose of data | Determination of ER |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | $B_{manure,generated}$ |
| Unit | T |
| Description | Average amount of animal manure generated per household per year and animals kept in shed per day. |

| | |
|---|---|
| Source of data | Survey of a sample of households by SKG Sangha (taluk level monitoring team). |
| Value(s) applied | 0.87 |
| Measurement methods and procedures | Survey of a representative sample (at least 5%) of beneficiaries. The surveys will be carried out once per year by the taluk level monitoring team. Annex 6 contains the survey sheet. The amount will be determined by during discussions with the beneficiaries. |
| Monitoring frequency | Annual |
| QA/QC procedures | Monitoring team from the project level will do random checks to check whether the data recorded by the taluk level team is reasonable. Additionally the parameter will be cross-checked with calculated amount of generated manure by multiplying heads of different types of cattle by typical amount of manure generated by these cattle types. |
| Purpose of data | Determination of ER |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | $\mathbf{B_{manure,fed}}$ |
| Unit | T |
| Description | Average amount of animal manure fed into a biogas digester per year. |
| Source of data | Survey of a sample of households by SKG Sangha (taluk level monitoring team). |
| Value(s) applied | 0.0625 |
| Measurement methods and procedures | Survey of a representative sample (at least 5%) of beneficiaries. The surveys will be carried out once per year by the taluk level monitoring team. Annex 6 contains the survey sheet. The amount will be determined from discussions with the beneficiaries and by weighing the dung to be fed into the digester using a weighing machine/scale on the day of the visit. |
| Monitoring frequency | Annual |
| QA/QC procedures | Monitoring team from the project level will do random checks to check whether the data recorded by the taluk level team is reasonable. |
| Purpose of data | Determination of ER |
| Additional comment | |

| | |
|---|---|
| Data / Parameter | **Application of sludge** |
| Unit | n/a (qualitative information) |
| Description | Proper application of the sludge from the biogas unit. |
| Source of data | Survey of a sample of households by SKG Sangha (taluk level monitoring team). |
| Value(s) applied | - |
| Measurement methods and procedures | Survey of a representative sample (at least 5%) of beneficiaries. The surveys will be carried out once per year by the taluk level monitoring team. Annex 6 contains the survey sheet. Application of the sludge will be determined from discussions with the beneficiaries on where, how and when the sludge is used. |
| Monitoring frequency | Annual |
| QA/QC procedures | Monitoring team from the project level will do random checks to check whether the information recorded by the taluk level team is reasonable. |
| Purpose of data | Determination of ER |
| Additional comment | |

### B.7.2. Sampling plan

Through its work with biogas plants over the last 15 years, SKG Sangha has developed a system of installing and maintaining the biogas units. The operational and monitoring plan builds on this experience.
The scheme in the page below shows distribution of monitoring tasks and responsibilities between different levels of project implementation: the project level (the main SKG Sangha office: project coordinator with a team), the taluk level (supervisor with a team) and the village level (so-called motivator). Please see Appendix 5 for detailed monitoring information

### B.7.3. Other elements of monitoring plan

Please see Appendix 5 for detailed monitoring information

### B.8. Date of completion of application of methodology and standardized baseline and contact information of responsible persons/ entities

10th August 2009. SKG Sangha (see Appendix I for full contact details).

## SECTION C. Duration and crediting period

### C.1. Duration of project activity

### C.1.1. Start date of project activity

The project activity is not yet started and the project idea was presented in the stake holder meeting and the project activity starting was anticipated to be on 1st January 2015 or the date on which the project is registered with the UNFCCC whichever is later. This is the foreseen date of the start of implementation. Note that crediting period will start in 2015 (see C.2.2).

### C.1.2. Expected operational lifetime of project activity

A biogas unit will work for a period at least 20 years.

### C.2. Crediting period of project activity

### C.2.1. Type of crediting period

Fixed crediting period

### C.2.2. Start date of crediting period

The crediting period will start on 01/01/2015, or on the date that the CDM project activity is registered with the CDM Executive Board, whichever is later

### C.2.3. Length of crediting period

10 years

## SECTION D. Environmental impacts

### D.1. Analysis of environmental impacts

No negative environmental impacts were identified. The project will have the following positive environmental impacts in addition to the reduction in $CO_2$ and $CH_4$ emissions:

- The project will reduce consumption of fuel wood reducing pressure on scarce forest resources. Currently the major part of collected fuel wood represents non-renewable biomass;

- Efficient clean cooking biogas stoves will reduce indoor air pollution;
- Soil quality and its water retention capacity are expected to improve after replacing indiscriminate use of chemical fertilizers with application of high-quality compost; and
- The risk of water pollution will be reduced due to proper management of wastewater and reduced use of chemical fertilizers and pesticides more over leaching from compost pits.

## SECTION E. Local stakeholder consultation

### E.1. Solicitation of comments from local stakeholders

Representatives of the local government (Zilla Panchayath, Taluk Panchayath and Gram Panchayath) and general population in the project areas (people from households that could potentially be project beneficiaries, farmers, women from local self-groups, NGOs, as well as village representatives) were invited to the stakeholder consultation meetings. Some village people were consulted at their homes.

Representatives of the local government were invited to the meeting by sending to them invitation letters together with a non-technical summary of the project. Village people were invited in the form of tom tom (a form of announcement made in the villages beating a leather drum to gain attention of the people to announce the subject) one day in advance of the consultation meeting, and in the bigger villages SKG Sangha members also personally met people and invited them to the main consultation meeting.

The main meeting was held in Govt, Higher primary school premises in Pattlu village of Channapatna Taluk, Ramanagara District on 06-12-2009.
In the main consultation meetings, SKG Sangha presented the project, some farmers who already have biogas systems installed told about their experiences. Meeting attendees were invited to make comments and discuss the project. A blind sustainable development exercise was also conducted to identify stakeholders' opinion on project's environmental and social impacts. Finally, the attendees filled in short evaluation forms.
(Meeting report is attached as Annex 1)

### E.2. Summary of comments received

During the discussion participants raised a number of questions and wanted clarifications on area limitation, size of the plant, cost to the beneficiary, etc. Organizers explained the limitation of the small scale CDM project for its restricted carbon savings, price of the CERs as the limiting factor for recovery of unit cost and upfront payment required for the project implementation and the related issues as clarifications.

The meeting attendees expressed overwhelming support to the project and welcomed the initiative taken by SKG Sangha. Main comments and answers are summarized in a table below.

| Stakeholder Comment | Response to comment |
|---|---|
| Explain better how the households contribute | Beneficiaries contribute in labour or by purchasing some of the materials, e.g. manual work to build the plant together with the mason; getting sand; or purchasing bricks. |
| Why don't atmosphere spoilers bare the entire cost? | Explained about the Kyoto Mechanism, CDM Gold Standard methods and CER pricing. Organizers assured the participants that they will try their best to get the highest price for the CERs so that the stakeholders' contribution will be minimal. |
| Why not take up this programme in other taluks? | The present programme is meant for 6 taluks and SKAG Sangha is looking for possibilities to do similar projects in |

| | |
|---|---|
| | other taluks |
| Why has the SKG Sangha not undertaken this programme earlier? | They were told that CDM EB approved the needed methodology during later period of 2007 and since then the SKG Sangha is collecting the baseline information required for the project and now it came to this stage. |
| Why not do something for the household who does not have cattle? | SKG Sangha is trying to take up the installation of improved cook stove programme in the near future to tackle the problem of indoor air pollution in the households who do not have cattle and bioreactor. |

The majority of responses to written evaluation forms also indicate that stakeholder consultation meeting attendees liked the meeting and enjoyed learning about biogas. Some representative answers and main points raised in the meeting evaluation forms can be summarised as follows:

**Q: What is your impression of the meeting?**

1. 'I learned about biogas / composting.'
2. Majority of the participants simply wrote that the meeting went well

**Q: What do you like about the project?**

1. 'Savings and health improvement'
2. 'Now we can afford the unit'
3. 'Clean environment and affordability '
4. Faster cooking, time saving

**Q: What do you not like about the project?**

1. 'It is not useful to the people who do not own cattle', 'Cow dung is a must'
2. 'Limiting the project to our areas alone'

Many said there is nothing in the project they do not like

### E.3. Report on consideration of comments received

The comments did not influence the project design, as no negative comments and assessments that could influence the project design were received from stakeholders. Stakeholders liked and welcomed the project idea. Negative comments were only related to reasons behind project area restriction – why it cannot be expanded to other taluks and to households with fewer cattle. Households with fewer cattle may not profit from the biogas reactors as the reactors would not generate enough biogas. Project expansion to other taluks may be possible if a biomass availability study can be conducted and if it shows a high share of non-renewable biomass.

## SECTION F. Approval and authorization

The host country letter of approval for the project activity is available at the time of submitting the PDD to the validating DOE. A Copy of the same has been submitted to DOE.

