**Project design document form**

**(Version 10.1)**

*Complete this form in accordance with the instructions attached at the end of this form.*

| BASIC INFORMATION | |
|---|---|
| **Title of the project activity** | Social Education and Development Society (SEDS) Biogas CDM project for the rural poor |
| **Scale of the project activity** | ☐ Large-scale<br>☒ Small-scale |
| **Version number of the PDD** | 14 |
| **Completion date of the PDD** | 31/05/2018 |
| **Project participants** | M/s Social Education and Development Society (SEDS)<br>Evangelisches Werk für Diakonie und Entwicklung e.V. |
| **Host Party** | India |
| **Applied methodologies and standardized baselines** | AMS. I.E. Switch from non-renewable biomass for thermal applications by the user. Version 7. |
| **Sectoral scopes linked to the applied methodologies** | 1 |
| **Estimated amount of annual average GHG emission reductions** | 15,749 $tCO_2e$ |

## SECTION A. Description of project activity

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

The project "Social Education and Development Society (SEDS) Biogas CDM project for the rural poor" is a registered CDM project activity. The details of the registered project are as follows:

| | |
|---|---|
| UNFCCC Project Number: | 3541 |
| Registration date: | 09th Sept 2010 |
| Crediting Type: | Renewable |
| First Crediting Period: | 01 Jan 11 - 31 Dec 17 (Renewable) |
| Issued CERs so far: | 1st Monitoring Period from 1st Jan 2011 to 31st Dec 2012 – 6043 CERs;<br>2nd Monitoring Period from 1st Jan 2013 to 30th April 2014 – 9932 CERs;<br>3rd Monitoring Period from 1st May 2014 to 31st October 2015 – 17,443 CERs |

Through the submission of this PDD, the project proponent intends to renew the crediting period in line with section 10 that describes the procedures for Renewal of the crediting period of a registered CDM project activity, specified in the CDM project standard, CDM-EB93-A04-STAN and the PDD has been accordingly updated. Based on guidelines of the document, sections of the CDM-PDD have been updated relating to the baseline, estimated emission reductions and the monitoring plan using an approved baseline and monitoring methodology as follows:

- The registered CDM project activity was registered under I.E. version 01.
- For renewal of the crediting period of the project activity, the applied methodology is AMS I.E. Version 07.0.
- The emission reductions and the monitoring plan have been updated based on the approved baseline and monitoring methodology, AMS I.E. Version 07.0, which is the methodology version applicable at the time of submission for renewal of crediting period.

The changes to the PDD is over version 08 of the PDD dated 26th March 2013 which has the Post Registration Changes.

The Social Education and Development Society (SEDS) is a grass-root Non-Governmental Organization (NGO) working for the past 35 years in Anantapur District which is in South Western part of Andhra Pradesh, Southern India. The district is a drought-prone area. The main focus of SEDS is to help the poorest of the poor through integrated rural development activities with an emphasis on women's empowerment, watershed programmes, reforestation and natural resource management. SEDS is currently working in 287 villages, supporting 40,000 women and their families, in 5 Mandal Mahila Samakhya. Through its sustained efforts, SEDS has made a significant impact on the lives of the people in the area and the local environment with a motive to make a greener tomorrow[1].

The purpose of this Biogas CDM Project activity is to set up 5,000 biogas plants (digesters) of 2 $m^3$ capacity each for single households in 5 Mandals of Anantapur District. Each household has installed a 2 $m^3$ biogas plant and feed cattle dung and other organic waste into the anaerobic digester for the production of biogas for cooking purpose and heating of hot water. The baseline scenario is the use of non-renewable biomass for cooking, on inefficient wood fired mud stove technology. The aim of the project is to replace the commonly used inefficient wood fired mud stoves technology, with clean, sustainable and efficient biogas and in this way replace Non-Renewable Biomass with biogas for cooking and hot water heating. So far during the first crediting

[1] http://sedsngo.org/

period at the time of submission of the PDD for renewal of crediting period, all the 5,000 biogas units have been constructed and commissioned.

By utilizing cattle dung in a controlled anaerobic digestion and combustion system, biogas is available for cooking energy and heating hot water. The biogas is used on a two-ring gas stove with a flame temperature of 870$^{o}$C, supplied as part of the project activity. Households having cattle or willing to collect cattle dung will participate in the project. The project was implemented upon registration of the project as a CDM project activity, as the project was financed completely from carbon revenues. The project contributes to social, environmental, economic and technological benefits which contribute to sustainable development of the local environment and the country as follows:

Social benefits:

- Reduces drudgery to women who spend long hours and travel long distances in search of fuel wood
- Increases women and children's overall health situation by reducing smoke in kitchen, thus eliminating health hazards from indoor air pollution.
- Energy supply security
- Better management of dung and organic wastes
- Improves education of children as women have more time and resources to nurture their children and send them to school

Environmental benefits:

- Improves the local environment by reducing uncontrolled deforestation in the project area
- Avoids local environmental pollution through better waste management
- Will lead to soil improvement by providing high quality manure
- Avoided global and local environmental pollution and environmental degradation by switching from non-renewable biomass to renewable energy, leading to reduction of GHG emissions
- Reduces deforestation, preservation of pasture land, reduced indoor pollution, increased use of manure rather than chemical fertilizers and reduced soil erosion.

Economic benefits:

- Higher productivity of workers as they have adequate cooking fuel supply
- Will provide employment to local communities through construction and maintenance of biogas units.
- The project will reduce cooking time, thus providing women to take up other activities.

Technological benefits:

- Better biogas digester models, thus improving biogas yield.
- Training in chemistry of biogas for masons and users leading to improved scientific temper in community and more jobs.

The project qualifies as Small Scale Project, Type I: Renewable energy project activity with maximum output capacity less 15 MW or 45 $MW_{th}$

### A.2. Location of project activity

(a) Host Parties: India
(b) Region/State/Province: Andhra Pradesh
(c) City/Town/Community: Ananthpur District, 5 Mandals – Penukonda, Roddam, Somandepalli, Gorantla and Chilamathur.
(d) Physical/Geographical location

Anantapur District lies between 13'-40' and 15'-15' Northern Latitude and 76'-50' and 78'-30' Eastern Longitude. It is bound by Bellary, Kurnool District on the North, Cuddapah and Kolar

Districts of Karnataka on South East and North respectively. The coordinates of the Mandals are as follows:

| Mandals | Co-ordinates |
|---|---|
| Penukonda | 14° 05' 00" North, 77° 35' 00" East |
| Roddam | 14° 06' 00" North, 77° 26' 00" East |
| Somandepalli | 14° 00' 44" North, 77° 36' 30" East |
| Gorantla | 13° 59' 21" North, 77° 46' 13" East |
| Chillamathur | 13° 34' 25" North, 80° 00' 12" East |

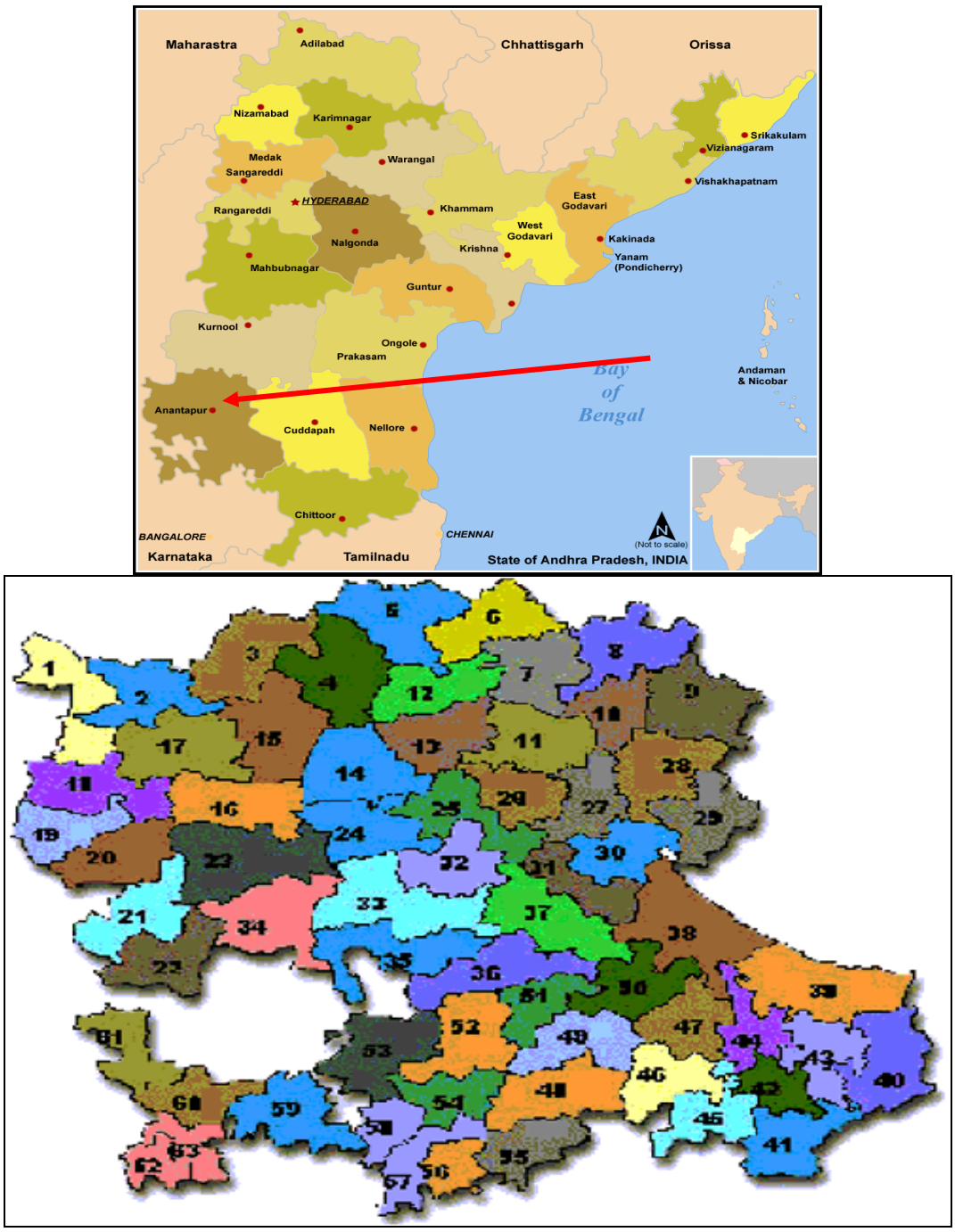


Fig 1: Map of Andhra Pradesh with an arrow indicating the location of Anantapur district and Anantapur district showing the Mandals in which the project will be implemented

## A.3. Technologies/measures

>> The chosen type and category is TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 07. The chosen technology is a domestic biogas plant. It is a small thermal appliance that displaces the use of non-renewable biomass by introducing a system for utilising dung and converting it into renewable energy by means of a digester in which the substrate undergoes acidification and methanation. This end-user technology involves the switch from non-renewable biomass to a renewable source of energy. Biogas is included in the specified methodology as an example of a suitable end user technology: biogas stoves are deemed a measure that involves the switch to renewable energy sources from non-renewable biomass in the baseline.

**Technology/measure:**
Biogas is a mixture of methane and carbon dioxide. It also has traces of hydrogen sulphide, ammonia, oxygen, hydrogen, water vapour etc., depending upon feed materials and other conditions. Biogas is generated by fermentation of cellulose rich organic matter under anaerobic conditions. In anaerobic conditions, the methane-producing bacteria become more active. Thus, the gas produced becomes rich in methane. The optimum utilization depends upon the successful physical installations, which in turn depend upon plant design and its selection. The basic conversion principle is that when a non-ligneous biomass is kept in a closed chamber for a few days, it ferments and produces an inflammable gas. The anaerobic digestion consists of three stages:I Hydrolysis; II Acid formation and III Methane fermentation.

The processes are carried out by two sets of bacteria namely acid forming bacteria and methane formers. The acidogenic phase I is the combined hydrolysis and acid formation stages in which the organic wastes are converted mainly into acetate, and phase II is the methanogenic phase in which methane and carbon dioxide are formed. The better the three stages merge with each other, the shorter the digestion process.

Users prepare batches of slurry in the mixing tank, before allowing the final mixture to flow into the digester for methane formation phase. After digestion, evacuated slurry may be re-used in the process. The recovered gas is combusted and used for cooking and water heating. The chosen methane recovery and combustion system is the time tested Deenabandhu model biogas technology which is well-known in India[2]. The project activity will organize the 5,000 users to use cattle dung and organic wastes in individual household methane recovery systems of biogas for cooking and water heating. The 5,000 individual plants consist of a mixing chamber where waste water and cow dung are mixed, an inlet pipe to feed the slurry into the reactor, the main biogas reactor / digester where methane formation / recovery takes place, a slurry outlet pipe, an outlet chamber, and a slurry platform. The outlet pipe and tank are provided to remove the digested / treated sludge or fermentation residue and the slurry platform is provided to maintain the treated slurry in clean condition. A pipe leading from the top of the dome to the stove will be provided to supply biogas to a 2-ring stove inside the house.

## A.4. Parties and project participants

| Parties involved | Project participants | Indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| India (host) | M/s Social Education and Development Society (SEDS) | No |
| Germany (Annex I country) | Evangelisches Werk für Diakonie und Entwicklung e.V. | No |
| … | … | |

[2] Approved design by the Ministry of New and Renewable Energy. http://mnes.nic.in/ http://mnes.nic.in/

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

There is no public funding involved in the project activity

### A.6. History of project activity

This PDD is submitted as a stand-alone CDM project activity for renewal of first crediting period.

This is to confirm that:
(a) The CDM project activity is not included as a component project activity (CPA) in a registered CDM programme of activities (PoA);
(b) The CDM project activity is not a project activity that has been deregistered.

This is to further declare that:
(a) The CDM project activity is not a CPA that has been excluded from a registered CDM PoA;
(b) Is not a CPA under a registered CDM PoA

### A.7. Debundling

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.

Also, according to Para 14 of Methodological Tool 20, if each of the independent subsystems/measures (e.g., biogas digesters, residential solar energy systems, kerosene or incandescent lighting replacements) included in one or more CDM project activities is no greater than 1% of the small scale thresholds defined by the applied methodology and the subsystems/measures are indicated in the PDDs to be each implemented at or in multiple locations (e.g., installed at or in multiple homes) then these CDM project activities are exempted from performing a de-bundling check, i.e., considered as being not a de-bundled component of a large scale activity.

- Each of the independent biogas unit is having an installed capacity of 1.78 $kW_{th}$ (Section B.2). This is not greater than 1% of small scale thresholds defined by the applied methodology I.E. under Type I – renewable energy project activity, i.e. not greater than 0.45 $MW_{th}$ or 450 $kW_{th}$ (as per Para 114 iii, CDM-EB93-A04-STAN Standard CDM project standard for project activities Version 01.0, SSC limits for biogas is 45 $MW_{th}$).

Thus the project activity is also exempted from performing the debundling check.

## SECTION B. Application of selected methodologies and standardized baselines

### B.1. Reference to methodologies and standardized baselines

TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 07.

Methodological Tool Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period. (Version 03.0.1).

TOOL20 Methodological tool Assessment of debundling for small-scale project activities Version 04.0

## B.2. Applicability of methodologies and standardized baselines

- >> The project activity comprises of biogas units that generate thermal energy for end users that displaces the use non-renewable biomass. As shown in section B.4, non-renewable biomass has been used since 31st December 1989.
- The project also qualifies as a small-scale project as the rate capacity of each biogas is 1.78 kW and the total capacity of the project activity for 5,000 biogas units is 9 $MW_{th.}$
- The capacity of the project activity is below 45 $MW_{th}$ and will remain under the limits of small-scale project activity during every year of the crediting period as shown below.

| Activity Data | Value | Unit | Reference |
|---|---|---|---|
| $E = \eta . H_b . V_b$ | | | |
| **Where:** | | | |
| **E = Energy available from a biogas digester** | | | |
| $\eta$ = combustion efficiency of burners | 60% | | Reference: Biogas Technology, B.T. Nijajuna, New Age International Publishers, New Delhi, 2002 |
| $H_b$ = heat of combustion per unit volume of biogas | 22.1 | MJ/m3 | |
| $V_b$ = Volume of the biogas | 2 | m3/day | Deenabandhu Model, of 2 cum, construction |
| **E =** | 26.52 | MJ/day | Calculated $E = \eta . H_b . V_b$ |
| **E =** | 7.37 | kWh/day | Calculated @ 1 megajoule = 0.277 777 777 78 kilowatt hour |
| **E =** | 1.78 | kW thermal Capacity | Calculated installed capacity of biogas |
| **E =** | 9 | MW, thermal | Calculated for 5000 biogas units |

Hence the project qualifies as Small Scale Project, Type I: Renewable energy project activity with maximum output capacity less 45 $MW_{th}$

## B.3. Project boundary, sources and greenhouse gases (GHGs)

>> According to the methodology, the project boundary is the physical, geographical site of the use of biomass or the renewable energy. The projects boundary will therefore encompass the sum of the 5,000 physical geographical sites of all individual biogas plants (digester system, pipe leading to the stove and the stove itself) realized by the project activity.

