**Annex E: Gold Standard Community-Focused Micro Scale Scheme**
**PROJECT DESIGN DOCUMENT FORM**
**Version 01 - in effect as of: May 1st 2010**

## CONTENTS



## Annexes

## SECTION A. General description of micro-scale project activity

### A.1 Title of the micro-scale project activity:

Title: LAYA PADERU ENERGY EFFICIENT WOODSTOVES PROJECT
Dated: 20th May 2011
Version: 3

### A.2. Project participants:

| Name of Party involved ((host) indicates a host Party) | Private and/or public entity(ies) project participants (as applicable) | Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No) |
|---|---|---|
| India (host) | LAYA Resource Centre | No |

### A.3 Description of the micro-scale project activity:

The objective of the project activity is to improve the health of tribal communities and reduce fuel wood demand by providing improved cook stoves for cooking (SARALA) in the tribal region of Eastern Ghats region of India. The project will be implemented in 3 Mandals of Paderu Division, Visakhapatnam District, Andhra Pradesh, India. The dissemination of smokeless stoves improves the health of women and children by avoiding inhalation of smoke and smoke induced eye irritation. Moreover, efficient stoves substantially reduce the demand for wood fuel, which in turn decreases environmental degradation and greenhouse gas emissions.

The project will be implemented by LAYA Resource Centre, an NGO working for the tribal communities in the region for the past 25 years. LAYA's work on climate change is focused especially on its impacts on vulnerable tribal communities. Initiatives on the energy front took momentum after the insights gained as part of a study on decentralized energy options undertaken in the tribal region of the Eastern Ghat regions of India. This study attempted to look at the energy situation in the energy starved tribal regions and recorded the perceptions of these communities on access to energy/electricity, government approach and the potential of community based energy solutions. Meeting lighting demand, cooking and milling needs were the most crucial. The relevance of micro hydro, solar lighting system and improved household cook stoves emerged as potential solutions in the community context. The study has been followed up by the implementation of micro hydro, solar and energy efficient cooking stoves in a cluster approach. Demonstration of improved cooking stoves SARALA model from Technology Informatics Design Endeavour (TIDE) was taken up in the region. The demand of improved cooking stove is immense in Paderu region, Visakhapatnam district, Andhra Pradesh with depleting forest cover & unsustainable harvest of forest. This has translated into longer and further treks by the women to the forests leading to increased hardship for fuel wood collection for cooking. This needs to be addressed especially by

introduction of fuel efficient cooking stoves which would consume relatively lesser amount of fuel and reduced drudgery in cooking. Discussions were held with women in many tribal villages to understand their problems while cooking. The women face excessive heat and smoke from their traditional stoves. The smoke make the walls sooty and black, soils all the things in the house and results in high incidence of respiratory illness. They were unanimous that a better stove would be the one in which smoke would be reduced and would cook faster. This discussions/study brought to the fore the huge unmet demand for improved cooking stove in these tribal regions.

This project is well in line with the National initiative of the Ministry of New and Renewable Energy, Government of India, which aims to primarily enhance the availability of clean and efficient energy for the energy deficient and poorer sections of the society[1]. The various intervention options being initiated by the Ministry of New and Renewable Energy, for realizing this objective also include dissemination of improved stoves.

The main activity of the project will be to introduce SARALA stoves in the target communities and to train women in constructing and using the stoves. Trained promoters or women will conduct trainings and supervise the stove construction. For this, illustrative training materials and construction guides have been provided by TIDE to few women trainers. The project will provide the necessary construction materials, such as mould for construction, mud bricks, clay, a cast iron grate and a chimney for construction.

The improved stove was developed by the Centre for Sustainable Development, Indian Institute of Science and promoted by TIDE. The training conducted for stove promoters was promoted by LAYA, wherein initially training was provided by TIDE staff. Based on the knowledge acquired from the training and their long time experiences, LAYA will be providing SARALA Improved cook stoves to about 3750 households in this region through forward funding of VERs.