# Appendix 1. Contact information of project participants and responsible persons/ entities

| | |
|---|---|
| Project participant and/or responsible person/ entity | ☒ Project participant<br>☐ Responsible person/ entity for application of the selected methodology (ies) and, where applicable, the selected standardized baselines to the project activity |
| Organization name | SKG Sangha |
| Street/P.O. Box | 2nd Main Road, Gandhi Nagar |
| Building | 532 |
| City | Kolar |
| State/Region | KarnatakaState |
| Postcode | 563 101 |
| Country | India |
| Telephone | +91 9243436266, +91 81522 25370 |
| Fax | +91 8152224146 |
| E-mail | skgsangha@gmail.com |
| Website | www.skgsangha.org |
| Contact person | |
| Title | Mr. |
| Salutation | |
| Last name | Devabhaktuni |
| Middle name | |
| First name | Vidya Sagar |
| Department | |
| Mobile | +91 98441 60038 |
| Direct fax | +91 81522 24146 |
| Direct tel. | +91 9243436266 |
| Personal e-mail | info@skgsangha.org |

# Appendix 2. Affirmation regarding public funding

The proposed project activity does not involve any public funding. The participating households will make a small in kind contribution of materials and labour but otherwise no other funding or assistance will be available to implement the project. The project will be funded solely from the sale of the offsets created from the project's GHG emission reductions.

# Appendix 3. Applicability of methodology and standardized baseline

## A. Baseline survey sheets

| Household Energy & Manure management Survey | | |
|---|---|---|
| Village : | Taluk : | Date<br>Survey Number in Village. |

1. General Data

| | | | | | |
|---|---|---|---|---|---|
| Name : | | | | | |
| Number of people in the family : | | | | | |
| Income : .....Rs | ☐ per day | ☐ per week | ☐ per month | ☐ per year | |

| | | | |
|---|---|---|---|
| 1. Electrical Appliances in the Home.<br>a. Bulbs..... | b.Fans ..... | c. Others..... | |
| 2. What kind of bulbs.<br>a. Incandescent..... | b. Fluorescent..... | c. CFL..... | |
| 3. No. of units consumed in a month. | | | |

2. Fuel Consumption

| | Kerosene | | | | | |
|---|---|---|---|---|---|---|
| Use for | Quantity (Litres) | | | | | Price per litre (Rs) |
| Cooking : | | ☐ per day | ☐ per week | ☐ per month | ☐ per year | Subsidised : |
| Lighting Fire : | | ☐ per day | ☐ per week | ☐ per month | ☐ per year | |
| Lighting : | | ☐ per day | ☐ per week | ☐ per month | ☐ per year | in the market : |
| Other : | | ☐ per day | ☐ per week | ☐ per month | ☐ per year | |
| Quantity subsidised by government : | | ☐ per day | ☐ per week | ☐ per month | ☐ per year | |

| Firewood | | | | | |
|---|---|---|---|---|---|
| Used and Source | Quantity (kg) | | | | |
| Used for cooking | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |
| Used for other purposes | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |
| Purchased | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |
| Collected from forests | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |
| collected from private land | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |
| Other source | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |
| (specify)..... | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |

| | | | | | |
|---|---|---|---|---|---|
| Purchased wood : | Price :<br>Price trend in recent years : | .....Rs/Kg, or.....Rs / tonne<br>☐ increasing ☐ stable ☐ decreasing<br>☐ don't know | | | |
| Collected wood : | Time spent collecting (hours) : | ☐ per day | ☐ per week | ☐ per month | |
| | Trend in time taken to collect wood in recent years : | ☐ increasing ☐ stable ☐ decreasing<br>☐ don't know | | | |
| | Distance to collection area : | | | | |
| | Distance trend in past years : | ☐ increasing ☐ stable ☐ decreasing<br>☐ don't know | | | |
| | Type of firewood collected (if possible, provide approximate share) | Chopped trees : ☐ | | | |
| | | Chopped branches : ☐ | | | |
| | | dead wood on ground ☐ | | | |
| | | other : ☐ | | | |

| Other biomass | | | | | |
|---|---|---|---|---|---|
| Type (Specify) | (Quantity (kg) | | | | |
| | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |
| | | ☐ per day | ☐ per week | ☐ per month | ☐ per year |

3. Manure management

| | | | | |
|---|---|---|---|---|
| Livestock numbers | Dairy cows :..... | Buffalos :..... | | Other cattle :..... |
| Where do you normally keep the animals ? | ☐ in a shed | .....☐ hours per day<br>.....☐ share (%) | ☐ in the fields | .....☐ hours per day<br>.....☐ share (%) |
| Where is the manure from the shed put ? | ☐ in a pit | ☐ on the fields | ☐ other..... | |
| What happens to the dung from the animals when they are in the fields ? | ☐ Collected and put in pit | ☐ Left in the fields | ☐ other ..... | |
| Total quantity of manure produced by animals (approximately, if known) : | ☐ kg<br>☐ tonnes<br>☐ baskets | ☐ per day<br>☐ per month | ☐ per week<br>☐ per year | |
| Total quantity of dung collected from shed and put in pit : | ☐ kg<br>☐ tonnes<br>☐ baskets | ☐ per day<br>☐ per month | ☐ per week<br>☐ per year | |
| Total quantity of dung collected from fields and put in pit : | ☐ kg<br>☐ tonnes<br>☐ basket | ☐ per day<br>☐ per month | ☐ per week<br>☐ per year | |

If some dung goes into a compost pit

| | | |
|---|---|---|
| (i) What is the depth of the pit (in metres) ? | .....m | |
| (ii) Apart from dung, what else is added to the pit ? | ☐ Crop waste ☐ Food waste ☐ Toilet waste ☐ Other | |
| (iii) What share of the pit is made up of this other waste ? | Approximately.....% of the total material in the pit | |
| (iv) For how many months of the year is the material in the pit most like the following state ? | ☐ An uncovered slurry<br>☐ A covered slurry or slurry with crust<br>☐ Solid material but wet<br>☐ Solid material and dry | ..... months<br>..... months<br>..... months<br>..... months |
| (v) How long does it take the pit to fill up ? | .....months | |
| (vi) What happens to manure and other pit waste once the pit is full ? | ☐ Manure and other waste is piled on top of the existing pit<br>☐ A new pit is dug and manure and waste is put in there<br>☐ Other ..... ..... | |
| (vii) Does the material in the pit get mixed or turned ? | ☐ yes ☐ no (if yes please indicate how often) | |
| (viii) How often does the pit get emptied | ☐ once per year (indicate month(s) when pit emptied.....)<br>☐ more than once per year (indicate how often .....) | |

4. Interest in biogas

| | | | | | |
|---|---|---|---|---|---|
| Are you interested in getting a biogas unit ? | ☐ yes | ☐ no | | | |
| If yes, why ? | ☐ less smoke | ☐ time saving | ☐ money saving | ☐ cleaner | ☐ organic manure |
| | ☐ more convenient to cook | | ☐ other | | |
| If no, why ? | | | | | |

Signature of the Compiler

Signature of the interviewer

B. **Survey results:**

| Nr. | Survey Question | Unit | Average | Corresponding parameter | Value | Unit |
|---|---|---|---|---|---|---|
| | | | | | | |
| 1 | Kerosene use | | | | | |
| 1.1 | for cooking | l/month | 1.1559 | F_kerosene | 13.87 | l/year |
| 1.2 | for starting fire | l/month | 0.50099 | F_kerosene | 6.0119059 | l/year |
| 2 | Firewood use | | | | | |
| 2.1 | cooking | kg/day | 9.70637 | Biomass for cooking | 3.543 | t/year |
| 2.2 | other use | kg/day | 4.856 | Biomass for other uses | 1.772 | t/year |
| 2.3 | total | kg/day | 14.5624 | $B_y$ (Quantity of biomass that is substituted or displaced in tonnes (per unit per year) | 5.3153 | t/year |
| 3 | Animals | | | | | |
| 3.1 | dairy cows | head | 2.2309 | N_dairy_cow | 2.231 | number |
| 3.2 | buffalo | head | 0.24805 | N_buffalo | 0.248 | |
| 3.3 | other cows | head | 1.0277 | N_other_cattle | 1.028 | |
| 3.4 | animals kept in the shed | h/day | 20.3528 | f_collected | 0.867 | % |
| 3.5 | animals graze in the fields | h/day | 3.133 | | | |
| 3.6 | animal manure production | kg/day | 71.2761 | | | |
| 3.7 | manure collected and put into pit | kg/day | 61.1368 | f_collected | 0.858 | % |
| 4 | Manure pits | | | | | |
| 4.1 | Depth | m | 1.21849 | | | |
| 4.2 | material as uncovered slurry | months | 4.96356 | MS_liquid = E4.2 / ∑(E4.2:E4.5) * f_collected) | 0.363 | Factor |
| 4.3 | material as covered slurry | months | 4.12488 | MS_covered slurry = E4.2 / ∑(E4.2:E4.5) * f_collected) | 0.302 | Factor |
| 4.4 | solid material but wet | months | 2.21298 | MS_solid but wet = E4.2 / ∑(E4.2:E4.5) * f_collected) | 0.162 | Factor |
| 4.5 | solid material but dry | months | 0.53544 | MS_solid but dry = E4.2 / ∑(E4.2:E4.5) * f_collected) | 0.039 | Factor |

# Appendix 4. Further background information on ex ante calculation of emission reductions

**Non Renewable Biomass:**
The baseline survey was conducted in 2009. Since then the NRB rate has been increasing. The current data available is from Ministry of Environment and Forests, Government of India. They have conducted baseline surveys, collected data from state forest departments and correlated this information with the satellite imageries to come to conclusions ((http://www.fsi.org.in ). The PP has decided to use the current data for its NRB calculations as the project has not yet been started. The project implementation only starts after successful registration of the project. The following methodological point wise description leads to the quantity of NRB.