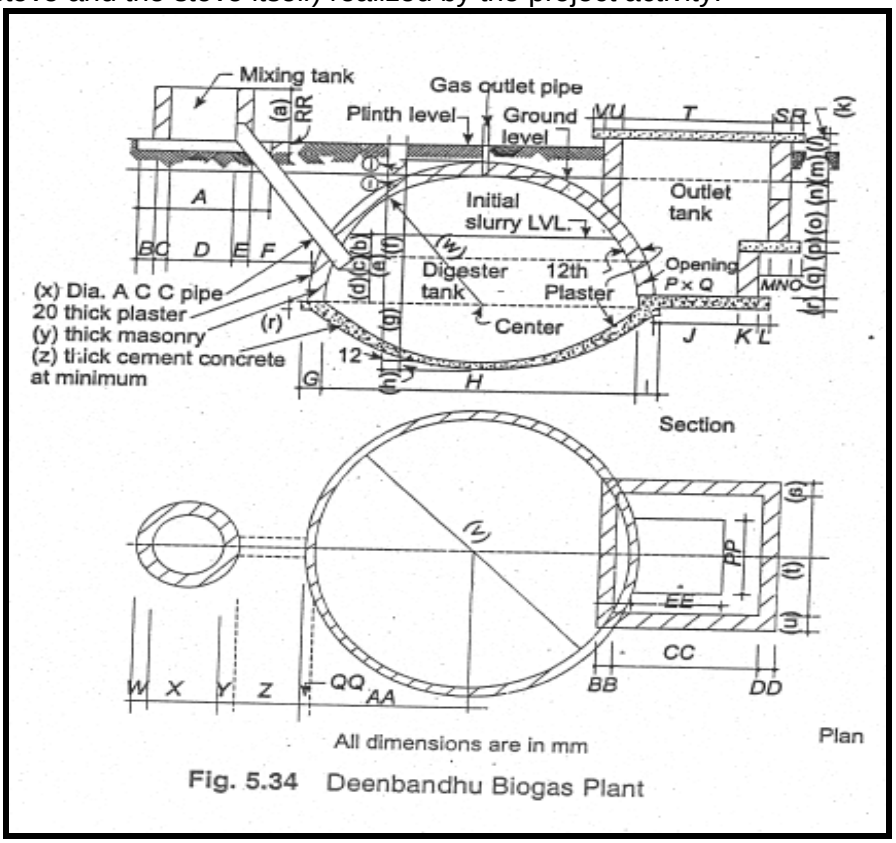


Fig. 5.34 Deenbandhu Biogas Plant

Figure 2: The Biogas model

The project boundary is the physical, geographical area where the renewable energy in 5,000 biogas digesters is being generated and used. Each digester comprises the following main installed components made of brick and cement:

- A digester measuring 2.1 metres in diameter, and 1.545 metres internal height from bottom of digester to top of dome
- 45 cm high mixing tank with internal wall length of 45 cm
- An optional additional acidification tank for pre-treatment of substrate may be built
- An outlet tank with an outlet opening of 60 cm and a height of 25.7 cm above the ground, covered by a cement slab of 7 cm thickness and area of 1 m x 1.17 m
- A pipe of between 5 and 100 metres in length leading from the top of the dome to the stove
- A 2-ring stove inside the house

Based on the methodology, the GHGs included are as follows:

| Source | | GHG | Included? | Justification/Explanation |
|---|---|---|---|---|
| Baseline scenario | Emissions from burning non-renewable wood | $CO_2$ | Included | Major source of emission |
| | | $CH_4$ | Excluded | Not a major source |
| | | $N_2O$ | Excluded | Not a major source |
| Project scenario | Project emissions due to cultivation of biomass | $CO_2$ | Excluded | As per methodology it is applicable. But as there is no cultivation of biomass in the project activity it is excluded. The renewable source is cattle dung. |
| | | $CH_4$ | Excluded | Not a source |
| | | $N_2O$ | Excluded | Not a source |
| Leakage | From use of non-renewable woody biomass by non- project households/users that previously used renewable energy. | $CO_2$ | Included | Major source of emission |
| | | $CH_4$ | Excluded | Not a source |
| | | $N_2O$ | Excluded | Not a source |

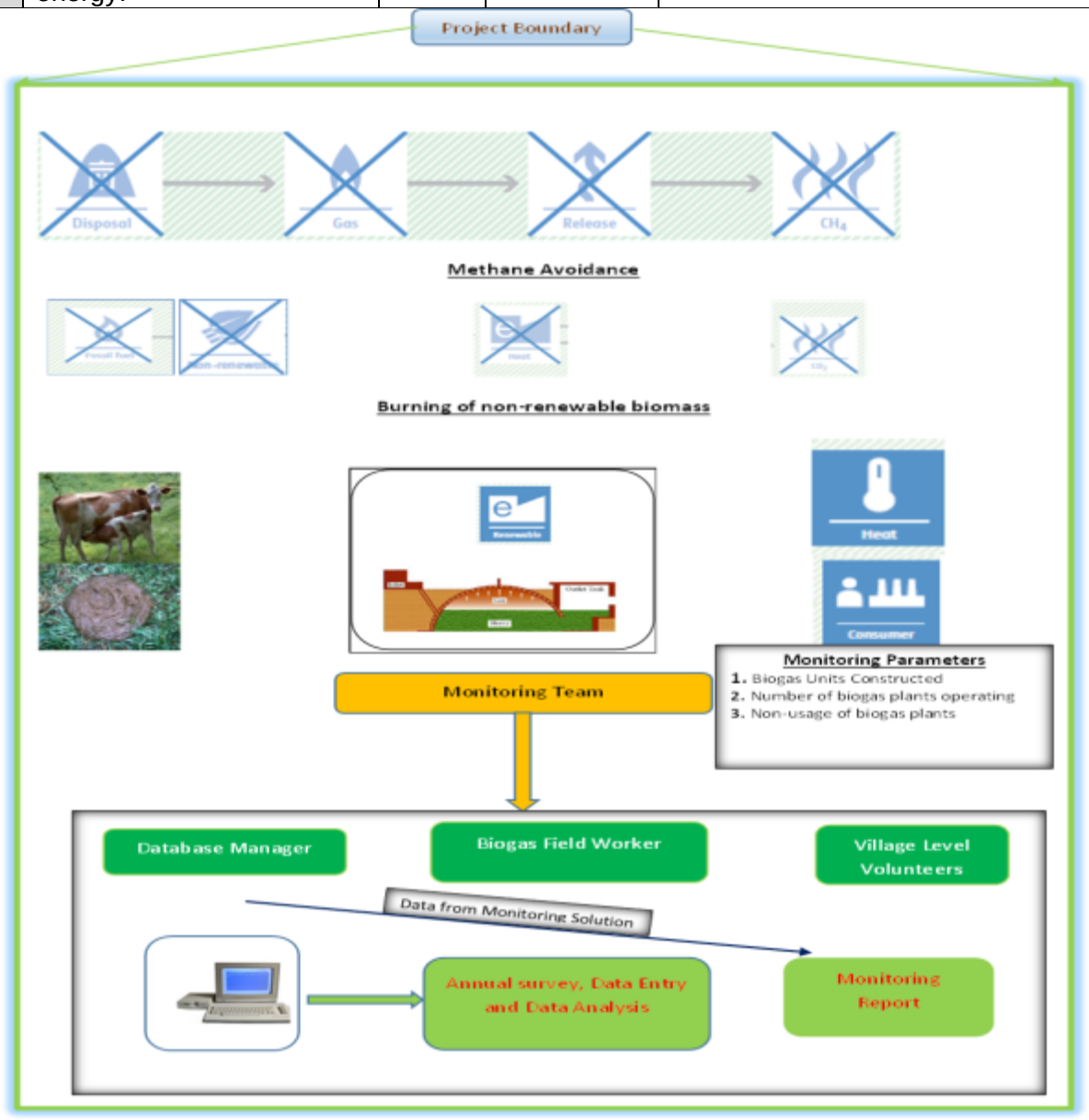


**Fig 3: Technical process of the project**

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

>> In line with Methodological Tool, Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period – v3.0.1, to assess the validity of the original/current baseline and update of the baseline at the renewal of a crediting period, Annex 47, EB 66, Version 3.0.1" it stipulates the following procedures to be used for the assessment of continued validity of the original baseline and its update.

***Step 1: Assess the validity of the current baseline for the next crediting period***

*The procedures for the renewal of the crediting period of a registered CDM project activity approved by the CDM Executive Board require assessing the impact of new relevant national and/or sectoral policies and circumstances on the baseline,* using the following sub-steps:

***Step 1.1: Assess compliance of the current baseline with relevant mandatory national and/or sectoral policies***

There are no relevant national and/or sectoral policies and circumstances ever since the project was registered that have an impact on the baseline. The Ministry has been supporting programmes for the deployment of renewable energy systems and devices such as biogas plants, in rural areas of the country[3]. But the implementation of biogas is still very low. The national level potential is 12.3 million of which only 4.9 million have been built[4]. The baseline scenario remains unchanged and is the same as that determined during the start of the project activity, i.e. use of thermal energy from woody biomass.

***Step 1.2: Assess the impact of circumstances***

The baseline scenario identified at the validation of the project activity was thermal energy from fuel wood, of which a large part of it was non-renewable for domestic cooking and water heating. This project activity was a voluntary investment which replaced equivalent amount of thermal energy from renewable source, the biogas. The project proponent was not bound to incur this investment as it was not mandatory by national and sectoral policies. Thus, the continued operation of the project activity would continue to replace thermal energy from fuel wood, hence the same baseline as identified in the previous crediting period is still valid for the project. Therefore, the assessment of the changes in market characteristics is not required for the renewal of the project's crediting period under CDM.

The target population are the rural households of Anantapur District. The rural households are primarily dependent on fuel wood for cooking and heating water. This is concurrent with the latest survey conducted at the national and state level, wherein nearly 67.3% of rural household use fuel wood for household energy need at national level, 67.5% at the state level of Andhra Pradesh (NSSO, 2015)[5] and 85.71% of the rural population in Anantapur District use fuel wood for cooking (Census of India data)[6]. The region is scarce of biomass and non-renewable biomass is part of the biomass used for cooking and heating water. In the project households, fuel wood has been replaced with biogas, a renewable source of thermal energy through this CDM project activity.

Hence, the new circumstances do not have an impact on the baseline emission. The conditions used to determine the baseline emissions in the previous crediting period are still valid even now. In the absence of the project activity, the baseline scenario in the project boundary is the use of non-renewable biomass for cooking and heating water on traditional cook stoves with low

[3] http://mnre.gov.in/file-manager/annual-report/2016-2017/EN/pdf/6.pdf

[4] http://mnre.gov.in/file-manager/annual-report/2016-2017/EN/pdf/6.pdf , Page 109.

[5] NSSO 2015. National Sample Survey Organization, Energy sources of Indian Households for cooking and lighting, 2011-12. Ministry of Statistics and Programme Implementation, Government of India. (Page No.14)

[6] http://www.censusindia.gov.in/2011census/Hlo-series/HH10.html . Census data of Households By Availability Of Separate Kitchen And Type Of Fuel Used For Cooking.

efficiencies. There are no mandatory national and sectoral policies or regulations for use of biogas (renewable energy) at household level. Thus, the GHG emissions under the baseline condition comprise $CO_2$ emissions from the use of non-renewable biomass for thermal energy.

***Step 1.3: Assess whether the continuation of use of current baseline equipment(s) or an investment is the most likely scenario for the crediting period for which renewal is requested.***

This sub-step should only be applied if the baseline scenario identified at the validation of the project activity was the continuation of use of the current equipment without any investment and the project proponents would undertake an investment later due to, for example, to the end of the technical lifetime of the equipment before the end of the crediting period or the availability of a new technology.

This sub-step is applicable to the project activity since the baseline is the continuation of the existing practice, i.e. the households will rely on traditional cook stoves using non-renewable biomass in the absence of the project activity. The traditional stoves made from local materials are expected to continue in the absence of the project. The materials needed for traditional mud stoves are free and only require minimal time to construct and maintain. These stove only require periodic recoating with mud/clay[7]. Therefore, the continued use of baseline stoves is possible. As can be seen, the penetration of other technologies is still very low and the predominant rural population of Anantapur which account to 85.71% use fuel wood for cooking on traditional cook stoves[6].

As it can be seen, the continuation of use of current baseline equipment, (non-renewable biomass based cook stove) is the most likely scenario for the crediting period for which renewal is being requested.

***Step 1.4: Assessment of the validity of the data and parameters***

This step stipulates to *"assess whether data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period are still valid or whether they should be updated.*

In the context of the present project activity the emission factor has been updated along with the approach used to calculate the emission factor. The registered CDM project activity was registered under I.E. Version 01. The applicable methodology at the time of submission of this PDD is AMS I.E, Version 07 and hence applied and updated.

According to the guidelines, updates should be undertaken in the following cases:

*Where IPCC default values are used, the values should be updated if any new default values have been adopted and published by the IPCC, for example, in guidelines for national GHG inventories, IPCC assessment report or special reports by the IPCC;*

The default values for net calorific value (NCV) for woody biomass and emission factor (EF) for fossil fuels given in the methodology I.E., Version 07 has been adopted for emission reduction calculations. Emission factor for the substitution of non-renewable woody biomass by similar consumers has been updated as given in the I.E. methodology Version 07.

*Where emission factors, values or emission benchmarks are used and determined only once for the crediting period, they should be updated, except if the emission factors, values or emission benchmarks are based on the historical situation at the site of the project activity prior to the implementation of the project and cannot be updated because the historical situation does not exist anymore as a result of the CDM project activity.*

[7] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3945541/

The emission factors have been updated for emission reduction calculations as the baseline situation exists even now even after the implementation of the CDM project activity.

- The fraction of woody biomass used in the absence of the project activity that is non-renewable ($f_{NRB}$) has been updated.
- The fuelwood use is also updated based on survey conducted in the project area.

***Thus, the data and parameters that were only determined at the start of the crediting period and not monitored during the crediting period have been updated based on the latest version of the methodology and other parameters to determine emission reduction. The current baseline has been established for the subsequent crediting period.***

***Step 2: Update the current baseline and the data and parameters***

This step is only applicable if any of the Steps 1.1, 1.2, 1.3 and/or 1.4 showed that the current baseline needs to be updated.

***Step 2.1: Update the current baseline***

According to the guidelines, *the current baseline emissions has to be updated for the subsequent crediting period, without reassessing the baseline scenario, based on the latest approved version of the methodology applicable to the project activity. The procedure should be applied in the context of the sectoral policies and circumstances that are applicable at the time of request for renewal of the crediting period.*

Without reassessing the baseline scenario, the baseline emissions has been updated for the subsequent crediting period based on the latest methodology i.e. I.E., Version 07 now applicable to the project activity. At the time of the request for renewal of the crediting period, the circumstances that are applicable are as follows:

The Central Sector Scheme has been implementing National Biogas and Manure Management Programme (NBMMP) that caters to setting up of family type biogas plants since 1981-82. National Biogas and Manure Management Programme provides for central subsidy in fixed amounts for biogas plants built for various capacities. A cumulative total of 4.9 million family type biogas plants have been set up in the country against estimated potential of 12.3 million plants[3]. This scheme was in force at the time of the completion of the baseline study for the registered PDD.

All these fiscal and financial incentives were in force at the time of completion of the baseline study for the registered PDD of the project activity and still continue to exist. However, in spite of the financial incentives given by the government to biogas units in India, the use of fuel wood has continued and the extent of use of biogas is still very low. Based on the latest report, biogas is used for cooking by 0.41% at the national level; 0.61% at the state level and 0.49% at the district level[6].

***Step 2.2: Update the data and parameters***

If the application of Step 1.4 showed that the data and/or parameter(s) that were only determined at the start of the crediting period and not monitored during the crediting period are not valid anymore, project participants should update all applicable data and parameters, following the guidance in Step 1.4.

***Updated baseline for the second crediting period***

According to the methodology applicable for the project activity, 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. As this is for renewal of crediting period, and the latest methodology has to be applied, hence based on the latest methodology, 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.