### A.3.1. Location of the micro-scale project activity:

#### A.3.1.1. Host Country:

India

#### A.3.1.2. Region/State/Province etc.:

State: Andhra Pradesh
District: Visakhapatnam
Division: Paderu
Mandal: Paderu, Pedabayalu, Hukumpeta

#### A.3.1.3. City/Town/Community etc:

[1] http://mnre.gov.in/press-releases/press-release-02122009.pdf

The project will be implemented in 3 Mandals in Visakhapatnam District, Paderu Division, 17 Panchayats, 109 Villages and 3750 Households. The beneficiaries will be from the following Panchayats, and Villages.

| Name of the Panchayat | Name of the Villages | Total Households |
|---|---|---|
| **Hukumpeta Mandal** | | |
| **Bhemavaram** | Bhemavaram | 20 |
| | Chittampadu | 31 |
| | Ramachandrapuram | 36 |
| **Boddaput** | Bandhamamidi | 35 |
| | Boddaput | 32 |
| | Pottupanasa | 11 |
| **Mottujoru** | Dhabbabandha | 29 |
| | Kunthurla | 84 |
| | Mottujoru | 61 |
| | Munthamamidi | 15 |
| | Nakalaput | 36 |
| | Pattugodalu | 32 |
| | Rangapalli | 66 |
| **Olda** | Esukagaruvu | 18 |
| | Jankaramput | 26 |
| | Nimmlapadu | 44 |
| | Nittaput | 24 |
| | Olda | 62 |
| | Padirai | 23 |
| | Peddapadu | 10 |
| | Thigalavalasa | 8 |
| | Verulla | 12 |
| **Sukuru** | Maba | 45 |
| **Paderu Mandal** | | |
| **G.Munchingput** | G.Munchingput | 57 |
| | Jallipalli | 45 |
| | Kavurai | 24 |
| | Kothapalli | 83 |
| | Naraodivalasa | 24 |
| | Patharaputtu | 40 |
| **Kujjalli** | D.Modhaput | 54 |
| | Goralagondhi | 20 |

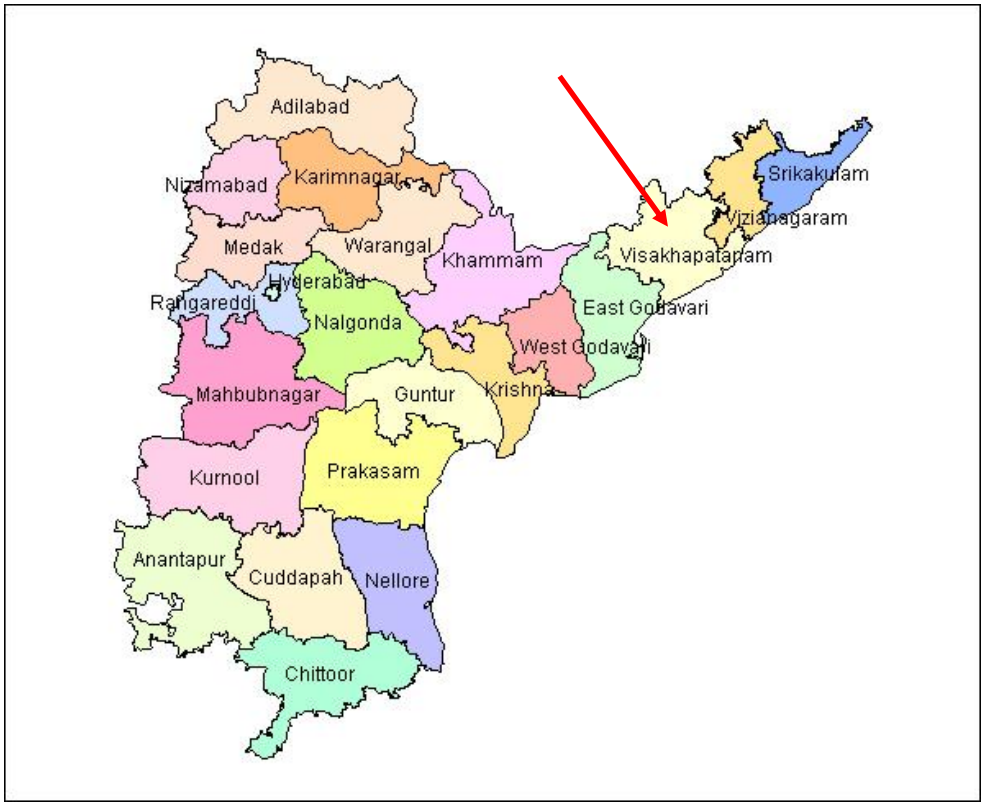
| | | |
|---|---|---|
| | R.Kothuru | 25 |
| | Ramulaput | 59 |
| **Minumuluru** | Sangodi | 86 |
| **Modhapalli** | Gurragaruvu | 66 |
| | Modhapalli | 49 |
| **Vanugupalli** | Chidikudda | 12 |
| | Jamiguda | 29 |
| | Kandamamidi | 62 |
| | Munthamamidi | 12 |
| **Pedabayalu Mandal** | | |
| **Adugulaput** | Adugulaput | 61 |
| | Allamput | 22 |
| | Gondhi Kodaput | 32 |
| | Jangamput | 30 |
| | Kothaput | 19 |
| | Lakeputtu | 30 |
| | Sampangiput | 23 |
| | Sekariput | 14 |
| | Thamarada | 37 |
| | Thangula | 17 |
| | Vaddaput | 24 |
| | Vadekodaputtu | 17 |
| **Aradakota** | A.Badama | 10 |
| | Aradakota | 130 |
| | B.Badama | 11 |
| | Bongadari | 25 |
| | Charvuvedhi | 11 |
| | Chuttumetta | 47 |
| | Gullurayi | 8 |
| | Kagu valasa | 40 |
| | Nimmagunta | 26 |
| | Palavalasa | 17 |
| | Pandhigunta | 13 |
| | Puruguduputtu | 66 |
| **Galaganda** | Edulaput | 34 |
| | Galaganda | 81 |
| | Gasabu | 54 |