***Differentiation between non-renewable and renewable woody biomass***

| | | | |
|---|---|---|---|
| Demand | 20,967,000 | t/year | SFI -2011 page 77 |
| supply from forests | 30,000 | t/year | SFI -2011 page 72 |
| Supply from TOF | 907,000 | t/year | SFI -2011 page 73 |
| non renewable | 20,030,000 | t/year | Demand - supply |
| NRB | 0.9553107 | NRB/(NRB+DRB) | calculated |

1. *Project participants shall determine the shares of renewable and non-renewable woody biomass in* $B_y$ *(the quantity of woody biomass used in the absence of the project activity) the total biomass consumption using nationally approved methods (e.g. surveys or government data if available) and then determine* $f_{NRB,y}$ *as described below.*

Karnataka state demand and supply of fire wood
The total fuel wood consumption and supply data is published by the government of India. (http://www.fsi.org.in/sfr_2011.htm).
It is evident that 95% of the fire wood used by the households is non – renewable.

*The following principles shall be taken into account:*

***Demonstrably renewable woody biomass (DRB)***

*Woody biomass is "renewable" if one of the following two conditions is satisfied:*

1. *The woody biomass is originating from land areas that are forests where:*

   (a) *The land area remains a forest;*

   The land area remained forest area see table below:.

| **Year** | **2005** | **2011** | Source |
|---|---|---|---|
| Geographical area in Sq. Km. | 38,284 | 38,284 | SFR 2005 and 2011 |

Source:

1. http://www.fsi.org.in/sfr_2011.htm
2. http://www.fsi.org.in/sfr_2005.htm

(b) *Sustainable management practices are undertaken on these land areas to ensure, in particular, that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and*

Indian forests are managed by the Ministry of Forests and sustainable management is practiced to maintain carbon stocks (http://www.fsi.org.in/sfr_2011.htm)

(c) *Any national or regional forestry and nature conservation regulations are complied with*.

The forests are reserve forests under the law and are protected by forest departments of those particular state or union territory governments (http://www.fsi.org.in/sfr_2011.htm).

2. *The biomass is woody biomass and originates from non-forest areas (e.g. croplands, grasslands) where:*

(a) *The land area remains cropland and/or grasslands or is reverted to forest;*

The land areas remain croplands or fallow lands and there is no change of land extent for more than a decade.

Source: 1.http://www.fsi.org.in/sfr_2011.htm
2.http://www.fsi.org.in/sfr_2001.htm

(b) *Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and*

(c) *Any national or regional forestry, agriculture and nature conservation regulations are complied with.*

No regulations are preventing farmers to use biomass in their lands for fire wood use.

**Non-renewable biomass**

*Non-renewable woody biomass (NRB) is the quantity of woody biomass used in the absence of the project activity ($B_y$) minus the DRB component, as long as at least two of the following supporting indicators are shown to exist:*

- *A trend showing an increase in time spent or distance travelled for gathering fuel-wood, by users (or fuel-wood suppliers) or alternatively, a trend showing an increase in the distance the fuel-wood is transported to the project area;*

100% respondents, who are collecting wood from forests of the baseline survey, confirmed that they have to travel longer distances to collect firewood. They also said that the distance trend is increasing for more than a decade. See base line survey data provided in the ER Spread sheet.

- *Survey results, national or local statistics, studies, maps or other sources of information, such as remote-sensing data, that show that carbon stocks are depleting in the project area;*

The Forest Survey of India monitors the forests and provides bi-annual reports about the status of bio resources in India. They use survey methods and collect information from local forest personnel and compare data with remote sensing images and publish the data. The data provided by the reports of 1987, 1989 and subsequent reports until 2009 shows that the carbon stocks are depleting in India.

Actual tree cover in Karnataka is 32,264 sq. kilometers according to 1987 State of Forest report (page 38) of Government of India.

The tree cover has come down to 32,100 Sq kilometers by the time of 1989 report (page 20) and it came down further to 5,683 sq. kilometers according to the same report of 2009 (page:34) (Source: http://www.fsi.org.in/ )

**Depleting bio-resources in the project areas:**

| **Dist.** | **Bangalore Rural** | |
|---|---|---|
| **Year / Type of forests** | **2001** | **2011** |
| Geographical area | 5815 | 5815 |
| Very dense forest | 338 | 6 |
| Total | 836 | 812 |
| % of GA | 14.38 | 13.96 |
| Scrub | 261 | 253 |

Source of data: Forest survey of India reports of 2011 and 2001.

1. http://www.fsi.org.in/sfr_2011.htm
2. http://www.fsi.org.in/sfr_2001.htm

The above table shows that even though the forest geographical area remained same; the forest cover has come down from 836 Sq. Km in 2001 to 812 Sq. Kilometers in 2011, a degradation of 24 Sq. Kilometers in a decade's time. More over the % of tree cover has come down from 14.38 % to 13.96%. By the time of 2011 study the dense forests in the year 2001 of 338 Sq kilometers has become only 6 Sq. kilometers. This trend shows the depleting bio-resources in Bangalore Rural district to which the project district belong (Ramanagara district was carved out of Bangalore Rural District).

A number of studies have shown that project area taluks are a bio-resource deficient zone meaning that not only is there insufficient fuel wood to meet cooking and water heating demands, there is also a shortage of other possible bio-resource substitutes like animal, crop and horticultural residues. Project area taluks were included in the eastern dry agro climatic zone which is identified as having a bio-resource availability to demand ratio of 0.39 i.e. only 39% of the bio-resources that were used could be considered to be renewable. Similar comments were made in the study "*Bioresource Potential of Karnataka: Technical Report No. 109*" (Ramachandra and Kamakshi)

With more than 70% of the population in rural areas, Ramachandra et al note that there is tremendous demand on resources such as fuel wood and agricultural residues to meet people's daily fuel needs. The more recent baseline survey has noted the high level of biomass use in the project area taluk for cooking and water heating needs.

The baseline survey described in section B.4 showed that the average distance for collecting fire wood by the households is 0.15 km, and the maximum distance mentioned was 5 km. So the collection of fire wood from the neighbouring districts is not possible. More over the neighbouring districts to Ramanagara district, Bangalore rural, Mandya, Tumkur and Chamarananagara are also bio resource deficit zones according to the *Bioresource Potential of Karnataka: Technical Report No. 109*" (Ramachandra and Kamakshi)[2]. The above studies and the present NRB rate shows that the bioresources are depleting in the project area.

- *Increasing trends in fuel wood prices indicating a scarcity of fuel-wood;*

The baseline survey indicates the rising prices of fire wood in the project area. 100% of the people who are purchasing fire wood stated that the prices are going up. This find is also proven by the study taken up by Dr. N.C Saxena. In his document titled "The wood fuel scenario and policy issues in India" for Food and Agricultural Organisation of the United Nations, Bangkok Dr. NC Saxena of Centre for Sustainable Development, LBS National Academy of Administration, Mussoorie demonstrated that the fuel wood prices are increasing by 50% in a decade's time. The price has increased from 91 rupees per ton in the year 1973 to rupees 438 in 1985 and the baseline survey showed that price has risen to 3,530 rupees per ton in 2009.

This study and the baseline survey results clearly show the increasing fuel wood price trend.