Emission reductions would be calculated as:

$$ER_y = BE_y - PE_y - LE_y$$

Where:

| | | |
|---|---|---|
| $ER_y$ | = | Emission reductions in year y, tonnes $CO_2$eq |
| $BE_y$ | = | Baseline emissions in year y, tonnes $CO_2$eq |
| $PE_y$ | = | Project emissions in year y, tonnes $CO_2$eq |
| $LE_y$ | = | Leakage, tonnes $CO_2$eq |

**Baseline emissions**

Baseline emissions would be calculated as:

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel}$$

Where:

| | | |
|---|---|---|
| $BE_y$ | = | Baseline emissions during the year *y* in t $CO_2$e |
| $B_y$ | = | Quantity of woody biomass that is substituted or displaced in tonnes |
| $f_{NRB,y}$ | = | 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 or government data or approved default country specific fraction of non-renewable woody biomass (fNRB) |
| $NCV_{biomass}$ | = | 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 t $CO_2$/TJ[8] |

**Determining $B_y$:**

$B_y$ is determined by using option (a), which is as follows:

Calculated as the product of the number of households multiplied by the estimate of average annual consumption of woody biomass per household that is displaced by the project activity (tonnes/household/year);

$$B_y = N_{HH} \times (BC_{BL,HH,y} - BC_{PJ,HH,y})$$

Where:

| | | |
|---|---|---|
| $N_{HH}$ | = | Number of households in the project activity, number |

[8] 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 per cent weight is assigned to coal as the alternative solid fossil fuel (96 t $CO_2$/TJ) and a 25 per cent weight is assigned to both liquid and gaseous fuels (71.5 t $CO_2$/TJ for kerosene and 63.0 t $CO_2$/TJ for liquefied petroleum gas (LPG).

| | | |
|---|---|---|
| $BC_{BL,HH,y}$ | = | Average annual consumption of woody biomass per household before the start of the project activity, tonnes/household/year |
| $BC_{PJ,HH,y}$ | = | If it is found that pre-project devices were not completely displaced but continue to be used to some extent, average annual consumption of woody biomass per household in the pre-project devices during the project activity, tonnes/household/year |

$BC_{BL,HH,y}$ & $BC_{PJ,HH,y}$ can be derived from historical data or estimated using survey methods

During 2016-17 a baseline survey was conducted in the project region with regard to quantity of fuelwood use. Based on the survey, the per capita fuelwood use is 1.86 kg/capita/day. The average family size of the 5,000 families with biogas is 4.20. Accordingly, the $B_y$ value is as follows:

| Amount of Biomass using survey method - option a) | |
|---|---|
| **Item** | **Value** |
| Number of Households ($N_{HH}$) | 5,000 |
| Average annual biomass consumption per biogas Unit (tonnes/year) (1.86 kg x 365 days X 4.2 persons)/1000 (($BC_{BL,HH,y}$) | 2.85 |
| $BC_{PJ,HH,y}$ (Considered 0 for ex-ante calculations) | 0 |
| $B_y$ = Quantity of Biomass that is substituted or displaced (in tonnes) | 14,257 |

The fuelwood use considered for this crediting period is lesser than that considered in the first crediting period. This is mainly because the family size has decreased over the years.

In accordance with Paragraph 14 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 07:

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

According to Paragraph 17 of the methodology, the fraction of woody biomass saved by the project activity is year y that can be established as non-renewable is

$$f_{NRB,y} = \frac{NRB}{NRB + DRB}$$

Where

NRB = Non-renewable woody biomass
DRB = Demonstrably renewable woody biomass

A national study was conducted by the Forest Survey of India, Ministry of Environment and Forests, Government of India to assess the woody biomass demand and availability at the state and national level[9]. Based on the study, the consumption of fuel wood for each of the state was determined based on surveys conducted at household level for each of the state. The annual

[9] FSI, 2011. Chapter 7: Socio-economic contribution of forests: Production and consumption of forest resources in India. State of Forest Report. Forest Survey of India, Ministry of Environment and Forests, Government of India. Page numbers 72, 73 and 76.

production of wood from forests was determined from records of each of the forest division in the state. Using this data, the state and national level data was generated. Further, the production of wood and fuel wood from the trees outside forests was determined from short rotation, medium rotation and long rotation species. Also the trees harvested for industrial wood provide substantial quantity of fuel wood as by-product. This has also been accounted for the production fuel wood from trees outside forests. According to the study, the total annual fuel wood consumption for Andhra Pradesh state is 24.293 Mt. Fuel wood productions from forests and from trees outside Forests account for 0.002 Mt and 1.024 Mt respectively. Therefore the DRB component of total fuel wood production is 1.026 Mt. Accordingly; the NRB component of fuel wood consumption is 23.267 Mt. This accounts for an $f_{NRB}$ of 0.95. The following table summarizes the calculations for $f_{NRB}$ based on FSI, 2011.

| **$f_{NRB}$ Calculations for Andhra Pradesh State based on Forest Survey of India, 2011** | | |
|---|---|---|
| **Parameter** | **Value** | **Source of Data** |
| **Fuel wood Consumption (tonnes)** | 2,42,93,000 | State of Forest Report, Forest Survey of India, Ministry of Environment and Forests, Government of India, 2011 (the latest available survey in the region) |
| **Fuel wood production from Forest (tonnes)** | 2,000 | |
| **Fuel wood production from trees outside Forests (tonnes)** | 10,24,000 | |
| **Non-Renewable Biomass (NRB) (tonnes)** | 2,32,67,000 | (Consumption) minus (Production from forests and outside forests)(24293000-(2000+1024000) |
| **Demonstably Renewable Biomass (DRB) (tonnes)** | 10,26,000 | Production from forests and from trees outside forests (2000+1024000) |
| $f_{NRB,y} = \frac{NRB}{NRB + DRB}$ | **0.95** | Based on formula given in I.E. Version 7.0 of the methodology |

The fraction of non-renewable woody biomass used in the absence of the project activity **is 0.95.**

*According to the methodology, the Non-renewable woody biomass (NRB) is the quantity of woody biomass used in the absence of the project activity ($B_y$) minus 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 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;*
- *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;*
- *Increasing trends in fuel-wood prices indicating a scarcity of fuel-wood;*
- *Trends in the types of cooking fuel collected by users that indicate a scarcity of woody biomass.*

To demonstrate the non-renewability of woody biomass, the supporting indicators that exist are as follows:

- *Increase in time spent for gathering fuel-wood by users:* The baseline household survey conducted in the project area showed that 100% respondents spend more time to collect fuel-wood now compared to that 20 years back. This is due to depletion of biomass stocks in wastelands and forests. They need to trek longer distances to collect fuel-wood compared to that 20 years back resulting in increased time spent. A survey was conducted wherein the communities identified declining fuel wood availability as a dynamic and a very important problem. They defined the problem in terms of their perception of the availability of fuel wood in the forest and elaborated on the problem using indicators such as longer time taken and distance travelled to collect fuel wood.

- *Increasing trends in fuel wood price indicating scarcity;* Yearly consumer expenditure survey among Indian households is carried out by the National Sample Survey Organisation (NSSO) for rural areas at the state level. Information on energy sources used both for cooking and lighting is collected as part of the survey. It can be seen that there is an increase in price beyond the yearly inflation rate, indicating scarcity (Fig 5). Respondents were also asked to recall the price of a head load of firewood in 20 years ago and the cost of the same today. The present price of each head load of firewood is around Rs 50. Communities recalled that 20 years ago fuel wood was available in abundance near to their villages and there was no need to buy from outside. The baseline survey also revealed that they travel long distances compared to 20 years ago (Appendix 4 of the PDD).

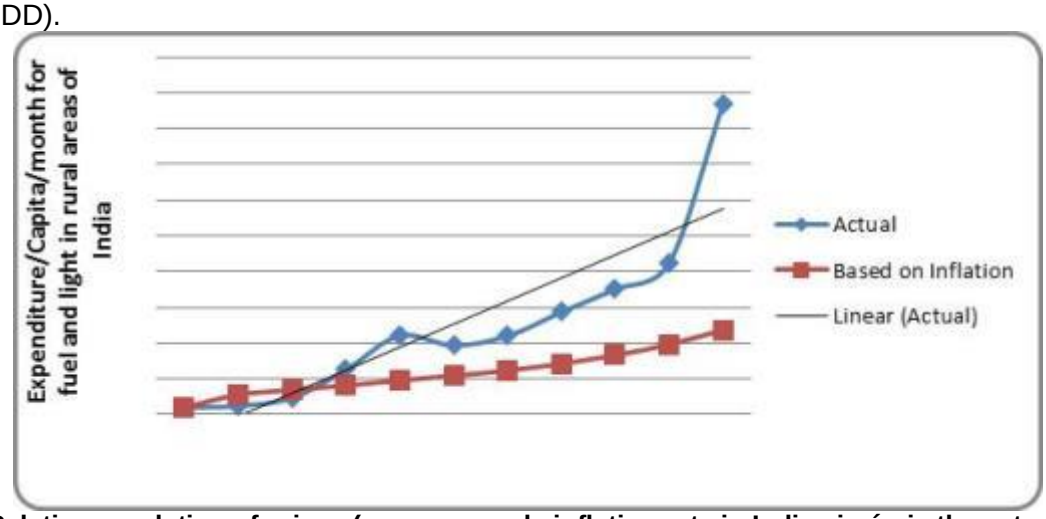


**Fig 5: Relative escalation of prices (average yearly inflation rate in India vis-á-vis the actual prices) towards fuel and light spent by rural population in Andhra Pradesh[10]**

- *Decrease in carbon stocks:* A periodic 2-year assessment of status of forest cover in India is carried out by Forest Survey of India, Ministry of Environment and Forests, Government of India. This assessment is carried out at District level for all the States of India. An assessment of forest cover of Anantapur District shows a decrease in dense forest cover from 182 $km^2$ in 2001 to 144 $km^2$ in 2015[11]. Further, density of open forest cover shows that there has been considerable increase in open forests from 329 $km^2$ in 2001 to 545 $km^2$ in 2011 and further scrub forests have decreased from 992 to 716 $km^2$. Dense forests are forests with a crown cover between 70-40%. This accounts to a decrease of 20% area of dense forests in 15 years. This implies a decrease in biomass i.e. carbon stocks. Most of the dense forests have got converted to open forests i.e. a crown cover between 40-10%.

[10] http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=442&type=NSSO (1997) (Page no 19)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=448&type=NSSO (1998) (Page no 22)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=454&type=NSSO (1999-2000) (Page no 52)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=476&type=NSSO (2000-01) (Page no 22)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=484&type=NSSO (2002) (Page no 23)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=490&type=NSSO (2003) (Page no 24)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=509_P1&type=NSSO (2004-05) (Page no A-201)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=523&type=NSSO (2005-06) (Page no A-8)
http://mospi.nic.in/rept%20_%20pubn/ftest.asp?rept_id=527&type=nsso (2006-07) (Page no A-8)
http://mospi.nic.in/Mospi_New/upload/530_final.pdf (2007-08) (Page no A-8)
http://mospi.nic.in/Mospi_New/upload/KI-68th-HCE.pdf (Page no A-19)

[11] Anantapur District, GIS Assessment by the Forest Survey of India for 2001 and 2011. http://www.fsi.org.in/sfr_2015.htm and http://www.fsi.org.in/sfr_2001.htm

As mandated in the methodology, three conditions; decrease in carbon Stocks, increase in time spent for gathering fuel wood by users and increasing trends in fuel wood price indicating scarcity clearly proves non-renewable woody biomass use in the project area


**Fig 6: Forest Cover Map based on Remote Sensing of Andhra Pradesh State showing Anantapur District. Source: Forest Survey of India, Government of Environment and Forests, Govt. of India.**

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

The district is facing fuelwood crisis since many years as the area has scanty vegetation (Figure 6). The use of non-renewable biomass since 1989 is demonstrated below applying the same steps as shown above. As can be seen from Table 6, 87% of the biomass used as fuelwood was non-renewable biomass. The non-renewable use of biomass has increased over the past 20 years though large-scale plantations are being promoted in the district by the Forest Department. This is due to the fact that the population has increased by 20% over the past 20 years.

Table 6: Use of non-renewable use in 1989 in the 5 Mandals of the project area.

| Activity Data | Value | Source |
|---|---|---|
| **RENEWABLE BIOMASS IN THE PROJECT AREA** | | |
| Geographical Area of 5 Mandals (ha) | 147,575 | Hand Book of Statistics 1988-89[12] |
| **I. Renewable biomass from forests** | | |
| Forest Land (ha) | 23,678 | Hand Book of Statistics 1988-89 |
| % of forest land classified as tropical dry deciduous | 100% | Anantapur Forest Department |
| Sustainable rate of fuelwood extraction from Tropical Dry Deciduous Forests (t/ha/yr) | 0.22 | Ravindranath *et al*. 2001[13] |
| **Renewable biomass extraction from forests (t/ha)** | **5,209** | **Area x sustainable rate of extraction** |
| **II. Renewable biomass from Culturable non-forest land** | | |
| Total Culturable Non-Forest land (ha) | 122,919 | Hand Book of Statistics 1988-89 |
| No of trees/ha of Culturable Non Forest Area (trees/ha) | 11.2 | FSI, 2003[14] |
| Mean Annual Increment (as % of standing biomass) | 2.84% | Shailaja and Sudha, 1997[15] |

[12] Hand Book of Statistics – Anantapur District, Chief Planning Officer, Anantapur, 1990

[13] Ravindranath, N.H., Sudha, P & Sandhya Rao. 2001. Forestry for sustainable biomass production and carbon sequestration in India. Mitigation and Adaptation Strategies for Global Change 6: 233-256.

[14] FSI 2003. State of Forest Report 2001, Forest Survey of India, Govt. of Environment and Forests, Govt. of India. 2003. http://www.fsi.nic.in/sfr2001/Andhra%20Pradesh.pdf

[15] Shailaja Ravindranath and Sudha Premnath. 1997, Biomass Studies. Field Methods for Monitoring Biomass. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi

| | | |
|---|---|---|
| Average Standing biomass/tree (t) | 0.24 | |
| Average Standing biomass/ha (t) | 2.67 | Calculated (No of trees/ha x standing biomass/tree) |
| Mean Annual Increment (t/ha) | 0.08 | Calculated (2.84% of standing biomass) |
| **Sustainable extraction from trees on CNFA (t)** | **9,384** | **Area x sustainable rate of extraction** |
| **III. Renewable biomass from Plantation** | | |
| Plantation area including trees and groves (ha) | 977 | Hand Book of Statistics 1988-89 |
| Sustainable extraction rate from plantations (t/ha/yr) | 2.00 | Ravindranath et al. 2001 |
| **Sustainable extraction from plantations (t)** | **1,955** | **Calculated** |
| **Total Renewable biomass in the project area** | | |
| **Total Renewable Biomass available (t)**[16] | **16,547** | **Total of I, II and III** |
| **FUELWOOD REQUIREMENT FOR THE 5 MANDALS** | | |
| Population (Households) | 46,415 | Hand Book of Statistics 1988-89 |
| % of households reliant on biomass for cooking | 82.3% | Govt of India, Census of India, 2001 |
| Fuelwood requirement per HH (t/yr) | 3.37 | Based on household survey |
| **Total fuelwood requirement (t/yr)** | **128,732** | Calculated |
| **Availability ratio** | **13%** | Calculated |
| Fraction of non renewable biomass used in the absence of the project activity $f_{NRB,y}$ | **87%** | **Calculated** |

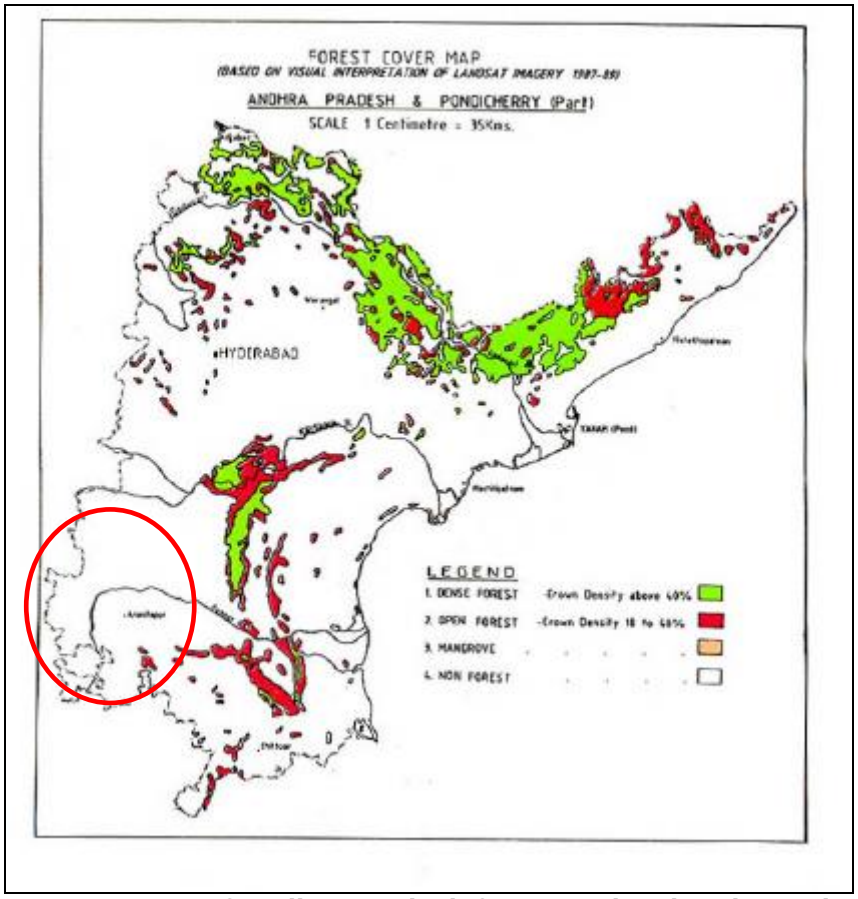


**Figure 6: Forest Map of Andhra Pradesh for 1989 showing the project area.**

[16] Sustainable extraction from all land use - forests, croplands, grasslands and wastelands have been considered.