| | | |
|---|---|---|
| | Kuthangiput | 31 |
| | Mangabandha | 54 |
| | Sirasapalli | 91 |
| **Gamparai** | Allangiput | 31 |
| | Boddaput | 23 |
| | Chidiput | 40 |
| | Jamiguda | 12 |
| | Kagula | 46 |
| | Kulluba | 41 |
| | Sundruputtu | 27 |
| | Thurakalavalasa | 20 |
| **Kimudupalli** | Chaduput | 92 |
| | Kimudupalli | 139 |
| | Maredapalli | 45 |
| **Pedakodapalli** | Andravara | 55 |
| | Bangaruput | 50 |
| | Baringibandha | 21 |
| | Bondaput | 17 |
| | Buradhamamidi | 25 |
| | Chakarai | 46 |
| | Chemalamamidi | 22 |
| | Durupalli | 23 |
| | Gochari | 19 |
| | Jathikota | 14 |
| | Kodaput | 64 |
| | Kothapoipalli | 50 |
| | Kusumagaruvu | 15 |
| | Malkariput | 22 |
| | Marakachintha | 40 |
| | Mettaveedhi | 28 |
| | Mondikota | 26 |
| | Olugupalli | 37 |
| | Pardhanput | 45 |
| | Pedakodapalli | 98 |
| | Peddagondhi | 19 |
| | Tadeput | 37 |
| | Thulabarangi | 41 |

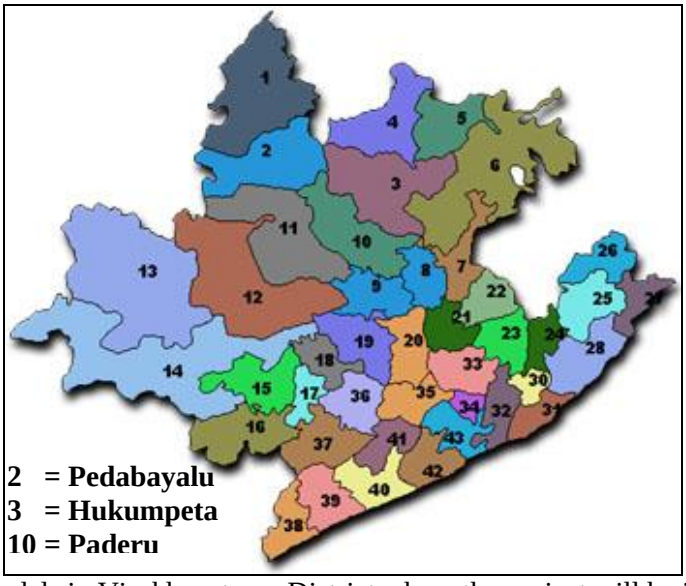
| | | |
|---|---|---|
| | Urreda | 40 |
| | Vakapalli | 11 |
| **Sekari** | Arimara | 32 |
| | Kavurupalli | 28 |
| | Sariyapalli | 28 |
| **Total number of Households** | | **4051** |

The survey has been conducted for 4051 households. Initial implementation will be done in 3750 households. Stoves will be constructed in subsequent years, but with a limitation of 5,000 VERs/year.