- *Trends in the types of cooking fuel collected by users that indicate a scarcity of woody biomass.*

In the baseline people are resorting to burning agricultural residues for cooking food and heating water as the bio resources are depleting in an alarming rate. There is a vast shortage of wood for cooking and people are forced to use agricultural residues for cooking and depriving the soils much needed organic fraction, humus. The resent document of Forest survey of India reinstated the same scarcity of fuel wood in its 2011 report.( http://www.fsi.org.in/sfr_2011.htm)

The following table shows the demand and supply of the fuel wood in Karnataka state.
Karnataka state demand and supply of fire wood. source: http://www.fsi.org.in/sfr_2011.htm

1. Thus, the fraction of woody biomass saved by the project activity in year *y* that can be established as non-renewable, is:

$$f_{NRB,y} = \frac{NRB}{NRB + DRB} \qquad \textbf{(1)}$$

There is a demand of 20,967, 000 tons of fuel wood per year. On the supply side there is only 937,000 tons of fuel wood is available from sustainable sources. This leaves a gap of 20,030,000 tons of fuel wood. This gap between the higher demand and lower supply deemed to be non renewable biomass. If the data is substituted in the above formula the resulting value is 0.955. It means that 95.5% of the wood used in Karnataka state is coming from non renewable sources and hence treated as NRB. This trend shows the depleting fire wood availability in the project areas.

*2. Project participants shall also provide evidence that the trends identified are not occurring*

| | | | |
|---|---|---|---|
| Demand | 20,967,000 | t/year | SFI -2011 page 77 |
| supply from forests | 30,000 | t/year | SFI -2011 page 72 |
| Supply from TOF | 907,000 | t/year | SFI -2011 page 73 |
| non renewable | 20,030,000 | t/year | Demand - supply |
| NRB | 0.9553107 | NRB/(NRB+DRB) | calculated |

*due to the enforcement of local/national regulations.*

There are no laws or regulations mandating people to use renewable bio resources for cooking and water heating. Fuel wood prices increase, trekking longer distance and spending longer time to collect fuel wood is happening due to the shortage of fuel wood and depleting carbon stocks but not because of any laws or regulations.

**Leakage**

*Leakage related to the non-renewable woody biomass saved by the project activity shallbe assessed based on ex post surveys of users and the areas from which this woody biomass is*

*sourced (using 90/30 precision for a selection of samples). The following potential source of leakage shall be considered:*

(a) *The use/diversion of non-renewable woody biomass saved under the project activity by non-project households/users that previously used renewable energy sources. If this leakage assessment quantifies an increase in the use of non-renewable woody biomass used by the non-project households/users that is attributable to the project activity, then* $B_y$ *is adjusted to account for the quantified leakage. Alternatively,* $B_y$ *is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.*

The gross NRB has been multiplied by 0.95 and the resulted value has been taken as net value to calculate the emission reductions. Hence no yearly monitoring surveys are required and the saved time of the project personnel can be used in other aspects related to the project.

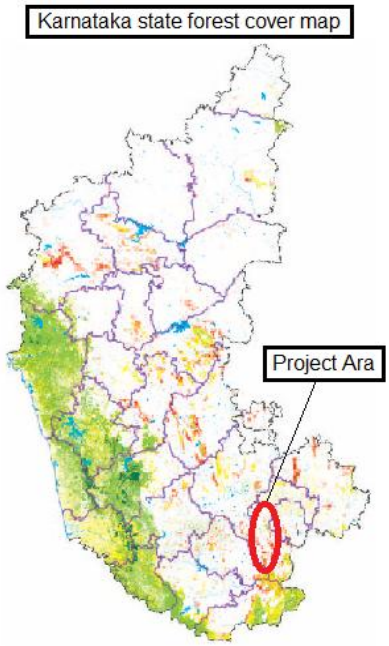
*3. If the equipment currently being utilised is transferred from outside the boundary to the project boundary, leakage is to be considered.*

The equipment currently in use is the traditional mud stoves. These stoves will remain in the household as the project is not replacing the 100% wood used by the household. Hence transferring of equipment does not arise.

*4. Project participants are able to show that non-renewable biomass has been used since 31 December 1989, using survey methods or referring to published literature, official reports or statistics.*

**Use of non-renewable biomass since 31st December 1989**

The project area is facing fuel wood crisis since many years as the area has scanty vegetation (see below figure).




Based on remote sensing imagery, the area had a vegetative cover of only 13.89% of geographic area (FSI, 2011). A study was conducted for the Karnataka Forest Department by Ranganathan *et al,* to assess the biomass demand and availability for all the districts of Karnataka during 1986-87. The sustainable biomass available for the districts was 3.7 million tons whereas the consumption is 19 million tons per annum. Thus the fraction of non-renewable biomass utilization during 1986- 87 was **0.80**. Thus non-renewable biomass is being used since 1989 in the project Districts.(Source: page 76, sources and supply of fuel wood in this document:

http://books.google.co.in/books?id=LEg9iHAyfmoC&pg=PA42&lpg=PA42&dq=V.Ranganathan,+Subba+Rao,+S+and+Prabhu,+G.S.+1993.+Demand+and+supply+of+fuel+wood+in+Karnataka.+Forest+Department,+Government+of+Karnataka,+Indian+Institute+of+Management,+Bangalore.&source=bl&ots=joOdkT1AnH&sig=zLkOL7hupliPUxamsaYRQUBCYM4&hl=en&sa=X&ei=Ca7hT5qSLIbNrQensNyTAw&ved=0CGEQ6AEwAQ#v=onepage&q=V.Ranganathan%2C%20Subba%20Rao%2C%20S%20and%20Prabhu%2C%20G.S.%201993.%20Demand%20and%20supply%20of%20fuel%20wood%20in%20Karnataka.%20Forest%20Department%2C%20Government%20of%20Karnataka%2C%20Indian%20Institute%20of%20Management%2C%20Bangalore.&f=false)

A number of studies on bio-resource use in Karnataka show that non-renewable biomass has been used since 31 December 1989. In particular, Ramachandra et al in "Bio-resource Status in Karnataka"[1] noted that the share of fuel wood in cooking in rural areas increased from 56% in 1989/90 to nearly 62% in 1994/95. This increased demand could not have been met by renewable supplies of fuel wood in the project area due to the serious bio-resource shortages in the project area district of Ramanagara. A number of studies have shown that project area taluks are a bio-resource deficient zone meaning that not only is there insufficient fuel wood to meet cooking and water heating demands, there is also a shortage of other possible bio-resource substitutes like animal, crop and horticultural residues. Project area taluks were included in the eastern dry agro climatic zone which is identified as having a bio-resource availability to demand ratio of 0.39 i.e. only 39% of the bio-resources that were used could be considered to be renewable. Similar comments were made in the study "*Bioresource Potential of Karnataka: Technical Report No. 109*" (Ramachandra and Kamakshi).

With more than 70% of the population in rural areas, Ramachandra et al note that there is tremendous demand on resources such as fuel wood and agricultural residues to meet people's daily fuel needs. The more recent baseline survey has noted the high level of non renewable biomass use in the project area taluks. The pattern that was established from 1989/90 has continued in more recent years due to the sustained demand on bio-resources to meet rural energy needs. This is supported by the baseline survey of a sample of households in the region which confirmed that the time for collecting fuel wood and the price for purchasing fuel wood has been increasing, which shows persistent and growing non renewable biomass use. (Source: 1. Ramachandra, T.V. et al, *Bioresource Status in Karnataka,* Renewable and Sustainable Energy Reviews, Volume 8, Issue 1, February 2004, pages 1-47. *2.* Ramachandra, T.V. and Kamakshi, G, *Bioresource Potential of Karnataka: Technical Report No: 109,* Energy and Wetlands Research Group, Indian Institute of Science, Bangalore, 560012 (November 2005).

Actual tree cover in Karnataka is 32264 sq. kilometers according to 1987 State of Forest report (page 38) of Government of India.

The tree cover has come down to 32100 Sq kilometers by the time of 1989 report (page 20) and it came down further to 5683 sq. kilometers according to the same report of 2009 (page:34) (Source: http://www.fsi.org.in/ )

This trend proves the state of bio resource depletion and non renewable biomass use since 1987

**Project emissions:**

Project emissions were calculated using the methodology AMS II D para 13, option (b): default value of 0.05 $m^3$ biogas leaked/$m^3$ biogas produced

| Parameter | Abbr. | Value for 3 cubic meter unit | Value for 2 cubic meter unit | Unit |
|---|---|---|---|---|
| | | | | |
| Leakage factor | LF | 0.05 | 0.05 | $m^3/m^3$ |

| | | | | |
|---|---|---|---|---|
| Number of households | N | 3810 | 3810 | total units |
| Installed capacity of the project unit | $m^3$ | 3 | 2 | Size of the digester |
| Methane content in the Biogas | % | 60 | 60 | |
| GHG potential of methane | times | 25 | 25 | |
| Days in a year | days | 365 | 365 | |
| Specific gravity of Methane | $m^3$ to Kg | 0.67 | 0.67 | |
| | | | | |
| Emission reductions | | 2096.40 | 1397.60 | t CO2e |
| Net project emissions | | 3494 | | t CO2e |
| Average per unit | | 0.55 | 0.36 | t CO2e |
| Total | | 0.4585 | | |
| Therefore, PE annual for 1 average unit | | 0.46 | | t CO2e |

# Appendix 5. Further background information on monitoring plan

Through its work with biogas plants over the last 15 years, SKG Sangha has developed a system of installing and maintaining the biogas units. The operational and monitoring plan builds on this experience.