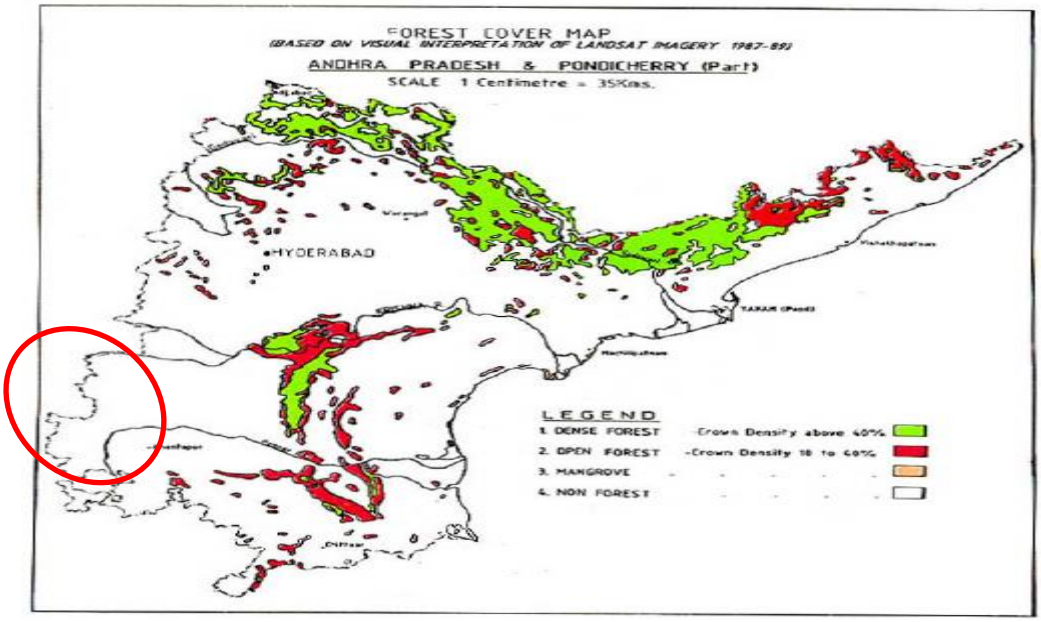


**Fig 8: Forest Map of Andhra Pradesh for 1989 showing the project area.**

Andhra Pradesh, the state in which the project is implemented, is a forest scarce state with less than a critical minimum of 0.1 hectares per person during 1989. Though forest cover has stopped declining further, its quality however is still declining in terms of lowered growing stock and annual incremental rates depicting a lowered volume of the forest's stock and of the productivity of India's forest covered areas. Between the years 1989-1997, there has been a decrease of 10% change in the crown cover in Andhra Pradesh. Thus not only at the national level, even at the state level of Andhra Pradesh there has been non-renewable biomass used since 31st December 1989. Based on the FSI, 1989 (Fig 6), at the level of consumption of forest produce and the productivity of forests, the country needed a minimum of 0.47 ha of forests per capita to meet their needs which includes fuel wood. Andhra Pradesh had forest cover of 0.05 – 0.1 ha per capita, below the critical minimum required for sustainable production and extraction of forest produce including fuel wood.

Thus non-renewable biomass is being used since 1989

## B.5. Demonstration of additionality

According to Appendix B of the simplified modalities and procedures for small-scale CDM project activities; Indicative simplified baseline and monitoring methodologies for selected small-scale CDM project activity categories project participants shall provide an explanation to show that the project activity would not have occurred anyway due to at least one of the following barriers:

*(a) Investment barrier: a financially more viable alternative to the project activity would have led to higher emissions;*

The alternatives to the project activity are the i) continued use of non renewable biomass for cooking, ii) use of kerosene for cooking, iii) use of LPG for cooking and iv) implementation of the project in the absence of CDM revenue, all of which are in compliance with mandatory laws and regulations.

There is no investment barrier to the continued use of non renewable biomass for cooking. The use of traditional wood stoves represents the baseline situation in the local area with an emission of 3.25t$CO_2$/family/yr. The traditionally used stoves come in 3 basic categories; traditional mud stove and improved vented mud stove costing about Rs.200 and basic 3 rock stove with no costs. The running cost of all of these stoves is also not considered an investment barrier as biomass is

collected free from local wasteland, forest land, and agricultural land[17]. The rural poor do not have much cash to spend on energy and use the fuels they collect to meet their cooking needs[18]. Therefore, at the national level 75% of the households[6] and at the state level in Andhra Pradesh 80% of the households[6] use firewood as the primary source of energy in rural areas.

For the use of kerosene as the main fuel, two litres of kerosene are supplied each month via the public distribution system in Anantapur district at a subsidised rate of Rs.10 per litre to ration card holders. Additional kerosene can be bought at the market rate of Rs.35 per litre. Approximately 1.25 litres of kerosene are required to meet the cooking requirements of an average rural household per day. Reliance on kerosene as the sole cooking fuel would equate to a monthly cost of Rs. 1300 for the average family and is thus not a viable alternative for any of the participating families. The survey revealed an average monthly consumption of only 0.07 litres per household for cooking purposes. The remainder of kerosene obtained via the government distribution service is used as fuel in kerosene lamps for lighting and not for cooking. This is also substantiated by the fact that kerosene is not the primary fuel for cooking in rural households at the national or state level[6].

A 12 litre cylinder of LPG costs approximately Rs. 400 and will last an average family approximately one month if used to meet all cooking/hot water requirements. An LPG connection (deposit for the pressurised cylinder/canister) and stove constitute a large upfront cost (when compared with the equipment for other fuels), so that some who can afford the fuel cannot make the initial investment[19]. LPG appears to be the preferred option for those able to afford the initial and refill costs. But it is unaffordable by the rural families. This represents substantial a cost to be met by any of the families participating in this biogas project. There is also a lack of infrastructural support (e.g. lack of facilities for refilling at doorstep) that further prohibits the widespread adoption of LPG in the rural context. Currently, rural areas of the country are located far from distribution centres, so that users have to pay for the extra costs of cylinder supply. Moreover, for small and remote markets, refills often take more than a week. Due to logistical problems the few rural LPG users that exist often have to wait for long duration to get a cylinder refilled. Due to such circumstances it is impossible for even a wealthy rural household to rely on LPG as its main cooking fuel.

An individual 2 meter cubed biogas unit costs approximately Rs.12,500[20] (inclusive of cook stove and pipe). This is a sum that far exceeds what the target population of this project can afford. They are not able to save or get personal loans to meet this cost. A socio economic reality that further confirms this fact is that even though all the project participants are aware of the potential of biogas technology they continue to put up with the adverse health effects caused through the use of traditional wood stoves in unventilated kitchens. This can be evidenced by the low rate of biogas units installed and running so far in the project area.

A National Programme for Biogas Development (NPBD) is implemented by the Government of India that offers subsidy for installing biogas units. According to NEDCAP, the state nodal agency responsible for the implementation of the NPBD programme, 2.84 lakh family biogas plants have been installed within the state of Andhra Pradesh to date. They estimate the overall potential to be

[17] N.C. Saxena. Forest, People and Profit net equations for sustainability. Planning Commission, Govt. of India.

[18] P.Sharath Chandra Rao, Jeffrey B.Miller, Young Doo Wang, John B. Byrne. Energy microfinance intervention for below poverty line households in India. Energy Policy 37 (2009) 1694 - 1712

[19] Antonette D'Sa and K.V.Narasimha Murthy. 2004. Report on the use of LPG as a domestic cooking fuel option in India. International Energy Initiative.

[20] http://www.solutionexchange-un.net.in/environment/cr-public/cr-se-wes-18070601-public.pdf

10.9 lakh units[21]. Based on 2001 census, only 0.7% of the households were using biogas for cooking at the state level[22]. In the past 5 years, on an average, 1,000 biogas units/year have been built in the district, whereas based on the livestock population the potential in the district is approximately 275,000. Even with subsidies it is beyond the reach of the rural poor communities.

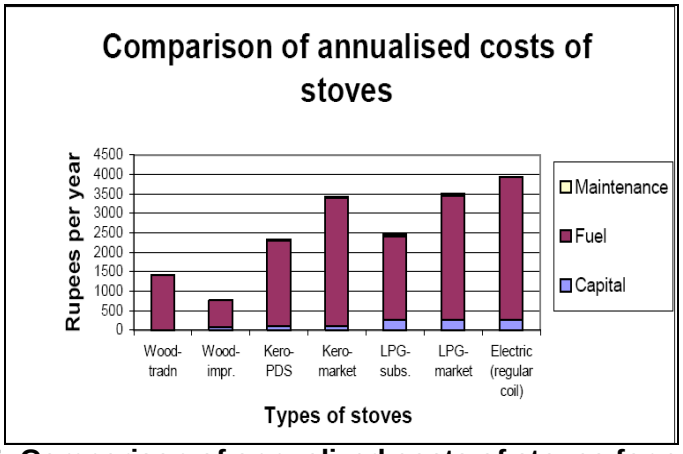


**Figure 7: Comparison of annualized costs of stoves for cooking[27]**

Thus the continued combustion of non-renewable biomass fuel for cooking and water heating is the cheapest option (Figure 7), leading to higher GHG emissions. Thus even now all the households use traditional fuel wood stoves for cooking and water heating in the mandals.

There is an investment barrier preventing this project activity taking place in the absence of CDM: no debt funding is available. Individual loans to poor farmers for building biogas plants are not available. SEDS approached the local banks for a loan for the construction of the biogas plants based on CERs revenue. The banks refused to provide loans without guarantee. The combination of no guarantees, no equity, no security, and CER price risk means the loan is not available. No banks are willing to gamble on CER price and thus there is no risk-free income stream in this project and banks are not willing to lend anyway, even leaving aside the problem of guarantees. This project will be implemented exclusively with carbon finance through forward sale of CERs after registration of the project as a CDM activity.

*(b) Technological barrier: a less technologically advanced alternative to the project activity involves lower risks due to the performance uncertainty or low market share of the new technology adopted for the project activity and so would have led to higher emissions;*

There are no technological barriers preventing the use of the traditional stoves for cooking which are widely available in regional market towns and the basic 3-rock stove usually used by the rural women can be built by the women themselves without any special skills.

Biogas plants have to be constructed very carefully. This takes skill, diligence, careful working with acute attention to detail and the careful design of each plant so that it is suited to the local conditions at each plot of land where it is to be constructed[23]. At present there is a shortage of adequately trained biogas masons capable of constructing and maintaining high quality functioning biogas units.

---

[21] Non Conventional Energy Development Corporation of Andhra Pradesh (NEDCAP), http://www.aponline.gov.in/apportal/departments/departments.asp?dep=05&org=58&category=About

[22] Census of India, 2001. Government of India.

[23] Shaik et al. Barriers to dissemination of renewable energy technologies for cooking. Centre for Energy Studies, Indian Institute of Technology, Delhi, Hauz Khas, New Delhi – 110016, India.

Taking all of this into account it can be concluded that the target population of this project in the absence of CDM financing would not find themselves of fully functioning biogas that could be utilized to meet their cooking energy requirements. In the absence of the project the baseline situation would prevail where by the target population will continue to resort to non renewable biomass as the chief source of their cooking energy requirements.

*(c) Barrier due to prevailing practice: prevailing practice or existing regulatory or policy requirements would have led to implementation of a technology with higher emissions;*

The prevailing practice by the public sector in A.P and also in India today is to make kerosene as cooking fuel available to families below the poverty line through the public distribution system at subsidized prices. The public distribution system for subsidised fossil fuel in the cooking fuel sector (including LPG) is working well. However, in many cases the kerosene is still too expensive for families to buy in the open market and only 2 litres per month is given through the Public Distribution System. Subsidies for kerosene are limited to amounts sufficient only for lighting homes, and are inadequate for meeting the cooking requirements of poorer women. In spite of such subsidies for many decades they have failed to shift fuel consumption patterns away from biomass in rural areas[24]. An important reason for this is that subsidized fuel is not always available to the poor. In rural India, biomass is more easily available and access to LPG more difficult than in urban areas. This explains the lower use of kerosene and LPG among all expenditure class of the rural areas.

The NPBD of the Ministry of New Renewable Energy (MNRE) was started in 1981-82 for promotion of family type biogas plants, the current potential of which is estimated at 12 million, to provide clean alternate fuel to the rural masses and enriched organic manure for agriculture. The implicit objective of the programme is to reduce the use of fuel wood[25]. It is a central sector scheme covered under 20-point programme. According to NEDCAP, the state nodal agency responsible for the implementation of the NPBD programme, 2.84 lakh family biogas plants have been installed within the state of Andhra Pradesh to date. They estimate the overall potential to be 10.9 lakh units. An evaluation study undertaken by the Government of India found that majority of biogas users benefiting from the scheme are well-to-do farmers holding a sizeable amount of agricultural land. The household biogas plants that already exist have been built by individuals benefiting from a central subsidy (ranging between Rs.3500 – 2100 depending on beneficiaries economic status[26]). Even with subsidies, it is beyond the reach of the poor rural communities. To date this programme has resulted in very less penetration of biogas units being built inside the project boundary. Further the government programme for providing biogas plants for the poor has been reduced at the State level, and thus the capital shortfall prevents the continued expansion of the biogas programme in India. Thus a fossil-fuel based approach has come to dominate National and State level cooking fuel policy. The Central and State Government through subsidies has just supported about 5000 biogas units, on an average of 1000 biogas plants annually in Anantapur District in the past 5 years[27], while the potential is 275,000 in the district. These were largely implemented by rich farmers and the poor have not been able to afford them even with subsidies. The common practice for poor households is to depend on free sources of firewood. The evaluation concludes that the impact of the NPBD programme is not significant even though the programme has remained operational for about two decades. The findings of the PEO study tend to suggest that realization of the potential will remain a distant dream.

[24] Shubhashis Gangopadhyay, Bharat Ramaswami, and Wilima Wadhwa. 2005. Reducing subsidies on household fuels in India: how will it affect the poor? Energy Policy 33 (2005) 2326–2336.

[25] Ministry of New and Renewable Energy. http://mnes.nic.in/

[26] Ministry of Non Conventional Energy, National biogas and manure management programme, http://mnes.nic.in/prog-ftbp.htm

[27] Evaluation Study On National Project on Biogas Development, Programme Evaluation Organization Planning Commission, Government of India, New Delhi, 2002.

Taking all of this into account it can be concluded that the target population of this project in the absence of CDM financing would not find themselves of fully functioning biogas that could be utilized to meet their cooking energy requirements. In the absence of the project the baseline situation would prevail where by the target population will continue to resort to non renewable biomass as the chief source of their cooking and hot water energy requirements.

*(d) Other barriers: without the project activity, for another specific reason identified by the project participant, such as institutional barriers or limited information, managerial resources, organizational capacity, financial resources, or capacity to absorb new technologies, emissions would have been higher.*

One of the barrier to successful implementation of a biogas project is good maintenance; attending to structural and operational problems of the biogas units for continuous operation of the biogas units. The success or failure of any biogas plant mainly depends upon the quality of construction works. To come to a successfully constructed biogas plant, the mason should not only respect the dimensions as indicated on the drawing but also follow the correct construction method. It takes organizational and management skills and coordination to organize construction and continued use of the biogas units[28]. Not only do the plants have to be built to suit local soil conditions, but service and maintenance crews have to be trained and stationed in all the villages to ensure smooth running of the plants. Emissions from the combustion of non-renewable biomass fuel can only be avoided through professional attention to this rural renewable energy technology and manage it efficiently with sufficient resource – financial, technical, operational and managerial. Ineffective repair and maintenance strategy, poor service backup to handle the technical hiccups in field during operation are the main institutional barriers to this technology[29]. The Government evaluation studies shows that 55% of the biogas plans built are non-functional due to structural and operational problems, failure of dissemination strategy, lack of users training and follow-up services. These services are required for continuous operation of the biogas units.