**A.3.1.4. Details of physical location, including information allowing the unique identification of this micro-scale project activity :**




Map showing the project area: Country- India; State – Andhra Pradesh; District – Visakhapatnam




Map showing the 3 Mandals in Visakhapatnam District where the project will be implemented.

The co-ordinates of the Mandals[2] are as follows:

| Name | Latitude | Longitude |
|---|---|---|
| Paderu | $18^0$- 04 ' - 39 " | $82^0$ - 39 ' - 38 " |
| Pedabayalu | $18^0$- 17 ' - 08 " | $82^0$ - 35 ' - 38 " |
| Hukumpeta | $18^0$- 08 ' - 59 " | $82^0$ - 41 ' - 51 " |

**A.3.2. Description including technology and/or measure of the micro-scale project activity:**

**Traditional mud-stove and three-stone stove used for cooking in the baseline in project area.**

The project activity encompasses the construction of SARALA stoves at the household level.

[2] Hand book of Statistics, Visakhapatnam District, 2009. Chief Planning Officer, Visakhapatnam District.

SARALA is a two pan improved cook-stove with a single fuel feeding port for domestic cooking in houses. These stoves are smokeless, compact, durable, and compatible with a wide range of solid biomass. It was developed at ASTRA now Center for Sustainable Technologies, Indian Institute of Science as a consequence to the user response to its earlier version, the ASTRA stove. It uses mud bricks, clay, a cast iron grate and a chimney for construction. A mould of the stove is made for its construction. The features of SARALA are as follows:

- Can burn a variety of biomass fuels
- Smoke-free working environment
- Use of moulds for on-site stove construction with consistent dimensions that provide consistent performance
- Durable with minimal maintenance
- Compact, with low space requirement (Therefore, suitable even for small kitchens)
- Easy to install and operate, no deviation in cooking practice
- Conserves at least 25%-30% of biofuels as compared to open cooking

**Assembly of the SARALA Improved Cook-stove Mould by the local women**


**Mould for construction of SARALA Improved Cook-stove**


**A constructed SARALA Improved Cookstove**

**A.3.3 Estimated amount of emission reductions over the chosen crediting period:**

| Years | Annual estimation of emission reductions in tonnes of $CO_{2e}$ |
|---|---|
| 2011 – 2012 (Starting 1st August 2011) | 2,861 |
| 2012-2013 | 4,950 |
| 2013-2014 | 4,950 |
| 2014-2015 | 4,950 |
| 2015-2016 | 4,950 |
| 2016-2017 | 4,950 |
| 2017-2018 | 4,950 |
| 2018-2019 | 4,950 |
| 2019-2020 | 4,950 |
| 2020-2021 | 4,950 |
| Total emission reductions (tonnes of $CO_{2e}$) | 47,411 |
| Total number of crediting years | 10 |
| Annual average over the crediting period of estimated reductions (tonnes of $CO_{2e}$) | 4,741 |

This project is a Gold Standard Community-Focused Micro Scale Scheme with a limit of 5,000 emission reductions per year.

**A.3.4. Public funding of the micro-scale project activity:**

There is no public funding involved in the project activity. Please refer to ODA declaration form of the Project Proponent.

## SECTION B. Application of an existing baseline and monitoring methodology or of a new methodology submitted as part of this project activity

**B.1. Title and reference of the existing or new baseline and monitoring methodology applied to the micro-scale project activity:**

Methodology for Improved Cook-stoves and Kitchen Regimes V.02 – 08/02/2010
Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes.

**B.2 Justification of the choice of the methodology and applicability:**

The choice of methodology and applicability is justified as follows:

According to Annex C of GSv2.1 Annexes_A-N, Gold Standard Toolkit, Improved cooking devices are eligible under the Gold Standard project. As mentioned "Project activities involving a large amount of small, distributed heating, cooking or electricity generation devices using renewable energy sources shall provide the Gold Standard with a clear description of the transfer of credits ownership all along the investment chain and with proof that end-users are aware of and willing to give up their rights on emission reductions".