The scheme in the page below shows distribution of monitoring tasks and responsibilities between different levels of project implementation: the project level (the main SKG Sangha office: project coordinator with a team), the taluk level (supervisor with a team) and the village level (so-called motivator).

In each village where SKG Sangha starts installing biodigesters, a local person is selected to be the so-called motivator. The motivators are trained in how to:

- supervise project implementation in the village;
- maintain and repair the biogas units;
- monitor the functionality of biogas units;
- keep records;
- report to taluk level.

A number of separate training sessions are also run for the households who have biodigesters installed to ensure that beneficiaries use their units correctly. The motivator participates in the training sessions to ensure all beneficiaries are familiar with the main contact in the village. The beneficiaries are instructed to report any faults or problems with the units to the motivator.

During installation the household will sign three pieces of paper to confirm that the masonry work, the pipe fitting work and the overall biodigester has been installed satisfactorily. A technician from SKG Sangha will check the unit once it has been installed to ensure the biogas unit has been installed correctly and this information will then be recorded and logged in SKG Sangha's central records as well as in paper monitoring journals of the relevant motivator. The records will also include information on the size of each unit – whether it is a 3 $m^3$ unit or a 2 $m^3$ unit. Each biodigester is given a unique identification marking to indicate:

- who sponsored the biodigester;
- who built the biodigester;
- which year the biodigester was built in; and
- which number biodigester it is for that village for that year

A. <u>Monitoring of biogas unit functionality</u>

Once the unit is installed and checked by the technician, the motivator marks the start of unit operation. Beneficiaries are instructed to report any faults or problems with a biodigester or a burner to the motivator. Normally any problems with the biogas units will be resolved the same day as the original complaint. The motivator will record any periods (in days) when the unit was not operating. Households also have a separate pre-paid post form that they can send directly to SKG Sangha to inform SKG Sangha of any problems in the event that they experience any problems with their village representative. The fact that households make an in-kind contribution to the construction of biogas units also makes them more interested in making proper use of these units. Besides recording problems, the motivator will check all project units in the village at least once per month to record whether they are functioning properly. The records will be made by hand writing, on two

copies of a monitoring journal. At the end of each month one copy will be delivered to the taluk level monitoring team, and one copy remains with the motivator.

The taluk level monitoring team collects monitoring journals from the villages in their taluk, and compiles monthly taluk-level reports, which include:

- Number of units that started operations before the monitoring period (i.e. before the beginning of the relevant monitoring month), separately for 2 $m^3$ and 3 $m^3$ sizes;
- Detailed records of units installed during the monitoring month, including the location, the beneficiary, the size of the biodigester, and the date of start of operations;
- Sum of non-operational days of a 2 $m^3$ unit and a 3 $m^3$ unit (i.e. if there were 10 units of 2 $m^3$ size that were not operational for 1 day, the record is that a 2 $m^3$ unit was not operational for 10 days.

The monthly reports are made in two copies, one of which is delivered to the project level (main SKG Sangha office), and another one remains at the taluk level.

The project level monitoring team collects the monthly reports. Throughout the year it makes random visits to villages to check in total at least 5% of beneficiaries per year and to check whether the data recorded by the motivator is correct.

The project level monitoring team enters all data into the central project database, which includes:

- Records of every unit installed, including the location, the beneficiary, the size of the biodigester, the date of start of operations, and the end of operations in case the unit broke down
- Records of non-operational days,separately for 2 $m^3$ and 3 $m^3$ sizes, for every village (corrected after the random visits if needed)

B. Surveys of a sample of units

Taluk level monitoring teams will carry out annual surveys of a sample (at least 5% of 2 $m^3$ units and 5% of 3 $m^3$ units) of beneficiaries to determine the following parameters and information:

- Annual hours of operation of a unit (operation of a burner)
- Animal population per household (for each type of cattle)
- Amount of manure generated on the farm
- Amount of animal manure fed into the system
- Proper soil application of the final sludge

Survey sheet is given in Appendix A.

The schedule of surveys is projected to be as follows:

- 200 households in the 1st year
- 400 households in each subsequent year

Surveys will be carried out each year, but over an extended period, as only a few beneficiaries can be surveyed by one person or team in one day.

Survey sheets will be delivered to the project level monitoring team, which will enter the data into the database and calculate average values of each parameter, separately for 2 $m^3$ and 3 $m^3$ sizes. The resulting data will be sued for calculating and checking emission reductions.

C. Calculation of emission reductions

Emission reductions will be calculated using formulae (2), Monitored values $B_{manure\_generated}$ and $B_{manure\_fed}$ will be used for adjusting $f_{collected}$ in the formula $f_{collected}$ will be the hours of animal confinement at the shed

The overall project emission reductions will also be adjusted for the real proportion of operational 2 $m^3$ and 3 $m^3$ size units.

D. Monitoring of dung feeding and sludge handling:

(c) The dung will be fed to the biogas plants regularly. A 2 cubic meter biogas generation plant can handle up to 60kg of dung and a 3 cubic meter plant can handle up to 90 kg of dung per day in the summer days. With its full capacity a 2 cubic meter plant will generate 2 to 2.5 cubic meters of biogas per day and one burner can be used for about 5 1/2 hours a day with this generated gas. Accordingly a burner can be used for about 8 hours in a day in the case of a 3 cubic meter plant. In other day the maximum dung processing capacity of 2 and 3 size units will be 50 and 75 kg per day respectively. To monitor the amount of dung fed into the biogas plant 2 questions were asked, 1, quantity of dung fed into the plant, 2, for how many hours the burners are used per day. By correlating these two aspects we can conclude the amount of dung fed into the plant and the sludge generation.

(d) The sludge will be collected in a sludge collecting pit, about 50 centimetres deep every day. This sludge either will be dried on the ground or used to generate vermicompost or mixed with other organic waste like fodder waste and agricultural residues to be fermented in aerobic condition or applied directly on the agricultural soils as a thin layer. Every beneficiary will be trained not only on biogas unit maintenance but also proper handling of the sludge to avoid any kind of emissions.

(e) There is parameter in the monitoring sheet, "Describe application of the slurry from biodigester: where is it used, how, when". In this parameter all the above scenarios will be questioned and answers will be derived. More over the motivator or the local level supervisor regularly visits the plants will guide the farmers in proper handling of the sludge.

**Sampling Plan –in line with Version 02.0 of the Guidelines for sampling and surveys for CDM project activities and programme of activities ; EB69, Annex 5**

1. Sampling Objective.

Five different parameters will be monitored using sampling. Noperating, the number of units operating, is not included in the sampling plan as all units that are operating will be monitored. Whilst, the parameter, **Application of sludge**, is included in the sampling plan, it should be noted that this variable does not impact emissions arising from or saved by the project activity. This parameter is monitored for sustainability reasons. That is to ensure that project participants derive the most value from being able to use the sludge as a fertilizer.

The objective is to determine the mean average annual value of each of the parameters listed below during the crediting period and with a 95/10 confidence/ precision:

$\mathbf{N_t}$ (dimensionless) – annual average animal population in a household (number of heads of dairy, cow, buffalo and other cattle)

$\mathbf{B_{manure\_generated}}$(Tonnes) **–** Average amount of animal manure generated per household per year

$\mathbf{B_{manure,fed}}$ (Tonnes) – Average amount of animal manure fed into a biogas digester per year

$\mathbf{B_{collected\ (hours)}}$ – hours of animal confinement per day

**Application of sludge** (qualitative information)– Proper application of the sludge from the biogas unit

2. Field Measurement Objectives and Data to be collected.

Information on the variables and data to be collected, the scope and method of the survey and their frequency are provided for each parameter in the following paragraphs:

$\mathbf{N_t}$ (Dimensionless) – There is one key variable, annual average animal population in a household. Data for this variable will be collected by surveying 5% of project beneficiaries. The survey will be

carried out once a year by the Taluk level monitoring team. The team will meet with beneficiaries, count the number of heads of cattle on the day of their visit and will clarify through discussions with each relevant beneficiary whether there were changes in number of heads throughout the year. Team members will enter findings from their discussion into survey questionnaire sheets which will be completed for each beneficiary.

$B_{manure,generated}$ (Tonnes) – There is one key variable, average amount of animal manure generated per project beneficiary per year. Data for this variable will be collected of 5% project beneficiaries. The survey will be carried out once a year by the Taluk level monitoring team. The team will meet with the beneficiaries, and will determine the amount of manure generated through discussions with each relevant beneficiary and by weighing manure on the day of their visit. Team members will enter findings into survey questionnaire sheets which will be completed for each beneficiary.

$B_{collected\ (hours)}$– There is one variable, average hours of animals kept in shed/confinement. Data for this variable will be collected of 5% project beneficiaries. The survey will be carried out once a year by the Taluk level monitoring team. The team will meet with the beneficiaries, and will determine the hours of animals kept in shed/confinement through discussions as the animal confinement time varies during the seasons. Team members will enter findings into survey questionnaire sheets which will be completed for each beneficiary.