Thus, proper extension and support services will be provided by SEDS at the village level. In this way, plants will not be allowed to fall into disrepair, when their functioning may depend upon adequate maintenance skills, which should be available in every village. The emphasis will be to promote the participation of local people in the whole process of education, planning and monitoring, so that the renewable technology is viable and sustainable in the communities it is designed to serve. Coordinated management information systems will be developed as part of biogas development, in order for problems to be identified and remedial measures undertaken. A portion of the CER revenues received as forward funding by the project will be set aside for such repair and maintenance for the biogas units.

SEDS as an NGO would not be able to finance; the training of its field staff, the end users of the biogas units, the proposed biogas mason apprenticeship scheme and the training of a biogas maintenance team, without CDM revenue. It would also not be able to attract the managerial resources and undertake the required organizational building required.

**Conclusion**

The project will be implemented among the women self-help groups formed at the village level in villages across 5 Mandals. Taking into account the national and sectoral policies and circumstances, the emissions reductions will not occur in the absence of the proposed small-scale project activity. In spite of the fact that this technology is well known in India, the proposed project has to overcome various barriers like prevailing practice and economically viable options. Barriers make it unlikely that biogas plants are built and in the absence of CDM revenue, these barriers would automatically lead to an implementation of a technology with higher emissions. In the

[28] N.H. Ravindranath and D.O. Hal. M 1995. Biomass, Energy and Environment: A developing Country Perspective from India, Oxford University Press.

[29] Ramachandra, T.V. 2008. Geographical Information System approach for regional biogas potential assessment. Research Journal of Environmental Sciences 2 (3): 170-184.

absence of this CDM project the above barriers would prevent the construction and maintenance of the proposed biogas units. Thus the traditional mud stove which is financially a more viable alternative to the project activity and is less technologically advanced has lower risks to performance uncertainty leading to higher emissions. On the other hand, the project activity has low market share and is technologically more advanced, requiring skilled labour to build them. The hope is that CDM revenue will enable biogas technology for cooking to overcome the described barriers and promote biogas plants in the project area. The CDM project will overcome this barrier by providing upfront revenue for construction of the biogas units and continuous support for maintenance of the units.

The described project activity is clearly additional because it will be financed completely through the revenues from forward financing of CER sales, and cannot be realized without the revenues from the carbon credits. Thus it is clear that, in the absence of CDM project, which will provide the upfront investment for the establishment of 5,000 biogas plants for the rural poor, this project will not happen

## B.6. Estimation of emission reductions

### B.6.1. Explanation of methodological choices

**Emission reductions**

Emission reductions are to be estimated based on the equation below.

$$ER_y = BE_y - PE_y - LE_y$$

Where:

| | | |
|---|---|---|
| $ER_y$ | = | Emission reductions in year y, tonnes $CO_2$eq |
| BEy | = | Baseline emissions in year y, tonnes $CO_2$eq |
| PEy | = | Project emissions in year y, tonnes $CO_2$eq |
| LEy | = | Leakage, tonnes $CO_2$eq |

**Baseline emissions**

Baseline emissions would be calculated as:

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel}$$

Where:

| | |
|---|---|
| $BE_y$ | Baseline emissions during the year *y* in t $CO_2$e |
| $B_y$ | Quantity of woody biomass that is substituted or displaced in tonnes |
| $f_{NRB,y}$ | 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 or government data or approved default country specific fraction of non-renewable woody biomass (fNRB) |
| $NCV_{biomass}$ | 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 t $CO_2$/TJ[30] |

$B_y$ is determined by using option (a) which is as follows:

Calculated as the product of the number of households multiplied by the estimate of average annual consumption of woody biomass per household that is displaced by the project activity (tonnes/household/year).

$$B_y = N_{HH} \times (BC_{BL,HH,y} - BC_{PJ,HH,y})$$

Where:

| | | |
|---|---|---|
| $N_{HH}$ | = | Number of households in the project activity, number |
| $BC_{BL,HH,y}$ | = | Average annual consumption of woody biomass per household before the start of the project activity, tonnes/household/year |
| $BC_{PJ,HH,y}$ | = | If it is found that pre-project devices were not completely displaced but continue to be used to some extent, average annual consumption of woody biomass per household in the pre-project devices during the project activity, tonnes/household/year |

**Project Emissions**

There are no project emissions as there is no cultivation of biomass.

**Leakage Emissions**

According to the methodology, leakage emissions ($LE_y$) 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 $B_y$ 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.

There is on leakage due to use of biomass residue, hence leakage pertaining to the use of biomass residues will not be considered.

[30] 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 per cent weight is assigned to coal as the alternative solid fossil fuel (96 t CO2/TJ) and a 25 per cent weight is assigned to both liquid and gaseous fuels (71.5 t CO2/TJ for kerosene and 63.0 t CO2/TJ for liquefied petroleum gas (LPG).

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

*(Copy this table for each piece of data or parameter.)*

| | |
|---|---|
| Data / Parameter | $f_{NRB,y}$ |
| Data Unit | *Fraction* |
| Description | Fraction of woody biomass saved by the project activity during year y that can be established as non-renewable biomass |
| Source of data | Assessment of Non Renewable Biomass based on data provided by Forest Survey of India, 2011, Ministry of Environment and Forests, Government of India. |
| Value(s) applied | 0.95 |
| Choice of data or Measurement methods and procedures | Based on data from State of Forest Report, 2011. Forest Survey of India, Ministry of Environment and Forests, Government of India. The data gives the consumption of fuel wood and production of fuel wood from forests and from trees outside forests. This data is assessed at the state level. Thus the $f_{NRB}$ for Andhra Pradesh is applied for the project activity. |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | This parameter is fixed for the entire crediting period. The $f_{NRB}$ calculations is based on the latest available statistics of the Forest Survey of India, Government of India.<br>Further, $f_{NRB}$ calculations done at the project activity level, i.e. Anantapur district, based on latest statistics gives a value of 0.98. As this value is conservative, it has been used. |

| | |
|---|---|
| Data / Parameter | $N_{HH}$ |
| Data Unit | Number |
| Description | Number of households in the project activity in year y |
| Source of data | Online Monitoring Solution |
| Value(s) applied | 5,000 |
| Choice of data or Measurement methods and procedures | **Established ex ante prior to start of the project activity** |
| Purpose of data | Calculation of baseline emissions |
| Additional comment | During calculation of Emission Reduction, it will be based on actual number of households in which the units have been constructed and commissioned |

| | |
|---|---|
| Data / Parameter | $BC_{BL,HH,y}$ |
| Data Unit | tonnes/year/family |
| Description | Average annual consumption of woody biomass per household before the start of the project activity, tonnes/household/year |
| Source of data | Based on survey in the project region during 2016-17 as mentioned in the methodology |
| Value(s) applied | 2.85 tonnes/year/family and 14,257 t/year for 5,000 families |
| Choice of data or Measurement methods and procedures | Calculated using option (a) Calculated as the product of the number of households multiplied by the estimate of average annual consumption of woody biomass per household displaced by the project activity (tonnes/household/year). |

| | |
|---|---|
| Purpose of data | Calculation of baseline emissions |
| Additional comment | This parameter is fixed for the entire crediting period. According to CDM-EB93-A04-STAN Standard CDM project standard for project activities, if data and parameters used for determining the original baseline, that were determined ex ante and not monitored during the crediting period, are no longer valid, the project participants shall update such data and parameters in accordance with the "Methodological tool: Assessment of the validity of the original/current baseline and update of the baseline at the renewal of the crediting period".<br>85.71% of the rural population in Anantapur district still use fuelwood for cooking and hence the new circumstances have not impacted the baseline scenario. Based on a survey conducted during 2016-17, the fuelwood use has been updated, which is lesser than that considered for the first crediting period. |

| | |
|---|---|
| Data / Parameter | **Diversion of non-renewable biomass saved under the project activity by non-project households** |
| Unit | tonnes / year |
| Description | Diversion of non-renewable biomass saved under the project activity by non-project households |
| Source of data | Based on the methodology $B_y$ will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages. |
| Value(s) applied | The parameter shall be adjusted for leakage, wherein $B_y$ will be multiplied by 0.95, which is fixed for the crediting period.<br><br>Biomass (t) – 2.85 x 0.95 = 2.71 t/yr for 365 days. The biomass diversion is 2.85 – 2.71 = 0.14 t/family/yr. |
| Choice of data or Measurement methods and procedures | According to I.E, Version 07, $B_y$ can be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required.<br>2.85 x 0.95 = 2.71 t/household/yr.<br>Thus the diversion is 2.85 – 2.71 = 0.14 t/family/yr. |
| Purpose of data | Calculation of leakage |
| Additional comment | This parameter is fixed for the entire crediting period. Surveys will not be conducted to determine leakage |

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

Emission Reductions is calculated as

$$ER_y = BE_y - PE_y - LE_y$$

**Baseline emissions**

Baseline emissions would be calculated as:

$$BE_y = B_y \times f_{NRB,y} \times NCV_{biomass} \times EF_{projected\_fossil\_fuel}$$

**Baseline Emissions**

$B_y$ is determined by using option (a) which is as follows:

Calculated as the product of the number of households multiplied by the estimate of average annual consumption of woody biomass per household that is displaced by the project activity (tonnes/household/year).

$$B_y = N_{HH} \times (BC_{BL,HH,y} - BC_{PJ,HH,y})$$

$B_y$ = 5,000 x (2.85 – 0[31])

$B_y$ = 14,257 tonnes/year

| Baseline emissions | | |
|---|---|---|
| **Activity Data** | **Value** | **ID Ref** |
| Quantity of Biomass substituted (t/yr) for 5,000 families | **14,257** | $B_y$ |
| Fraction of NRB ($f_{NRB}$) | 95% | $f_{NRB, y}$ |
| NCV Biomass (TJ/t) | 0.015 | $NCV_{biomass}$ |
| Emission factor ($tCO_2$/TJ) | 81.6 | $EF_{projected\_fossil\_fuel}$ |
| **Baseline emissions ($tCO_2$/yr/5,000 family)** | **16,578** | ***$BE_y$*** |
| **Baseline emissions for a family ($tCO_2$/family/yr)** | **3.32** | ***$BE_y$*** |

**Project Emissions**

There is no cultivation of biomass for the project activity. Hence a project emission is zero.

$$PE_y = 0$$

**Leakage**

$B_y$ will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys will not be required.

Thus $B_y$ is considered as 14,257 t x 0.95 = 13,544.06 t for 5,000 families for 365 days taking into account leakage factor. Thus survey will not be conducted to account for leakage.

**Emission Reduction**

According to the methodology, Version 07, after considering leakage, the emission reduction calculations are as follows:

| Activity Data | Value |
|---|---|
| $B_y$ (t/year/5000 family) | 14,257 |
| **$B_y$ adjusted for leakage ($B_y$ x 0.95) (**t/year/5000 family) | 13,544.06 |
| $f_{NRBy}$ | 0.95 |
| $NCV_{biomass}$ (TJ/tonne) | 0.015 |
| $EF_{projected\ fossilfuel}$ ($tCO_2$/TJ) | 81.60 |
| **ER generated/year/5,000 households** | **15,749** |
| **ER generated/household/year after considering leakage** | **3.15** |

[31] Assumed zero for ex-ante calculations.

Thus Emission Reductions calculations from I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User is 3.15 $tCO_2$/year/family or 15,749 $tCO_2$/year for 5,000 households.

The biogas plants will be monitored continuously for non-usage. The emission reduction will be calculated only for usage days of all the constructed and operational units based on which $BC_{PJ,HH,y}$ will be determined and $B_y$ calculated for each of the household,

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

| Year | Baseline emissions (t $CO_2e$) | Project emissions (t $CO_2e$) | Leakage (t $CO_2e$) | Emission reductions (t $CO_2e$) |
|---|---|---|---|---|
| 2018 | 16,578 | 0 | 829 | 15,749 |
| 2019 | 16,578 | 0 | 829 | 15,749 |
| 2020 | 16,578 | 0 | 829 | 15,749 |
| 2021 | 16,578 | 0 | 829 | 15,749 |
| 2022 | 16,578 | 0 | 829 | 15,749 |
| 2023 | 16,578 | 0 | 829 | 15,749 |
| 2024 | 16,578 | 0 | 829 | 15,749 |
| Total | 116,046 | 0 | 5803 | 110,243 |
| Total number of crediting years | | | | 7 |
| Annual average over the crediting period | **16,578** | **0** | **829** | **15,749** |

## B.7. Monitoring plan

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

*(Copy this table for each piece of data or parameter.)*

| **Data/Parameter** | Date of commissioning of project device of type *i* |
|---|---|
| Data unit | Date |
| Description | Actual date of commissioning of the project device. |
| Source of data | Internal records – Monitoring Solution |
| Value(s) applied | - |
| Measurement methods and procedures | Fixed and recorded at the time of commissioning |
| Monitoring frequency | 100% of the units will be monitored from the procurement of material till construction and commissioning of the biogas units |
| QA/QC procedures | This can be triangulated with the receipts and audit statements for the project |
| Purpose of data | Calculation of Baseline emissions |
| Additional comment | End use agreements with the users will provide additional information of the units commissioned |

| **Data/Parameter** | $NCV_{biomass}$ |
|---|---|
| Data unit | TJ/tonne |
| Description | Net calorific value of the non-renewable woody biomass, briquettes or charcoal used in project devices |

| | |
|---|---|
| Source of data | Methodology I.E. Version 07. |
| Value(s) applied | 0.015 TJ/tonne |
| Measurement methods and procedures | As the baseline fuel is woody biomass, based on the methodology, 0.015 TJ/tonne is the value applied |
| Monitoring frequency | Yearly |
| QA/QC procedures | |
| Purpose of data | Calculation of Baseline emissions |
| Additional comment | |

| | |
|---|---|
| Data/Parameter | $BC_{PJ,HH,y}$ |
| Data unit | tonnes/household/year |
| Description | Average annual consumption of woody biomass per household in the pre-project devices during the project activity, if it is found that pre-project devices were not completely displaced but continue to be used to some extent |
| Source of data | Continuous monitoring for all the biogas units |
| Value(s) applied | Will range from 0 to 2.85 t/HH/year, depending on the extent of usage of traditional stoves in absence/parallel to biogas. Monitoring shall consist of estimation of all project devices |
| Measurement methods and procedures | As and when the biogas units are not functional, the beneficiaries will report to the village level volunteer, who in turn will report to the Biogas Field Worker of the project for the repair of the unit. A log book will be maintained for the reason of non-function and days under repair. Continuous monitoring and entered into the monitoring solution by the Village Volunteers.<br><br>Depending on the number of days the units are not working, the $BC_{PJ,HH,y}$ woody biomass consumption will be determined based on the baseline fuelwood use that would have been used in the absence of the project activity.<br><br>The days the units are under repair or not used due to other reasons such as migration, these days will be accounted as days when the woody biomass has been used. So essentially it will be based on data monitored for non-usage. For ex. if the unit was not used for 30 days in a year, the proportional woody biomass used is 2.85/365 x 30 days = 0.234 t.<br><br>In addition, the parallel use of traditional stoves in addition to biogas will also be monitored for all the systems. The village volunteers will also monitor the activities for which woody fuelwood is being used. This will be collected at a minimum of at least once a year for all households. For ex., if water heating is done using fuelwood weekly thrice for 6 months/year, it will be recorded for the household.<br><br>A Kitchen test will be done to assess the proportion of fuelwood (@90/10 confidence/precision level) used for each of the activity, i.e. i. cooking rice/vegetable, ii. Heating water iii. Making fodder for livestock, etc. This proportion of baseline fuelwood will be deducted for parallel use of woody biomass. This Kitchen test done will be applied for the entire second crediting period.<br><br>For ex. if heating water accounts for 10% of fuelwood use and is being used for 3 days/week for 6 months/year, the calculations are (2.85 x |

| | |
|---|---|
| | 10%)/365 x 6 months X 4 weeks x 3 days = 0.056 t/year |
| Monitoring frequency | Continuous |
| QA/QC procedures | Though the methodology requires sample survey biannually, continuous monitoring will be done, to ensure that the households use biogas with proper repair and maintenance. |
| Purpose of data | Calculation of Baseline emissions |
| Additional comment | ERs will be accounted only for functional days of the units |

| | |
|---|---|
| Data/Parameter | $B_y$ |
| Data unit | tonnes /year |
| Description | Quantity of woody biomass that is substituted or displaced |
| Source of data | Based on continuous monitoring |
| Value(s) applied | Ranges from zero when biogas is not used to 2.85 tonnes/year/family and 14,257 t/year for 5,000 families, when $BC_{PJ,HH,y}$ is zero |
| Measurement methods and procedures | Calculated as $B_y = N_{HH} \times (BC_{BL,HH,y} - BC_{PJ,HH,y})$ |
| Monitoring frequency | Continuous monitoring |
| QA/QC procedures | Continuous monitoring of all biogas units will be done to estimate $B_y$ |
| Purpose of data | Calculation of Baseline emissions |
| Additional comment | ERs will be accounted only for functional days of the units |

### B.7.2. Sampling plan

The parameters that will be required for calculation of emission reductions are the date of commissioning of the biogas units, units that are operational and the biogas units that are under repair and not operational. These parameters will be monitored by the village volunteers and the biogas case workers on a continuous basis and entered into the monitoring solution. Further, parallel use of traditional stoves will be monitored continuously at household level to determine $BC_{PJ,HH,y}$.