An end-user agreement will be signed between LAYA and the woman of the house, wherein a clear description of the transfer of carbon credits ownership is described and their willingness to give up their rights on emission reductions. The end user agreement will be written in Telugu, the local language, read to them before it is signed.

The technology that will be employed is an efficient fuel wood cook stove called SARALA that can be used for cooking in rural households.

The project activity involves introduction of improved cook-stove SARALA at household level, replacing the traditional cook-stove being used now by the tribal communities in the project area within a distinct geographical area as described in section A.3.1.3 and A.3.1.4 and also in Appendix 1. These traditional cook stoves have significant green-house gas emissions compared to SARALA, which is more efficient and has lower GHG emissions.

The kitchen regime in the project area encompasses only one practice that is use of traditional cook stove and cook with only one fuel type, wood throughout the project area (see section B.4).

The measures of the project activity are as follows:

- Low emission cook-stove SARALA will replace the traditional high-emission baseline scenario. Here the emphasis will be to replace the old stove will the new SARALA stove and not to be used in parallel with new stoves. This will be one of the pre-condition for the construction of SARALA cook stove in place of old stoves.
- The project boundary is clearly defined as shown in Appendix 1, section A.3.1.3 and A.3.1.4. This will not be included in any other voluntary market of CDM project. Thus no double counting will take place from the project activity.
- The project is located in a single country – INDIA
- Only one SARALA stove will be constructed per family. Thus 3750 SARALA stoves will be built for 3750 families in the project boundary. Thus it does not number more than ten per kitchen. The continuous useful energy output is less than 50 kW as shown below (defined as total energy delivered usefully from start to end of operation divided by time of operation).

| Useful Energy Calculation | | | |
|---|---|---|---|
| **Activity Data** | **Value** | **Unit** | **Source of information** |
| Fuelwood use /day | 6.60 | Kgs | Baseline Survey |
| Hours of Use/day | 4.8 | Hours | Baseline Survey |
| Efficiency | 25%[3] | | Methodology |
| Calorific value of wood | 0.015 | TJ/t | IPCC Value |
| Useful Energy (KJ) | 24750 | KJ | Calculated |
| Useful Energy (kW) | 6.88 | kWh | Calculated;<br>1 KJ = 0.000 2777777778 kWh |
| Useful Energy (kW) continuous use | 1.43 | kW | Calculated |

As described in section B.5.4, the project will not generate more than 5,000 $tCO_2$ emission reduction per annum and therefore qualifies as a Gold Standard Community-Focused Micro Scale Scheme.

Prior approval has been sought from Gold Standard to take it up under the Gold Standard Community-Focused Micro Scale Scheme.

## B.3. Description of the project boundary:

The project activity includes promoting the use of SARALA improved cook-stoves. This requires the definition of Project Boundary, Target Area, and Fuel Collection Area.

a. **Project Boundary:** The project boundary includes the domestic kitchens of the project population using SARALA improved cook-stove instead of traditional cook stove, thus reducing GHG emissions due to energy efficiency of SARAL cook-stove that will be introduced by the

[33] Jagadish, 2004. The development and dissemination of efficient domestic cook stoves and other devices in Karnataka. Current Science, Vol. 87, No. 7, 10, October 2004. http://www.ias.ac.in/currsci/oct102004/926.pdf

project. The list of households in which the project will be implemented in given in Appendix 1 as an excel sheet.

b. **Target Area:** The target area encompasses the three Mandals of Paderu, Pedabayalu, and Hukumpeta, which is in Visakhapatnam District, Paderu Division in the State of Andhra Pradesh, India.

c. **Fuel Collection Area:** The communities use only one fuel type – Wood for cooking and heating water. Thus the baseline fuel is only Fuelwood. The Fuelwood Collection Area as described by the methodology is the area within which this biomass is produced and supplied, or could reasonably be expected to be produced and supplied, whichever is the greater. According to the baseline survey conducted in 4051 families in 109 villages of the project boundary, the source of fuelwood collection is from forest areas in and around the village, as the communities walk to the nearby forests to collect them.

| Scenario | Source | Gas | Included? | Justification/Explanation |
|---|---|---|---|---|
| **Baseline** | Cooking | $CO_2$ | Yes | Important source of emissions |
| | | $CH_4$ | Yes | Important source of emissions |
| | | $N_2O$ | Yes | Significant |
| **Project** | Cooking | $CO_2$ | Yes | Important source of emissions |
| | | $CH_4$ | Yes | Important source of emissions |
| | | $N_2O$ | Yes | Significant |

## B.4. Description of the baseline and its development as per the chosen methodology:

**Selection of the most plausible baseline scenario**

As given in the methodology, the baseline scenario is the one experienced by each household purchasing an improved stove, prior to installation of the new stove.