$B_{manure,fed}$ (Tonnes) – There is one key variable, average amount of manure fed into a bio-digester per project beneficiary per year. Data for this variable will be collected of 5% project beneficiaries. The survey will be carried out once a year by the Taluk level monitoring team. The team will meet with the beneficiaries, and will determine the amount of manure fed into the bio-digester through discussions with each relevant household and by weighing manure on the day of their visit. Team members will enter findings into survey questionnaire sheets which will be completed for each beneficiary.

**Application of sludge** (qualitative information) – There is one key variable, use of sludge from the biogas unit. Information for this variable will be collected of 5% project beneficiaries. The survey will be carried out once a year by the Taluk level monitoring team. The team will meet with the beneficiaries, and will determine sludge application through discussions with each relevant beneficiary. Team members will enter findings into survey questionnaire sheets which will be completed for each beneficiary.

3. **Target Population and Sampling Frame.**

For all parameters the target population is the beneficiaries that will receive the bio-digesters in the project. The sampling frame for these parameters will be 5% of beneficiaries with bio-digesters. A clustered sampling approach considering 4 geographic clusters each corresponding to one of the 4 regions “Taluks” involved in the project will be adopted. As two sizes of bio-digester will be deployed in the project (a $2m^3$biogas unit and a $3m^3$biogas unit) there will also be an element of stratification in the sampling frame, distinguishing beneficiaries by sizes of biogas unit.

4. **Sample Method.**

The sampling method will be carried out as follows:

*Sampling objectives*

The sampling objectives have been clearly defined (as summarized in section 1 of the sampling plan above) and these objectives will be clearly communicated by the Project incharge and his team to Taluk supervisors, the project supervisors and Taluk monitoring team members that will carry out and review the surveys. To ensure that the data needs are clearly understood and collated in a consistent manner, standard survey sheets have been prepared for completion by all individuals that will carry out the sampling.

*Target population*

For all parameters with the target population is the beneficiaries that will receive the bio-digesters in the project.

*Sampling frame*

For all parameters the overall sampling frame will be the full list of households receiving bio-digesters in the project and have sufficient levels of literacy to track some of the data that will be required. To ensure that the target population accounts for literacy, information on the literacy of project beneficiaries will be recorded by Project supervisors at the time of installing the bio-digesters and this information will be kept in the central project database that will be managed by the Project in-charge. To enable clustering by geographic area, for each bio-digester installed, the Project in-charge and his team will, in the central project database, record details of the village and Taluk in which the bio-digester was installed and whether it was a small ($2M^3$biogas unit) or large ($3M^3$)biogas unit.

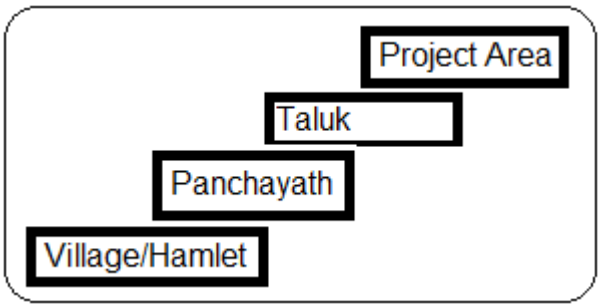
*Randomizing cases and drawing sample*

To promote the drawing of a representative and random sample, the Project Coordinator and his team will develop the sample list of households as follows:

*a. Developing a representative sample*

When drawing the sample the Project Coordinator and his team will firstly analyze the deployment distribution of operating biogas units to determine the number of households to be sampled in each Hamlet in order to generate a sample population that reflects the distribution of biogas units by region and size.

The project regions are structured as following:




A district contains several Taluks. A Taluks contains several Panchayats (is the basic administrative unit) and a Panchayat contains again several Hamlets (Villages). The Hamlets is the smallest defined unit in the hierarchy.

The approach will be a geographic cluster approach. To assure that all the geographical regions are represented in the sample, every taluk will be represented with a cluster in the sample. Therefore the number of taluks equals the minimum number of clusters to be surveyed.

Definition of Cluster

A cluster corresponds to a hamlet/village and all units included in this hamlet. The clusters will be selected randomly from the existing data base of beneficiaries. All the units in these selected hamlets will be surveyed. The number of clusters needed will be decided until the total sample size s reached 400 households.
Once the clustered villages were surveyed in year one then these villages will be removed from the list for the next year (but only for one year) from the monitoring survey.
Example:
As can be seen in the table below, 5 Taluks were exampled in the project region, so in every taluk there will be one Hamlet/Village to be selected randomly.

Number of biogas units and sizes in villages

| Size of unit / village | 1 | 2 | 3 | 4 | 5 | Total |
|---|---|---|---|---|---|---|
| 2m3 | 15 | 6 | 35 | 24 | 15 | 75 |
| 3m3 | 10 | 4 | 40 | 1 | 25 | 70 |

There are 5 villages with 140 units in this example. However, as the total number of units in the village/cluster does not equate to the the required sample size of 5%, more villages will be added randomly until the minimum sample size (5%) is reached.Selection of clusters:
Each Hamlet will be a cluster. Hamlets will be selected randomly until the number of units in the cluster reaches the sample size. If a village is having more than the sample size number of units then all the units in the village will be surveyed irrespective sample size.

Random selection:
All the villages which are having project units will be under the purview of the survey. In the first randomization process all the villages will be listed in alphabetical order. Then Excel function will be used to select the villages randomly. All the units in those selected villages will be surveyed.

*Selecting the most effective information gathering method*
As described in section 2, information will be gathered by the Project supervisors and Taluk level monitoring team using a mixture of visual inspections, measurement of parameters during visual inspections, self reporting and discussions with project beneficiaries.
In all cases data will be entered into standardized survey forms prepared by the Project in-charge and his team to be completed by members of the monitoring team/Project supervisors or beneficiaries.
The forms will then be transferred, on a monthly basis, upwards through the monitoring team hierarchy (shown above in the “Monitoring Scheme” figure) until finally data is entered into the database kept by the Project in-charge and his team.

*Conducting surveys and measurements*
Procedures will be put in place to ensure that field data collection is performed properly and that any potential intentional errors or unintentional errors are minimized and documented. These will include:

- Preparation of standard survey forms to be completed by the monitoring team and households (see Annex 6)
- Training of project monitoring team
- Establishing a clear project monitoring hierarchy, which will enable sample data to be checked at various stages
- Monthly analysis of survey findings by the Project in-charge and his team to identify outliers and possible errors, which will be documented in the database
- Subsequent discussion of possible errors with Taluk level in-charges, who will, in turn, discuss these errors with the individuals responsible for conducting the surveys. On the basis of these discussions, surveys will be carried out again or eliminated from the sample, with the resulting corrective action communicated to the Project Coordinator, who will then log this in the central project database.

*Minimizing non-response*
A core feature of the project is the central role that project supervisors play in the monitoring process. With project supervisors being members of the communities in which the biogas units are installed they will have existing relationships with the beneficiaries. These relationships should minimize the chance of non-response. Further, project supervisors will be involved in the installation of biogas units and will serve as a point of contact and issue resolution in the case that biogas unit do not work as planned and therefore will be continuously exposed to the households that will be surveyed.

Not-withstanding this feature of the project, a number of corrective measures will be employed, including over-sampling (see section 5). Further, as sampling will be carried out throughout the year, the Project incharge will be in a position to review response rates as the year progresses and take action to increase sampling efforts if non-response is an issue.

5. **Desired Precision/Expected Variance and Sample Size.**

Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project categories (I.E/ Version 3) states that a sample size shall be chosen for a 90/10 level of precision (a 90% confidence interval and 10% margin of error). But the according to the EB 69, Annex 5 decision the precision level will be 95/10. So the data will be collected at this level of confidence.
The proposed sampling approach has been found to meet this requirement. This is demonstrated as follows:

$n = (Z_{\alpha/2} * \sigma/E)^2$

Where:

n = the sample size
$Z_{\alpha/2}$= 1.96 for a confidence interval of 95%
σ = the standard deviation
E = the maximum error of estimate – in this case 10% of the average value of the specific parameter

As neither σ nor E is known for the parameters to be sampled, these values were calculated from an analysis of the results obtained from the baseline survey, the results of which have been inspected by the validator.
By applying the formulae to the values calculated from the survey findings, the minimum sample size (n) for each parameter was calculated and is summarized in the table below.