Hence the project activity does not rely on sample surveys

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

This biogas CDM project will be implemented and monitored by the Social Education and Development Society, a grass root people's organisation that has been operating in the project boundary for the last 35 years.

This biogas CDM project will be implemented for 5000 members of the SEDS village organisational network made up of individual village organisations.

The project implementation and monitoring team comprises of the following:

- CDM coordinator: Appointed by the SEDS board of trustees, manages the project on a full time basis.
- Project Staff: 1 database manager, 11 biogas field workers appointed by the CDM coordinator.
- Masons: 91 individuals were selected through the village organisations to partake in an apprenticeship programme through which they were fully trained as biogas masons. Each

was contracted, on a piece-rate basis, for the construction of these 5,000 units. Now for repair and maintenance, these masons are contacted as and when required.

- Village level volunteers (VLV): Villages have village level volunteers who maintain a daily usage register for each unit built in their village and enter them into the digitized monitoring system on a monthly basis.
- A maintenance team post implementation ensures that all units are fully operational for the lifetime of the project.

**Monitoring database**

An online digitized system, custom built for monitoring this Biogas CDM Project, is used to enter data on an everyday basis and generate real-time online Progress Reports. Inputting data into this intranet solution is permission driven – i. e. each Biogas Field Worker recorded construction progress of only those villages entrusted to her/him; Volunteers record daily usage only for their respective village; etc. Progress and Analytical Reports are totally transparent, open for one and all. These reports are perused by:

- Village organisation functionaries who meet regularly to discuss the progress made in their respective villages. All of these meetings are also attended by the respective biogas field worker of the area. Any problems identified are discussed and solutions found.
- Project staff meets regularly to ensure take stock of the functionality of biogas units.
- After the construction and satisfactory functioning of each biogas plant for a minimum of 2 weeks, an end user agreement on legal paper was signed with the respective beneficiary, and this date was taken as the day of commissioning of that particular biogas unit. Thus from day 1 of the commissioning of the biogas plant, full account of emission reduction is considered.
- All data is archived and stored throughout the crediting period and an additional two years.

**Maintenance/Servicing of the biogas units**

The post-construction daily usage monitoring immediately identifies dysfunctional units and specific problems faced by the end user.

Repairs and maintenance are undertaken by the maintenance team appointed post implementation. The village level volunteer through daily usage monitoring discovers if any unit has become dysfunctional. They inform the biogas field worker who will visit the unit and assess requirements. If necessary, a member from the maintenance team will be called out to fix the problem. The phone number of village volunteers, biogas workers and CDM coordinator is given to all the end users, so that they can inform for any repairs and maintenance.

**Monitoring Plan:**

- The single relevant project aspect deemed necessary to monitor and report reliable emission reductions is the continued use of the biogas plant. The number of systems operating annually is recorded through evidence of continuous daily monitoring at the village level by the village level volunteer.
- Provided all plants are in continuous use throughout the project period, and emergency preparedness arrangements are recorded as having been used, it is expected that the ex-ante emission reductions will be achieved.
- To monitor this single most important project aspect, the CDM Coordinator will depend on the continued servicing and maintenance management done by the project and documented in the database.
- All monitored data required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occur later both on paper and electronically.

**Frequency of Monitoring:**

- 100% of plants will be monitored every day for operation of the biogas units and monitoring report prepared for verification.

**Leakage:**

Leakage will not be monitored as $B_y$ is multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required

## SECTION C. Start date, crediting period type and duration

### C.1. Start date of project activity

01/07/2010

### C.2. Expected operational lifetime of project activity

25y-0m

### C.3. Crediting period of project activity

#### C.3.1. Type of crediting period

Renewable Crediting Period

#### C.3.2. Start date of crediting period

Start date of the First crediting period: 01/01/2011
Start date of the Second crediting period: 01/01/2018

#### C.3.3. Duration of crediting period

7y-0m

## SECTION D. Environmental impacts

### D.1. Analysis of environmental impacts

The project has several positive environmental impacts as detailed below:

Air quality: In the baseline, cooking from the unprocessed solid fuels release at least 50 times more noxious pollutants than gas. The incomplete combustion of biomass releases complex mixture of organic compounds, which include suspended particulate matter, carbon monoxide, poly organic material, poly aromatic hydrocarbons, formaldehyde, sulphur, trace metals etc. that cause many health hazards such as respiratory infections, eye infections, otitis media, chronic obstructive pulmonary diseases, lung cancer, pulmonary tuberculosis, cataract and also adverse pregnancy outcome [32]. Indoor smoke is one of the health risk factor among Indians [33].

[32] Tone Smith-Sivertsen, Esperanza Diaz, Dan Pope, Rolv T. Lie, Anaite Dıaz, John McCracken,Per Bakke, Byron Arana, Kirk R. Smith, and Nigel Bruce,Effect of Reducing Indoor Air Pollution on Womens Respiratory Symptoms andLung Function: The RESPIRE Randomized Trial, Guatemala.

[33] http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2568866/

Implementation of the project will eliminate indoor air pollution, as biogas is colourless and burns with a clean blue flame similar to that of liquid petroleum gas allowing for virtually smoke free combustion, thus reducing health hazards considerably[34]. Burden of disease due to indoor air pollution is highly concentrated among the society's most vulnerable groups: women and children in poor rural households. A wide range of interventions can contribute to reducing exposure to indoor air pollution. One such intervention which could improve the health of the poor is biogas[35].

Soil condition: The slurry manure is considered far more superior to farm yard manure in respect of NPK content. It will reduce the use of chemical fertilizers to a large extent[36]. A Government of India study showed that over 70% households perceived an improvement in crop production as a result of applying slurry manure in the fields and savings by reduced fertilizer usage @Rs.185/month[37]. The application of slurry improves the physical, chemical, and biological characters of the soil[38]. Balasubramanian and Kasturi BaI evaluated nutrient status of slurry and observed a 70% increase compared to the influent and observed an increase in biomass production after application[39].

Other pollutants: The slurry has lesser number of pathogens compared to dung. Most of the disease-causing organisms are killed. This serves as an effective control of parasitic diseases, hookworm, roundworm, etc. There is reduction of pathogens after digestion[40]. Mosquitoes and flies do not breed in digested slurry and thus biogas improves sanitation.

Biodiversity: Fuel wood collection and consumption are intricately linked to degradation of natural resource management. Demand for fuel wood from commons and forests cause resource degradation[41]. A single biogas system with a volume of 2.8 $m^3$ can save as much as 0.12 ha woodland each year.

The project will create additional business opportunities to the local communities. Employment for masons will be created with a high sense of ownership. At the village level, a volunteer will be involved in day to day monitoring of biogas units, thus providing them with good quality jobs.

The project would also lead to improvement in the quality of life due to reduced drudgery and time spent for women and children in fuel procurement, transporting, processing, storing and cooking time. Approximately two hours are spent in gathering biomass per day per household in the baseline[42]. Women can take up income generation activities thus alleviating poverty. Children can attend school as women are able to cook and serve breakfast to the children in time to attend school. There is also more time for leisure at homes. The national level evaluation studies also show that communities benefit from clean fuel for cooking, cleanliness of environment, improvement in the health of women, saving in manure cost, employment generation, saving in cooking time and traditional fuel. It is useful in the development of an economically viable system

---

[34] Jiwan Acharya, M. Sundar Bajgain, Mr Prem Sagar Subedi, Scaling up biogas in Nepal: What else is needed?(page 1)

[35] Y. Von Schirnding, N. Bruce,K. Smith, G. Ballard-Tremeer,M. Ezzati, K. Lvovsky, Addressing the Impact of Household Energy and Indoor Air Pollution on the Health of the Poor: Implications for Policy Action and Intervention Measures.(page 21)

36 http://www.nabard.org/modelbankprojects/biogas.asp

37 Evaluation Study on National Biogas Project, Planning Commission, Govt. of India,2002. (page 84)

38 ZEBIDER ALEMNEH, 2011. The Contribution Of Biogas Production From Cattle Manure At Household Level For Forest Conservation And Soil Fertility Improvement.(page no 45)

[39] http://www.iisc.ernet.in/currsci/jul10/articles13.htm

[40] A Review of literature on promotion of biogas systems, 1982, Tata Energy Institute, (page 22)

[41] http://www.jstor.org/discover/10.2307/3147225?uid=3738256&uid=2&uid=4&sid=21102563826333

[42] Ravindranath, N.H and Hall, 1995. Biomass, Energy and Environment: A developing country perspective from India. 376 pp. New York: Oxford University Press – e (page 105)

of use of this alternative resource through income and employment generation. Quantitative employment and income generation Construction of biogas units would create good employment opportunities in rural areas. It will provide regular means of livelihood to a large number of entrepreneurs and turnkey operators and provide employment to masons and daily-wage labourers.

Technical and awareness training programs will be conducted for the communities in proper operation and management of the biogas digester, system as well as correct methods and timing of biogas liquid and residue application in agricultural fields. Workshops and trainings conducted for participants outside the project boundary so that in future they also get benefited from the new technology. This will create awareness on sustainable energy solution for future energy demand.

The project activity does not fall under the purview of the Environmental Impact Assessment (EIA) notification of the Ministry of Environment and Forest, Government of India, 2006. Hence, it is not required by the host party[43] documentation on the analysis of the environmental impacts of the project activity

### D.2. Environmental impact assessment

Environmental Impact Assessment for the project activity is not required

## SECTION E. Local stakeholder consultation

### E.1. Modalities for local stakeholder consultation

The local stakeholders identified for this project were Village communities (Self Help Group members, Village level volunteers), Elected members of the Village organisations, Gram Panchayat members, SEDS staff, Members of the district forestry division, Members of the district NEDCAP division, Local NGO's and NGO's affiliated with the Gold Standard (REDS)

The stakeholders meeting was held on the 16th July 2008 at the SEDS vocational training centre situated in Penukonda, Anantapur district, Andhra Pradesh before the start of the project activity. A personal invitation along with a copy of the non-technical PDD was sent in an appropriate language (Telugu, English) to the stakeholders identified above. The SEDS field staff also spread word of the meeting to all village members they encountered in the weeks preceding the meeting. An open invitation to the meeting was posted on the SEDS web-blog and was also published in a local newspaper daily on Sunday the 13th July 2008. The meeting comprised of village members, village level volunteers, VO members, SEDS staff, Panchayat members, members of district NEDCAP division and members of Local NGO's. All the stakeholders were supportive of the SEDS initiative to undertake such a pro poor CDM project and promised to support the project in any way possible. No adverse comments were received by any of the local stakeholders.

[43] http://moef.nic.in/legis/eia/so1533.pdf

**Stakeholder's meeting conducted on 9th May 2017**

A stakeholders' meeting was conducted on 9th May 2017 to inform the stakeholders on the continuation of the CDM project activity. Ninety end user women attended the meeting

## E.2. Summary of comments received

**Village people (SHG members, VLV's, VO members):** The village people were very happy about the introduction of the project.

**Local Panchayats:** The local Panchayat members offered their support for the project. They asked whether any similar CDM initiative could be taken up to benefit the people residing in the town areas.

**NEDCAP:** The district level NEDCAP officer Mr. Kondanda Ramaiah, Executive Engineer, offered his encouragement for the project. He praised the initiative of the organisation in making the merits of clean cooking technologies available to all segments of society.

**Local NGO's:** The local NGO's said it was an excellent initiative to help the most vulnerable sector-the rural women and wished SEDS all the best in implementing the program. They see no negative environment or social impact.

**No adverse comments were received for the project.**

During the 2017 meeting, the end users expressed their satisfaction as it has enabled easy cooking, rid them of drudgery and improved their health due to reduction in indoor air pollution.

## E.3. Consideration of comments received

There were no adverse comments for other measures to be taken

## SECTION F. Approval and authorization

>>

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS

F.No.4/28/2008-CCC

30 June, 2009.

To,
Mrs.Manil Jayasena Joshua CEO
SOCIAL EDUCATION AND DEVELOPMENT SOCIETY (SEDS)
Anandapuram, Peddamanthur SO,
Penakonda, Anantapur District
Andhra Pradesh- 515124

Sub: Host Country Approval to **"Social Education and Development Society (SEDS) Biogas CDM project for the rural poor"** at 121 villages situated across the 5 Mandals of Roddam, Somandepalli, Penukonda, Chilamathur and Gorantla Mandals of Anantapur district by M/s Social Education and Development Society (SEDS) – regarding CDM

Sir,

I am directed to state that the Project Concept Note and Project Design Document of **"Social Education and Development Society (SEDS) Biogas CDM project for the rural poor"** at 121 villages situated across the 5 Mandals of Roddam, Somandepalli, Penukonda, Chilamathur and Gorantla Mandals of Anantapur district by M/s Social Education and Development Society (SEDS) was considered by the National CDM Authority in its meeting held on 24 December, 2008. The Authority confirms that:

(i) The Government of India has ratified the Kyoto Protocol in August 2002.

(ii) This is approval of voluntary participation in the proposed CDM project activity.

(iii) The project contributes to Sustainable Development in India.

Yours faithfully,

(R.K.Sethi)
Director (CC)

जहाँ है हरियाली।
वहाँ है खुशहाली।।

पर्यावरण भवन, सी.जी.ओ. कॉम्पलैक्स, लोदी रोड, नई दिल्ली - 110 510
PARYAVARAN BHAWAN, C.G.O. COMPLEX, LODHI ROAD, NEW DELHI - 110 510
Website : envfor.nic.in

भारत सरकार
पर्यावरण एवं वन मंत्रालय
GOVERNMENT OF INDIA
MINISTRY OF ENVIRONMENT & FORESTS

F.No.4/28/2008-CCC

30 June, 2009.

To,
Mrs.Manil Jayasena Joshua CEO
SOCIAL EDUCATION AND DEVELOPMENT SOCIETY (SEDS)
Anandapuram, Peddamanthur SO,
Penakonda, Anantapur District
Andhra Pradesh- 515124

Sub: Host Country Approval to **"Social Education and Development Society (SEDS) Biogas CDM project for the rural poor"** at 121 villages situated across the 5 Mandals of Roddam, Somandepalli, Penukonda, Chilamathur and Gorantla Mandals of Anantapur district by M/s Social Education and Development Society (SEDS) – regarding CDM

Sir,

Kindly refer to Ministry's letter No.: 4/28/2008-CCC dated 30 June 2009 conveying Host Country Approval to your CDM project to **"Social Education and Development Society (SEDS) Biogas CDM project for the rural poor"** at 121 villages situated across the 5 Mandals of Roddam, Somandepalli, Penukonda, Chilamathur and Gorantla Mandals of Anantapur district by M/s Social Education and Development Society (SEDS).

Please note that the following conditions shall also be complied with:

(i) M/s Social Education and Development Society (SEDS) shall not sell the CERs to any agency/ company/ organization, which purchases the CERs using ODA Funds.

(ii) M/s Social Education and Development Society (SEDS) shall inform the National CDM Authority regarding all transaction details of CERs including the name and address of the party to which CERs were sold within 30 days of transfer of the CERs.

(iii) M/s Social Education and Development Society (SEDS) shall furnish expeditiously any information, during the lifetime of the project as requested by the National CDM Authority.

(iv) M/s Social Education and Development Society (SEDS)shall obtain all statutory clearances and other approvals as required from the competent authorities for setting up of the project.

(v) All transactions shall be subject to supervision of the Executive Board of the CDM, under the authority and guidance of the COP/MOP.

(vi) This approval is not transferable. The authority reserves the right to revoke this Host Country Approval if the conditions stipulated in this approval are not complied with to the satisfaction of the National CDM Authority.