**Calculation of minimum sample size required to deliver a 95% confidence interval and a 10% margin of error for each parameter to be sampled.**

| Parameter | Units | $Z_{\alpha/2}$ | σ | Average value from survey | E | n |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| $N_t$ | No. of cattle | 1.96 | 1.04 | 3.76 | 0.38 | 29 |
| $B_{manure\_generated}$ | Kg | 1.96 | 25.5 | 73.32 | 7.33 | 46 |
| $B_{manure\_fed**}$ | Kg | 1.96 | 22.33 | 62.92 | 6.29 | 48 |
| $F_{collected}$ | Animals in confinement | 1.96 | 3.21 | 20.61 | 2.06 | 9 |

The table shows that the sample size required to achieve a confidence interval of 95% of the different factors ranges from 9 to 48
A minimum sample of 48 households is needed to achieve a confidence interval of 95%.
For all other parameters, we propose to sample a minimum of 10% of households with a maximum limit of 200 households having bio-digesters in Yr 1 and 400 households thereafter. In each year the Project incharge will be responsible for ensuring that an adequate number of households are sampled to deliver the required level of precision and will sample more households (than the 200, 400 approach detailed) if necessary to ensure a confidence interval of 95%. The table below shows the anticipated number of households that would be sampled in each year using various sampling approach when applied to the anticipated bio-digester deployment plan and shows that in each case more than 48 beneficiaries (the maximum value of n for all parameters) will be sampled, allowing for

the possibility of non-response. Specifically, 200, beneficiaries will be surveyed in years 1, Thereafter, 400 beneficiaries will be sampled.

| | **Year 1 2013** | **Year 2 2014** | **Year 3 2015** | **Year 4 onwards 2016 +** |
|---|---|---|---|---|
| Cumulative units installed | 4,000 | 7,620 | 7,620 | 7,620 |
| Average units operating in year | 2,000 | 6,715 | 7,620 | 7,620 |
| Units to be surveyed using: | | | | |
| 5% sampling | 100 | **390** | **390** | **390** |
| 10% sampling | 200 | 762 | 762 | 762 |
| 20% sampling | 1,000 | 1,524 | 1,524 | 1,524 |
| 30% sampling | **1,200** | 2,286 | 2,286 | 2,286 |

The baseline survey did not capture information on two of the parameters that will be sampled, $\mathbf{H_{stove}}$and **Application of sludge.** Neither of these parameters will be used to calculate project activity emissions. The sludge application will instead be monitored to check the appropriate use of sludge as a fertilizer. Information for parameters will be gathered by sampling 5% of households. Information on the application of sludge is qualitative and therefore a minimum sample size is difficult to calculate. However, as the sampling approach has been derived in order to ensure that a 95% confidence interval can be achieved for all other parameters, it is expected that this will ensure that sufficient information is captured for reliably monitoring this parameter.

6. **Procedures for Administering Data Collection and Minimizing Non-Sampling Errors.**

*Procedures for data collection*
As described in section 2, sampling will be carried out by the village level Project supervisors or the Taluk level monitoring teams, with review of findings carried out at the Taluk level and overall project level. Sampling will be carried out on a monthly basis, with the aim of collating information for 1/12 of the sample population in each month. This will overcome any issues associated with seasonality.

To promote effective data collection, project supervisors and monitoring team members will use standardized forms developed by SKG Sangha and will also receive training from SKG Sangha.

In all cases, the survey sheets for all beneficiaries and households surveyed in each village will be collected by the Project supervisor or the Taluk level monitoring teams. The data in a prescribed form will be retained by the persons who conducted the surveys and originals will be sent to the Project in-charge and his team.

The Project in-charge (and his team) has responsibility to enter all survey data into a database and to use the survey information to analyze sample findings.

*Quality assurance*
The results from sample findings will be reviewed once a month by the Project in-charge and his team to identify response rates, check that sampling is on track to achieve the 95/10 precision and to identify any values that appear to deviate significantly from what was expected. This will enable the Project in-cahrge to adjust sample sizes in subsequent months and to discuss unexpected results with the relevant Taluk level in-charges, Project supervisors or monitoring team members to check whether results can be justified or are the result of errors in data capture/ entry. If results appear to be the result of errors, this will be documented in the database and the household will be re-surveyed or excluded from the sample.

Response rates will be maximized by the involvement of project supervisors in sampling. Project supervisors will be individuals selected from the local communities in which the bio-digesters are implemented. As such project supervisors are likely to have good relationships with project beneficiaries that should maximize response rates. In addition, response rates will be maximized by use of a sufficiently large sample that allows room for non-response. Further, the Project in-charge and his team will review response rates on a monthly basis and adjust target sample numbers for subsequent periods, if response rates are lower than anticipated.

7. **Implementation.**

The schedule for implementing the sampling effort should be defined as well as indication of who will conduct the actual data collection and the analyses; include qualifications, experience and any potential conflicts of interest of those involved in the data collection and analyses.

The Project in-charger will have responsibility for determining and implementing the sampling schedule for the year. This will be carried out as follows:

At the start of each year, The Project incharge will be aware of the target number of beneficiaries and households to be surveyed in the period, 500 project households and 100 non-project households. The Project in-charge will, however, need to develop monthly sampling schedules that not only take account of these overall aims, but also reflect actual deployment rates by area and type of digester. The Project in-charge will receive information on the number of units installed and operating in each month from the Taluk level monitoring team (who, in turn, will receive this information from project supervisors).

The Project in-charge will then develop a schedule for the operating units to be sampled in the subsequent month. This will be done, using the sample method described in (4) and with a view to sampling the total number of beneficiaries required to achieve a 95% confidence interval (described in 5).
The Project in-charge will then issue the list of beneficiaries to be surveyed in each month to the Taluk level monitoring team, who in turn, will distribute lists to the project supervisors. At the end of each month, sample findings will be relayed to the Project in-charge and his team for analysis and the Project in-charge will use these findings to finalise the list of households to be surveyed in the subsequent month. This will be done with reference to possible errors, non-response rates and verification that sampling is on track to deliver the 95/10 level of precision.
The “Monitoring Scheme” diagram above summarises the individuals that will be responsible for the actual data collection and analyses.

Data collation will be carried out by a number of Project supervisors and the project monitoring team. Although these will be employees of S K G Sangha who is the Project Manager and will indirectly benefit from the sale of the CERs, there are no anticipated potential conflicts of interest in those involved in data collection and analyses. SKG Sangha will try for the upfront payment to implement the project. The funding is provided to project owner, SKG Sangha in advance and the funder takes the risk of short delivery hence the monitors are sufficiently removed from the reward that there is no potential conflict of interest.

**MONITORING SURVEY SHEET**

| **Project Beneficiary Energy & Manure Management Survey** | | | |
|---|---|---|---|
| Village and taluk: | | Date: | Biogas unit size: ..... $m^3$ |
| Name of the beneficiary: | | Biogas unit number: | |
| **Biogas use** | | | |
| Average hours of operating | | □ per day □ per week □ per month □ per year | |

| | | |
|---|---|---|
| burner*: | | |

| **Manure and slurry management** | | | |
|---|---|---|---|
| Livestock numbers**: | Dairy cows: …… | Buffalos: ….. | Other cattle: …… |
| Hours of animal confinement | | Hours /day | ..... |

| | | | |
|---|---|---|---|
| Total amount of manure produced by animals | ..... | □ kg<br>□ tonnes<br>□ baskets | □ per day □ per week<br>□ per month □ per year |
| Total amount of manure fed into the biodigester: | ..... | □ kg<br>□ tonnes<br>□ baskets | □ per day □ per week<br>□ per month □ per year |
| Describe application of the slurry from biodigester: where is it used, how, when | | | |

*** -** when two burners are functioning at the same time, count as one burner functioning double time

**** -** adjust the number to reflect the number prevailing over the year if e.g. at the moment there are 3 cows

but the third one was bought half a year ago, count as 2.5 cows

# Appendix 6. Summary of post registration changes

Reference number and title of the registered CDM project activity: 8936- "Ramanagara Biogas Project, version 02; 10th November 2010"

1. Change to the start date of the crediting period of the project activity: From 01/01/2013 to 01/01/2015 as per paragraph 280 of the Project Standard, version 09.

2. As per para 275 of the Project Standard (version 09), the PP has corrected the GWP of methane from 21 to 25 in keeping with the second commitment period of the Kyoto Protocol, the global warming potentials used by Parties to calculate the carbon dioxide equivalence of anthropogenic emissions by sources and removals by sinks of the greenhouse gases listed in Annex A to the Kyoto Protocol shall be those listed in the column entitled "Global Warming Potential for Given Time Horizon" in table 2.14 of the errata to the contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Also some typo error in the registered PDD is corrected which are very minor and does not have any impact.

Justification for non-applicability of Paragraph 289 (change in project design) of the Project Standard, version 09:

(a) Changes in the effective output capacity due to increased installed capacity or increased number of units, or installation of units with lower capacity or units with a technology which is less advanced than that described in the PDD;
- Effective output of the project activity has not been changed. The number of units have not been increased nor has the installed capacity increased. The technology remains the same and therefore the question of it being less advanced does not arise.
In summation, sub-para (a) of para 289 of the project standard does not apply to the Ramanagara project.
(b) Addition of component or extension of technology;
- No addition or extension of technology was proposed

(c) Removal or addition of one site (or more) of a project activity registered with multiple sites;
- This is a bundled biodigester project. The project activity will be implemented in rural areas in 4 taluks, namely, Ramanagara, Kanakapura, Magadi and Channapatna of Ramanagara District, Karnataka State, India as mentioned in the registered PDD. There is no change in the project locations.

(d) Actual operational parameters which are within the control of project participants differing from the expected parameters;
- No operational parameters were changed in the revision

(e) Any consequential changes to the baseline methodology and/or the standardized baseline resulting from subparagraphs (a)–(d) above, including changing or adding another baseline methodology and/or another standardized baseline or applying a baseline scenario that is more appropriate as a result of the proposed or actual modifications to the project activity.
- No baseline change has been proposed. No consequential changes to the baseline have occurred, thereforesub-paragraphs (a)-(d) do not apply to this project.

PP proposed to install 7620 biodigesters under the project. As IPCC changed the Methane Global Warming Potential to 25 from 21 for the second commitment period.The project activity continues to confirm to the small scale project activity threshold.
Documents submitted: Revised PDD in clear and track change modes.

**Annex 1: Stakeholder Consultation Process**

**Ramanagara Biogas Project**
**Local Stake Holder Meeting report**

**Place: Pattlu village, Channapatna Taluk, Ramanagara District,Date: 06-12-2009.**

The stake holder consultation meeting for the "Ramanagara Biogas Project, version 02; 10th November 2010" was held on 06-12-09 at Govt. Higher Primary School premises in Pattlu village, Channapaatna Taluk of Ramanagara District. Prior to the meeting all the Gold Standard foundation supporting NGOs, Govt.of India MoEF (DNA- CDM), local Govt. officials and concerned elected representatives from local bodies were invited through the invitation letters and by personal meetings. Pubic in general and women organisations' in the project area in particular are invited personally by the SKG Sangha staff.

195 people from the villages belonging to 4 project taluks, Channapatna, Kanakapura, Magadi and Ramanagara along with the Gold Standard Foundation Indian representative Ms. Neha Rao, Govt. Officials and two Panchayth presidents. Mr. Kiran Kumar, Secretary, SKG Sangha has welcomed the gathering and Mr. Nanjunde Gowda, Project Engineer, Integrated Rural Energy Programme, Government of Karnataka and Mr. Naik, Executive Officer, Taluk Panchayath, Channapatna explained about the biogas plants and benefits of it. They also have explained about the Govt. biogas programme and its limitations especially about the limited number of units per year. Secretary, SKG Sangha introduced the project to the participants by explaining all the aspects like global warming, clean development mechanism, emission savings, sustainable development etc.

Attendees actively posed questions and got the answers and clarifications from Mr. Nanjunde Gowda, Mr. Naik and Mr. Kiran. All the participants welcomed the project and demanded the SKG Sangha to start the project immediately.

The blind sustainable development exercise was conducted by Mr. Kiran and was recorded by Ms. Neha rao.

Later the organisers distributed feedback forms and collected back the same after due completion of them by the participants.

Photos of the meeting:

Poster announcing the meeting


Registration of the participants


Attendees in the meeting


Project introduction


Explaining about biogas and Govt. Programme


Posing Questions asking clarifications


About Sustainable Development


Feedback forms filing by the participants

Statistics about the project area

(a) Project area sub divisions:

(b) Magadi taluk:

(c) The total geographical area of the taluk is 79969 hectares. Magadi taluk has five hoblies and thirty two grama panchayaths and 275 villages. The hoblies are as follows:

a) Kasaba
b) Madabal
c) Thippasandra
d) Kudur
e) Solur

(d) Kanakapura taluk:

There are 43 Grama Panchayaths in the taluk. The taluk has geographical area of 1,59,426 Hectares consisting of 242 villages and 6 hoblis namely:

a) Kasaba
b) Harohalli
c) Maralawadi
d) Kodihalli
e) Sathanur
f) Uyyamballi

Channapatna Taluk:

The total geographical area of the taluk is 53,587 hectares. The total numbers of grama panchayaths in the taluk are 32 and 134 villages. It has three hoblies, namely:

a) Kasaba
b) Malur
c) Virupakshapura

Ramanagara Taluk:

It covers 62930 hectares of geographical area consists of 124 villages and 4 hoblies namely:

a) Kasaba
b) Kailancha
c) Kootagal
d) Bidadi

**Annex 2: References**

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2. Ramachandra, T.V. et al, *Bioresource Status in Karnataka,* Renewable and Sustainable Energy Reviews, Volume 8, Issue 1, February 2004, pages 1-47.http://wgbis.ces.iisc.ernet.in/energy/paper/bioresources.htm

3. Ramachandra T.V. and Rao, G.R, *Inventorying, Mapping and Monitoring of Bioresources Using GIS and Remote Sensing (Kolar District)* (2005). http://www.ces.iisc.ernet.in/energy/paper/Biores_using_RS_GIS/index.htm

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5. Nijaguna, B.T, *Biogas Technology* (New Age International (P) Ltd, 4835/24 Ansari Road, Daryaganj, New Delhi 110 002, 2002). – Relevant pages (hard copies provided to the DOE)
6. Mahesha M – Can organic fertiliser (manure) replace the chemical fertiliser.....?, - Assistant Professor, Department of Agricultural Engineering, University of Agricultural Sciences, Bangalore (Hard copy provided to the DOE)
7. M. Shankar – Studies on Scope for Biomass Management for Achieving Sustainable Soil Fertility in the Hassan District of Karnataka – Assistant Professor, Department of Agricultural Engineering, University of Agricultural Sciences, Bangalore (Hard copy provided to the DOE)
8. Temperature data by the Indian Meteorological Department, Government of India (Hard copy provided to the DOE)
9. Mapping of Fuel Wood Trees in Kolar District Using Remote Sensing Data and GIS – By Jagadeesh K, Rao G.R, Kiran M.K, Jagadish K.S and Ramachandra T.V – Indian Institute of Science, Bangalore http://wgbis.ces.iisc.ernet.in/energy/paper/fuelwood/fuelwood.html
10. Photo copy of a bill of Kedar gas agencies – showing the cost of the LPG refill (Hard copy provided to the DOE)
11. C. Muniraju, Civil Engineer and Approved Valuer, Sree Consultants – Cost estimates of 2 and 3 cubic meter capacity biogas plants (Hard copy provide to the DOE)
12. Documents submitted to the DNA on prior consideration of CDM (Hard copies provided to the DOE)
13. Ramnagar District was created out of Bangalore rural District on 24 August 2007 (http:// www.karnataka.com/**districts**).

14.http://www.hedon.info/BP42_EnvironmentalImplicationsOfTheEnergyLadderInRuralIndia&highlight=EnvironmentalimplicationsOfTheEnergyLadderInRuralIndia

15. http://www.methanetomarketsindia.com/sectors/agri.htm

Renewable energy for rural development, Annual report – 2008_2009, (Document provided as-'Rural_Development_RajPanchayat_Karnataka_AnnualReport_0809', page 26.

16.https://cdm.unfccc.int/Projects/PriorCDM/notifications/index_html

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## Document information

| *Version* | *Date* | *Description* |
|---|---|---|
| 06.0 | 9 March 2015 | Revisions to:<br>• Include provisions related to statement on erroneous inclusion of a CPA;<br>• Include provisions related to delayed submission of a monitoring plan;<br>• Provisions related to local stakeholder consultation;<br>• Provisions related to the Host Party;<br>• Editorial improvement. |
| 05.0 | 25 June 2014 | Revisions to:<br>• Include the Attachment: Instructions for filling out the project design document form for small-scale CDM project activities (these instructions supersede the "Guidelines for completing the project design document form for small-scale CDM project activities" (Version 01.1));<br>• Include provisions related to standardized baselines;<br>• Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the project activity in B.7.4 and **Error! Reference source not found.**;<br>• Change the reference number from *F-CDM-SSC-PDD* to *CDM-SSC-PDD-FORM*;<br>• Editorial improvement. |
| 04.1 | 11 April 2012 | Editorial revision to change history box by adding EB meeting and annex numbers in the Date column. |
| 04.0 | 13 March 2012 | EB 66, Annex 9<br>Revision required to ensure consistency with the “Guidelines for completing the project design document form for small-scale CDM project activities” |
| 03.0 | 15 December 2006 | EB 28, Annex 34<br>• 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. |
| 02.0 | 08 July 2005 | EB 20, Annex 14<br>• The Board agreed to revise the CDM SSC PDD to reflect guidance and clarifications provided by the Board since version 01 of this document.<br>• 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>. |
| 01.0 | 21 January 2003 | EB 07, Annex 05<br>Initial adoption. |

| *Version* | *Date* | *Description* |
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Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project design document, SSC project activities