Yours faithfully,

(R.K.Sethi)
Director (CC)

जहाँ है हरियाली।
वहाँ है खुशहाली।।

पर्यावरण भवन, सी.जी.ओ. कॉम्पलैक्स, लोदी रोड, नई दिल्ली - 110 003
PARYAVARAN BHAWAN, C.G.O. COMPLEX, LODHI ROAD, NEW DELHI - 110 003

# Appendix 1. Contact information of project participants

| | |
|---|---|
| **Organization name** | **M/s SOCIAL EDUCATION AND DEVELOPMENT SOCIETY (SEDS)** |
| **Country** | INDIA |
| **Address** | Anandapuram, Peddamanthur SO, Penakonda, Anantapur District, Andhra Pradesh, 515124 |
| **Telephone** | +91 8555 245424 |
| **Fax** | +91 8555 245436 |
| **E-mail** | sedsngo@gmail.com |
| **Website** | www.sedsngo.org |
| **Contact person** | Mrs. Manil Jayasena Joshua |

# Appendix 2. Affirmation regarding public funding

No ODA will be diverted for this project

# Appendix 3. Applicability of methodologies and standardized baselines

This is included in Section B.2.

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

**BASELINE INFORMATION**

**Baseline household level energy Consumption by households in Anantapur district during 2016-2017**

**Baseline survey**

A baseline survey was conducted in 2016-17 that provides critical information on target population characteristics, baseline technology use, fuel consumption, leakage, and sustainable development indicators as part of baseline survey for a carbon project to initiate improved cook stove for families that do not have biogas.

**Baseline Survey Representativeness:** In-person interviews were conducted with a robust sample of end users without project technologies that are representative of biogas end users in the project activity in Anantapur District of Andhra Pradesh State, India.

**Baseline Survey Sample Sizing:** In Anantapur district, 24,136 households were visited and data collected in 9 Mandals of Anantapur District, Andhra Pradesh District as follows:

| Mandal | Number of households |
|---|---|
| Chilamathur | 4,035 |
| Gorantla | 2,890 |
| Hindupur | 953 |
| Kotha Cheruvu | 11 |
| Madaksira | 419 |

| | |
|---|---|
| Parigi | 3,805 |
| Penukonda | 2,897 |
| Roddam | 5,368 |
| Somandepalli | 3,758 |
| **Total** | **24,136** |

**Data Collected:** The data collected was specific to the characteristics of the baseline scenario and data was collected of the following:

1. User follow up
    a. Address or location –Mandal, Gram Panchayat, Village, Details of the Family and the house type
    b. Unique ID or contact telephone number (when possible) – NREGA or Ration Card ID has been collected wherever available.
2. End user characteristics
    a. Number of people served by baseline technology – the details of the family members are collected and also their presence at home or not is also recorded
    b. Typical baseline technology usage patterns and tasks (commercial, institutional, domestic, etc.) – Use of type of stoves, fuel type for cooking and bathing is collected
3. Baseline technology and fuels
    a. Types of baseline technologies used and estimated frequency
    b. Types of fuels used and estimated quantities
    d. Sources of fuels; (purchased or hand-collected, etc.) and prices paid or effort made (e.g. walking distances, persons collecting, opportunity cost)
    e. Renewability and non-renewability indicators as required by Annex of the methodology

**Analysis of the Data Collected:**

- The baseline survey was conducted in the project area by SEDS, the NGOs guided by FCN Technical Team. Location of the data collected are as follows:

| Mandal | Village | Number of Households |
|---|---|---|
| **Chilamathur** | A. Thummalakunta | 94 |
| | Adepalli | 49 |
| | Adepalli Thanda | 23 |
| | Anji Thanda | 5 |
| | Appanapalli | 20 |
| | Arumakulapallli | 64 |
| | B. C. Colony | 110 |
| | B. Settipalli | 47 |
| | Balijapalli | 60 |
| | Bandapalli (C) | 14 |
| | Bandepalli | 3 |
| | Beedireddipalli | 23 |
| | Bhumaiahgaripalli | 36 |
| | Bhupasamudram | 41 |
| | Bramheswarampalli | 52 |
| | C. Maruvapalli | 36 |
| | Chagaleru | 14 |
| | Check Post | 5 |
| | Chenepalli | 43 |

| | | |
|---|---|---|
| | Cheruvukindapalli | 1 |
| | Cheruvumundarapalli | 15 |
| | Chilamathur | 7 |
| | Chinnanapalli | 27 |
| | Chinnapareddipalli (C) | 65 |
| | D. Gollapalli | 56 |
| | D. Thummalakunta | 47 |
| | Dadireddipalli | 12 |
| | Dadireddipalli Thanda | 31 |
| | Dalavaipalli | 29 |
| | Demakethapalli | 59 |
| | Diguvapalli Thanda | 38 |
| | Dornalapalli | 61 |
| | Gadralapalli | 77 |
| | Hussainpuram | 51 |
| | K. Chennampalli | 28 |
| | K.Vaddipalli | 8 |
| | Kallukunta (C) | 59 |
| | Kambalapalli (C) | 90 |
| | Kammaiahgaripalli | 67 |
| | Kammaiahgaripalli Thanda | 10 |
| | Kandurparthi | 11 |
| | Kanisettipali | 41 |
| | Kanugamakulapalli | 4 |
| | Kodikonda | 170 |
| | Kodur | 205 |
| | Korlakunta | 27 |
| | Kotha Samulapalli | 49 |
| | Kotlopalli | 69 |
| | Lakshmipuram | 55 |
| | Lalepalli | 69 |
| | Maddigirepalli | 4 |
| | Madhurepalli | 117 |
| | Madireddipalli | 12 |
| | Maruva Kothapalli | 67 |
| | Morampalli | 28 |
| | Morasalapalli | 76 |
| | Morasalavandlapalli | 36 |
| | Mothukapalli | 5 |
| | Muddappalli | 3 |
| | Muddireddipalli | 51 |
| | Nallabommanapallli | 53 |
| | Nallarallapalli | 60 |
| | Nanjireddipalli | 13 |
| | Nesevandlapalli | 55 |
| | Obulapuram | 51 |
| | Palagalapalli | 74 |
| | Palepalli | 6 |

| | | |
|---|---|---|
| | Patha Samulapalli | 120 |
| | Peddanapalli | 75 |
| | Peddireddipalli (C) | 8 |
| | Pothulapalli | 16 |
| | Rayalacheruvu | 3 |
| | Roddamvaripalli | 7 |
| | S. Kothapalli | 59 |
| | Sanaganapalli (Ghumallapalli) | 48 |
| | Sanjeevarayanipalli | 78 |
| | Somagatta | 6 |
| | Subbaraopeta | 9 |
| | Tekulodu | 84 |
| | Thamminayanipalli (C) | 44 |
| | Thimmadipalli | 32 |
| | Vaddi Channampalli | 105 |
| | Veerapuram | 111 |
| | Venkatapuram (C) | 172 |
| | Y. Gollapalli | 38 |
| | Yagnisettipalli | 32 |
| **Gorantla** | B. Gollapalli | 16 |
| | B. Kothapalli | 8 |
| | B. Kothapalli Thanda | 11 |
| | B. Papireddipalli | 8 |
| | B.N. Thanda | 18 |
| | Bachannapalli | 22 |
| | Bandameeda Thanda | 2 |
| | Bathalapalli | 30 |
| | Bellalacheruvu | 58 |
| | Boyalapalli | 38 |
| | Buchepalli | 55 |
| | Buddapalli | 38 |
| | Budidagaddapalli | 16 |
| | Budili | 90 |
| | Budilivandalapalli | 22 |
| | Buganipalli | 47 |
| | Buganipalli Thanda | 6 |
| | Chalamaiahgaripalli | 11 |
| | Chetlamorampalli | 1 |
| | Chinnarapalli | 17 |
| | Chintalapalli | 73 |
| | Chunduruvandlapalli | 12 |
| | D. Gangampalli | 28 |
| | D. Gangampalli Thanda | 20 |
| | Dasireddipalli Thanda | 20 |
| | Devulacheruvu | 4 |
| | E. Gangampalli | 21 |
| | G. Maravapalli | 8 |
| | Gaddam Thanda | 21 |

| | | |
|---|---|---|
| | Gajulavandlapalli | 9 |
| | Gangadevipalli | 25 |
| | Gopidevarapalli | 4 |
| | Gorantla | 24 |
| | Gownivaripalli | 26 |
| | Gummaiahgaripalli | 163 |
| | Gunthapalli | 11 |
| | Guntipalli | 18 |
| | Guntipalli Thanda | 10 |
| | Jakkasamudram | 33 |
| | Jeenamvandlapalli | 6 |
| | K. Ragimekalapalli | 6 |
| | Kaganipalli | 26 |
| | Kalekuntapalli | 12 |
| | Kaligera | 121 |
| | Kaligera Thanda | 12 |
| | Kalli Thanda | 15 |
| | Kamgareddipalli | 34 |
| | Kammalavandlapalli | 15 |
| | Kammavaripalli | 39 |
| | Karavulapalli | 76 |
| | Karavulapalli Thanda | 66 |
| | Katepalli | 31 |
| | Khajapuram | 19 |
| | Kolimipalli (G) | 30 |
| | Kommula Thanda | 5 |
| | Kondapuram | 25 |
| | Kondreddipalli | 6 |
| | Korevandlapalli | 2 |
| | Kothuru | 9 |
| | Kottabayannapalli | 14 |
| | M. Kothapalli | 15 |
| | Malasamudram | 45 |
| | Mallapalli | 93 |
| | Mallela | 1 |
| | Mandalapalli | 27 |
| | Mareddypalli | 6 |
| | Mereddipalli | 21 |
| | Mission Thanda | 4 |
| | Motrapalli | 38 |
| | Muddalakuntapalli | 6 |
| | Muttarayani Thanda | 16 |
| | Nallannapalli | 6 |
| | Narsimpalli | 44 |
| | P. Ragimekalapalli | 54 |
| | Palasamudram | 280 |
| | Petlakuntapalli | 4 |
| | Poppanapalli Thanda | 37 |

| | | |
|---|---|---|
| | Pulachetlapalli | 10 |
| | Puleru | 31 |
| | Pullagurlapalli | 41 |
| | Puttagundlapalli | 30 |
| | Ramannapalli | 12 |
| | Ramapuram | 1 |
| | Reddycheruvukatta | 1 |
| | Reddycheruvupalli | 149 |
| | Samulapalli | 31 |
| | Settichinnampalli | 14 |
| | Singireddipalli | 27 |
| | Sirigamvandlapalli | 15 |
| | Tatimakulapalli | 3 |
| | Thamminayanipalli (G) | 38 |
| | Thipparajupalli | 10 |
| | V. Gollapalli | 24 |
| | Vaddipalli | 38 |
| | Vadigepalli | 25 |
| | Vanavolu | 12 |
| | Vanavolu Thanda | 15 |
| | Venkatapuram | 9 |
| | Venkataramanapalli | 8 |
| | Yamukalaguttapalli | 7 |
| | Yerraballi | 7 |
| | Yerraiahgaripalli | 22 |
| **Hindupur** | Balampalli | 162 |
| | Cherlopalli | 111 |
| | Chinnaguddampalli | 45 |
| | M. Beerepalli | 111 |
| | Maluguru | 274 |
| | Pedda Guddampalli | 68 |
| | Rachapalli | 21 |
| | Sreekanthapuram | 161 |
| **Kotha Cheruvu** | Pothulakunta | 11 |
| **Madaksira** | Gowdanahalli | 102 |
| | Jammanpalli | 67 |
| | Peddapalli | 2 |
| | R. Anantapuram | 127 |
| | Rekulakunta | 121 |
| **Parigi** | Akkampalli | 28 |
| | Anandapalyam | 103 |
| | Beechiganipalli | 94 |
| | Boreddipalli | 79 |
| | Chinnapalli | 125 |
| | Dhanapuram | 177 |
| | Ganapathipalli | 42 |
| | Gollapalli (Parigi) | 58 |
| | Goravanahalli | 270 |

| | | |
|---|---|---|
| | Honnampalli | 99 |
| | K. Narasapuram | 26 |
| | Kodigenahalli | 397 |
| | Konapuram (P) | 92 |
| | M. Cherlopalli | 29 |
| | Moda | 262 |
| | Mullamothukapalli | 43 |
| | N. Kothapalli | 31 |
| | N. Muddireddipalli | 75 |
| | Nethulapalli | 70 |
| | P. Narasapuram | 108 |
| | Papireddipalli (S) | 82 |
| | Parigi | 1 |
| | Patragaripalli | 24 |
| | Pydeti | 232 |
| | S. Beerepalli | 54 |
| | S. Jangalapalli | 62 |
| | Sasanakota | 109 |
| | Seegipalli | 75 |
| | Sirekolam | 44 |
| | Srirangarajupalli | 276 |
| | Subbarayunipalli | 56 |
| | Utakur | 271 |
| | Vangalapalli | 55 |
| | Vittapalli | 139 |
| | Yerragunta | 117 |
| **Penukonda** | Adadakulapalli | 77 |
| | Ammavarupalli | 9 |
| | Bandapalli (P) | 113 |
| | Bapanakaluva | 3 |
| | Bojjireddipalli | 23 |
| | Chinnapareddipalli (P) | 78 |
| | Duddebanda | 110 |
| | Gollapalli | 7 |
| | Gondipalli | 4 |
| | Gonipeta | 114 |
| | Gonipeta Thanda | 41 |
| | Guttur | 128 |
| | Hanumappalli | 27 |
| | Haripuram | 42 |
| | Islapuram | 105 |
| | Kailasam | 4 |
| | Konapuram | 162 |
| | Kondampalli | 176 |
| | Kondapuram | 84 |
| | Kottala (Teginakatta) | 1 |
| | Kurubavandlapalli | 138 |
| | Mahadevapalli | 70 |

| | | |
|---|---|---|
| | Mangapuram | 75 |
| | Maruthi Nagar | 91 |
| | Mavatur | 196 |
| | Motuvaripalli | 12 |
| | Munimadugu | 44 |
| | Nagaluru | 57 |
| | P. Maravapalli | 229 |
| | Parameswarpuram | 44 |
| | Penukonda | 121 |
| | Rampuram | 41 |
| | Sattarpalli | 18 |
| | Settipalli | 40 |
| | Settipalli Thanda | 14 |
| | Suddabatlapalli | 23 |
| | Thimmapuram | 50 |
| | Vaggappagari Kunta | 5 |
| | Vannurappagari Kottala | 23 |
| | Venkatagiripalyam | 101 |
| | Venkatapuram Thanda | 5 |
| | Venkatareddipalli | 189 |
| | Yarrajinnapalli | 3 |
| **Roddam** | Beedanipalli | 52 |
| | Bommireddipalli | 89 |
| | Boxampalli | 60 |
| | Bucherla | 183 |
| | Budipalli | 58 |
| | Cherukuru | 171 |
| | Chinnaguvvalapalli | 46 |
| | Chinnakodipalli | 112 |
| | Chinnamanthur | 191 |
| | Cholemari | 192 |
| | D. Rangapuram | 10 |
| | D.R. Kottala | 1 |
| | Dandepalli | 69 |
| | Dodagatta | 129 |
| | Gonimekalapalli | 122 |
| | Gowrajupalli | 103 |
| | Jakkalacheruvu | 15 |
| | K. Maruvapalli | 69 |
| | Kalipi | 272 |
| | Kallukunta (R) | 91 |
| | Kambalapalli | 82 |
| | Kanchisamudram | 109 |
| | Kandukurlapalli | 84 |
| | Kanumara | 21 |
| | Kogira | 60 |
| | Kurlapalli | 37 |
| | L. Thimmapuram | 24 |

| | | |
|---|---|---|
| | Lakkasanipalli | 42 |
| | LGB Nagar | 36 |
| | M. Kothapalli | 34 |
| | Moparlapalli | 9 |
| | Nagireddipalli | 43 |
| | Nallur | 294 |
| | Narnagepalli | 56 |
| | P. Gobbarampalli | 41 |
| | P. Kothapalli | 98 |
| | P. Roppala | 158 |
| | Patharlapalli | 96 |
| | Peddaguvvalapalli | 75 |
| | Peddakodipalli | 85 |
| | Peddamanthur | 47 |
| | Peddipalli | 91 |
| | R. Kottala | 53 |
| | R. Locherla | 205 |
| | R. Maravapalli | 103 |
| | R.L. Kothuru | 41 |
| | Rachuru | 55 |
| | Ragimekalapalli | 102 |
| | Reddipalli | 165 |
| | Roddakampalli | 10 |
| | Roddam | 62 |
| | Sanipalli | 241 |
| | Seshapuram | 192 |
| | Shapuram | 62 |
| | Subbarayappa Kottala | 5 |
| | Thadangipalli | 20 |
| | Thurkalapatnam | 361 |
| | Upparapalli | 15 |
| | Y.T. Reddipalli | 19 |
| **Somandepalli** | Anandapuram | 178 |
| | Bhusaiahgaripalli | 54 |
| | Bramhanapalli | 66 |
| | Bramhasamudram | 51 |
| | Chakarlapalli | 65 |
| | Chalakuru | 181 |
| | Challapalli | 115 |
| | Chennapuram | 77 |
| | Chinnababaiahpalli | 61 |
| | Edulabalapuram | 118 |
| | Guddamnagepalli | 67 |
| | Gudipalli | 146 |
| | Julakunta | 143 |
| | Kadirepalli | 44 |
| | Kavetinagepalli | 71 |
| | Kethanganicheruvu | 71 |

| | | |
|---|---|---|
| | Kolimipalli (S) | 46 |
| | Kollakunta | 35 |
| | Konathattupalli | 53 |
| | Kugatimanipalli | 21 |
| | Magecheruvu | 181 |
| | Manchepalli | 55 |
| | Mandli | 56 |
| | Manikanta Colony | 17 |
| | Marakuntapalli | 42 |
| | Muddapukunta | 55 |
| | Nadimipalli | 107 |
| | Naginayanicheruvu | 67 |
| | Naginayanicheruvu Thanda | 58 |
| | Nallagondrayunipalli | 61 |
| | Obuladevarapalli | 51 |
| | Pandiparthi | 130 |
| | Papireddipalli | 31 |
| | Pathikuntapalli | 186 |
| | Peddababaiahpalli | 40 |
| | Peddireddipalli (S) | 39 |
| | Petakunta | 2 |
| | Polepalli | 20 |
| | Rambabu Coloney | 99 |
| | Rangepalli | 115 |
| | Renuka Nagar | 38 |
| | Rukalapalli | 69 |
| | S. Kothapalli | 33 |
| | Sai Nagar Colony | 67 |
| | Snehalatha Nagar | 151 |
| | Somandepalli | 48 |
| | Suddakuntapalli | 84 |
| | Thungodu | 33 |
| | Velagamekalapalli | 102 |
| | Velidadakala | 58 |
| **Total** | | **24,136** |

- The survey was in person interview of 24,136 households in Anantapur district of Andhra Pradesh. This is a large sample size. The data was entered into Tristle Monitoring Solution and exported to Microsoft excel spreadsheet and analyzed.

- The district, Mandal, village and the name of the head of the family is included in the database. The family is identified by a unique number and further the ration card/NREGA card number is also collected for each of the family.

- The objective was to assess the typical fuel consumption among the target population, as more than one type of fuel is used in the baseline scenario.

- The demographic survey of rural households of Anantapur District, Andhra Pradesh carried out by the NGO in the district reveals that rural families in the project area are predominantly using fuelwood for cooking. Nearly 99% of the households are using fuelwood for cooking. These

traditional stoves are inefficient having an efficiency of 10%. These rural families are totally dependent on forests for their daily fuel wood requirements.

- The technology used in the baseline for cooking is as follows:

| Fuel Type | Percent of Households |
|---|---|
| Fuelwood | 99.37% |
| LPG | 0.48% |
| Kerosene | 0.11% |
| Coal | 0.04% |
| Biogas | 0.01% |
| **Grand Total** | **100.00%** |

- The typical baseline technology usage patterns and tasks reveal that the mud/clay stoves are used for domestic purposes. No commercial/institutions are part of the project activity.

- This is in line with secondary source of data, wherein 85.71% of the rural population in Anantapur District use fuel wood for cooking (Census of India data)[44].

- There is not much of stacking of stoves in the project region. It is observed only in 3.74% of the households, LPG and traditional stoves are used. LPG and kerosene is used for quickly preparing coffee/tea. Nearly 69% of the households use mud/clay/3-stone stoves for all their cooking.

- Nearly 96% of the household collected fuelwood, while only 4% of the households purchased fuelwood.

- The average cost of fuel wood is Rs.3/kg based on the baseline household survey conducted based on cost of a headload and the weight of the headload.

**Baseline Fuel wood consumption**

According to the survey, the fuelwood use is 1.86 kg/capita/day. The family size of 5,000 biogas users is 4.20. The annual fuelwood use per family is (1.86 kg/capita/day x 365 x 4.2 members/household) = 2.85 t/year/household.

This is much lesser than that estimated for the 1st crediting period which was 3.37 t/HH/year.

**Baseline fuelwood and kerosene used by the households in Anantapur district of Andhra Pradesh during 1st Crediting Period**

**I. Project Description**

The project is installation of 5,000 biogas plants (digesters) of 2 $m^3$ capacity each for single households in 5 Mandals of Anantapur District, Andhra Pradesh, India. Each household will install a 2 $m^3$ biogas plant and feed cattle dung and other organic waste into the anaerobic digester for the production of biogas for cooking purpose and heating of hot water. The aim of the project is to replace the commonly used inefficient wood fired mud stoves technology, with clean, sustainable and efficient biogas and in this way replace Non-Renewable Biomass with biogas for cooking and hot water heating. The project would be implemented upon registration of the project as a CDM project activity, as the project will be financed completely from carbon revenues. The project

[44] http://www.censusindia.gov.in/2011census/Hlo-series/HH10.html Census data of Households By Availability Of Separate Kitchen And Type Of Fuel Used For Cooking.

contributes to social, environmental, economic and technological benefits which contribute to sustainable development of the local environment.

### II. Target Population/Beneficiaries

The target population for the project and the field data collection for the project are the beneficiary households from rural areas, who are using traditional cookstove and kerosene stoves for cooking and hot water bath. They are using fuelwood collected from forests, wastelands and other common property resources which is to a large extent non-renewable. The target population will be from the 5,000 households from 5 Mandals who will be the beneficiaries of the SEDS biogas Project. These communities are from the Self Help Groups formed by women in the villages and are below poverty line with a per capita income of less than 1$/day/person.

Objectives

A baseline survey was carried out in order to establish the prevailing practices of the local communities with regard to fuel use for everyday cooking and water heating purposes. The objective of the baseline survey was to establish the quantity of fuelwood and kerosene used by the rural communities for cooking and hot water bath. This is based on the FAO report: "A guide for woodfuel surveys", EC-FAO Partnership Programme (2000-2002). Sustainable Forest Management Programme, Forest Products Division, Forestry Department, FAO and "Biomass Studies; Field Methods for Monitoring Biomass" (1997) by Shailaja Ravindranath and Sudha (1997). Oxford & IBH Publishing Co.Pvt. Ltd. New Delhi.

### III. Method

The methodology used for the study was based on manual "Biomass studies" (1997) by Shailaja Ravindranath and Sudha (1997). The measurements involved were as follows:

- The amount of fuelwood and kerosene used for cooking and hot water bath by a family. This was based on actual measurements taken for a week in each household.
- The value obtained from the study was compared to other scientific studies conducted for similar ecological region.

### IV. Sample Frame

The NGO SEDS is working in Anantapur District for the past 30 years on rural development issues, and especially with the women. Self Help Groups have been formed at every village level for the women. The sample frame for the baseline survey was developed from the existing records of the beneficiaries with SEDS. The frame consists of currently active accounts with details of Mandal, village code, SHG group ID and SHG membership ID, income, father's name, etc.

The sample unit, which is the minimum unit or the clearly defined unit for constructing the sample frame is the traditional wood stove and the kerosene stoves used in each household for cooking and hot water bath.

### V. Sample Method[45]

The baseline survey was performed in 2008 on a sample of local communities in 40 villages across 5 Mandals of Gorantla, Chilamanthur, Penukonda, Roddam and Somandepalli. A **Random sampling** was adopted for the study in all the 5 Mandals of Anantapur district of Andhra Pradesh. The beneficiaries were drawn at random from the sample from which each case having an equal probability of selection. For each chosen sample that participated, they were involved in conducting

[45] Based on FAO report: A guide for woodfuel surveys; EC-FAO Partnership Programme (2000-2002). Chapter 3; http://www.fao.org/docrep/005/Y3779E/y3779e00.htm

the required survey along with the field staff of SEDS. The details of sampling parameters are given in section VIII.

## VI. Sample Size

The sample size was determined on three parameters: The variability, the level of confidence required and the acceptable level of error using the following formula:

$$n_o = \frac{(cv^2.t^2_{\alpha,v})}{e^2}$$

Where:

$n_o$ = size of sample

$t^2_{\propto,v}$ = critical value of student's t test with significance level $\propto$ and v degree of freedom

e = acceptable error

cv = coefficient of variation

v = degree of freedom = n-1

- The desired precision for the baseline fuelwood estimation is ±10%
- The confidence level is at 95% which has a critical t value of 1.96.
- The coefficient of variation is assumed at 1.

Thus $n_o = \frac{(1^2 x 1.96^2)}{(10\%)^2} = 384$

Thus the sample size required to estimate the fuelwood usage within a target range of 95% confidence level is 384. To be conservative and more precise, **500 samples or 10% of the target population** have been chosen. This also compensates for any sampling error due to sampling approach.

## VII. Survey Design

Structured interview and field studies were involved to obtain data on use of fuelwood and kerosene by the rural households. A questionnaire was designed, field tested and implemented at household level by the SEDS staff who were trained in field data collection. The measurement of fuel consumption from sample households was based on the manual Biomass studies by Shailaja Ravindranath and Sudha (1997).

- All the households are below the poverty line with an income of less than 1$/day/person.
- Survey of 500 households across the 5 mandals in 40 villages situated inside the project boundary was conducted i.e. 10% of the households.
- The type of cooking device used in the sample household was recorded.
- The person who cooks for the household was requested to set aside an approximate quantity of cooking fuel required for a week prior to cooking in the morning.
- The house was visited in the morning before the start of cooking activity.
- The type and weight of the fuel set aside was recorded.
- The fuel from weighed bundle was used for cooking every day.
- After 7 days in the evening after cooking, the remaining fuel was weighted and value recorded.
- The average fuel wood use/day was estimated.
- The timeline use of fuel wood over the 20 years period was also conducted based on PRA.
- The data from the survey was compiled using Microsoft Excel and analysed.

## VIII. Survey Findings

### a) Fuel Type:

| Type of fuel used | Fuel wood | Dung | Crop residue | Coal | Kerosene | LPG |
|---|---|---|---|---|---|---|
| Number of HH reporting to use the fuel type | 500 | 0 | 497 | 0 | 18 | 0 |
| % of HH reporting to use the fuel type | 100 | 0 | 99.4 | 0 | 3.6 | 0 |

- All households reported dependence on fuel wood and crop residue (red gram, mulberry etc.) to meet some if not all of their cooking / water heating fuel requirements.
- No household reported using dung cakes or coal as a source of fuel.
- 3.6% of households reported to be using kerosene supplied through the public distribution system as a cooking fuel. It transpired that although this cooking fuel was available to everyone, most used the fuel for lighting purposes burning the fuel in "whiskey bottle" lamps.
- No household was found to be using LPG. Reasons preventing its use were reported to be; too high a cost, the perception that it was unsafe and prone to explosion, and logistical problems associated with refilling empty gas bottles in rural areas.

**b) Source of fuel wood collection:**

- 86.2% of the households surveyed responded that they collect fuel wood from forest areas. (Kalligera forest, Penukonda forest, Errakonda forest, Somandepalli forest and riverside forest areas)
- Almost half the households (47.4%) collected some firewood from trees growing on the bunds of agricultural land.
- 41.66% of households sourced some of their firewood from wasteland areas. This also included areas of former agricultural land that had remained fallow for several years.
- 22.9% reported collection of firewood from plantation areas. This included watershed development areas.
- 10% reported collection from "other areas", this included village tank areas.

**c) Time taken to collect firewood:**

- Respondents were asked if it takes more time to collect fuel wood today than it had taken to collect the equivalent amount 20 years ago. All replied that it takes more time today due to a greater scarcity of available fire wood.

**d) Cost of fire wood:**

- Respondents were asked to recall what they remembered one bullock cart of firewood to cost in 1988 and what the same costs today. The answers show that the cost of firewood today is 5 times the cost was in 1988. The cost of one bullock cart of firewood now is about Rs. 464, while it was Rs. 92.20 years back.
- This price rise is far greater than what can be attributed to inflation alone and supports the idea that the price has risen due to the increasing scarcity of available firewood to local communities.

**e) Volume of kerosene used as a fuel for cooking / water heating:**

- Only 18 out of the 500 respondents reported to use kerosene for the purpose of cooking / water heating.
- These 18 respondents reported that kerosene was used as a supplementary cooking fuel and was generally used for the quick preparation of items such as tea.

**f) Volume of fire wood used as a fuel for cooking / water heating:**

The results from the survey indicate that on average the fuelwood usage is 1.85±0.04 kg/capita/day at 95% confidence level. At a household level, 3.37 tonnes per HH per year is being used.

**g) Time spent cooking/heating water per day:**

- Respondents reported spending an average of 4.14 hours cooking / heating water per day.

This is alarming because such prolonged time periods spent using traditional wood stoves in what are typically unventilated kitchens often results in negative health impacts such as eye inflammation, lung infection and skin diseases

## Appendix 5. Further background information on monitoring plan

The monitoring report provided to the verification agency will contain:

- Evidence that each is running, evidence that any found not to be running was recorded as being "under repair" on the central database for no longer than 7 days and had been visited by a member of the maintenance team within 24 hours of being reported dysfunctional.
- Leakage information as outlined in the monitoring plan above.

ER calculations based on the data collected on the above and applying ex-ante methodology

## Appendix 6. Summary report of comments received from local stakeholders

The summary of the comments received is included in section E.2. The detailed comments are included in the Gold Standard Passport of the project activity which can be accessed at https://mer.markit.com/br-reg/public/project.jsp?project_id=103000000002080

## Appendix 7. Summary of post-registration changes

During the first crediting period, post registration changes were made with regard to project design of a registered project activity. The changes were addition of multiple sites. This was approved by the UNFCCC on 11th July 2013 vide PRC reference number PRC-3541-001.

Before the implementation of the project, 121 villages were identified in 5 Mandals for implementation, which was changed to all villages in the Mandals. The changes were not known prior to the registration of the project activity. The changes occurred after the start of the implementation. The beneficiaries that showed interest and were identified upfront for the project activity during the survey in 2008 were in 121 villages in 5 Mandals of Anantapur. During the course of implementation the unit could not be constructed for many of the identified beneficiaries due to: (a) migrations of families to neighbouring villages, (b) unsuitable site conditions such as rocky or sandy, which prevents excavation of land to construct the biogas dome, etc. Thus, interested end users from within the project boundary of the 5 Mandals in Anantapur District were identified and provided with biogas units. The project is implemented in the villages of 5 Mandals of Anantapur, which is in the project boundary, but is in more than 121 identified villages. Thus the villages were more than that proposed 121 villages and the households were also different from that initially surveyed. Of course the proposed households are from the rural regions in the project boundary i.e. the 5 Mandals of Anantapur

Document information

| *Version* | *Date* | *Description* |
|---|---|---|
| 10.1 | 28 June 2017 | Revision to make editorial improvement. |
| 10.0 | 7 June 2017 | Revision to:<br>• Improve consistency with the “CDM project standard for project activities” and with the PoA-DD and CPA-DD forms;<br>• Make editorial improvement. |
| 09.0 | 24 May 2017 | Revision to:<br>• Ensure consistency with the “CDM project standard for project activities” (CDM-EB93-A04-STAN) (version 01.0);<br>• Incorporate the “Project design document form for small-scale CDM project activities” (CDM-SSC-PDD-FORM);<br>• Make editorial improvement. |
| 08.0 | 22 July 2016 | EB 90, Annex 1<br>Revision to include provisions related to automatically additional project activities. |
| 07.0 | 15 April 2016 | Revision to ensure consistency with the “Standard: Applicability of sectoral scopes” (CDM-EB88-A04-STAN) (version 01.0). |
| 06.0 | 9 March 2015 | Revision 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>• Make editorial improvement. |
| 05.0 | 25 June 2014 | Revision to:<br>• Include the Attachment: Instructions for filling out the project design document form for CDM project activities (these instructions supersede the "Guidelines for completing the project design document form" (Version 01.0));<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 Appendix 1;<br>• Change the reference number from F-CDM-PDD to CDM-PDD-FORM;<br>• Make editorial improvement. |
| 04.1 | 11 April 2012 | Editorial revision to change version 02 line in history box from Annex 06 to Annex 06b. |
| 04.0 | 13 March 2012 | Revision required to ensure consistency with the “Guidelines for completing the project design document form for CDM project activities” (EB 66, Annex 8). |
| 03.0 | 26 July 2006 | EB 25, Annex 15 |
| 02.0 | 14 June 2004 | EB 14, Annex 06b |

| *Version* | *Date* | *Description* |
|---|---|---|
| 01.0 | 03 August 2002 | EB 05, Paragraph 12<br>Initial adoption. |

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: project activities, project design document