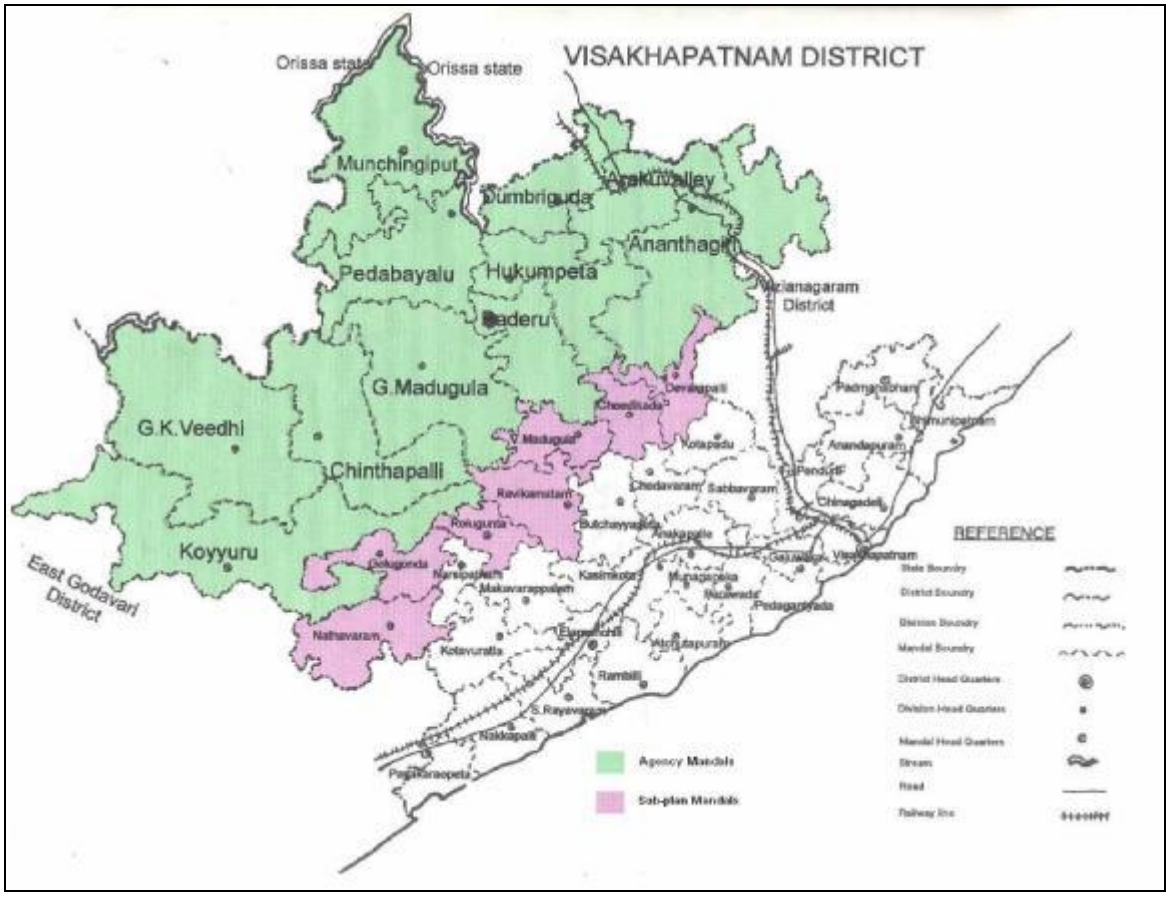
The SARALA improved stoves will be adopted progressively for over a period of 12 months through the project period. But the conditions will be unchanging in the project area through it will be implemented over a period of time. Thus a "fixed baseline" is adopted for the project area.

**Justification of fixed baseline**

Paderu division is one of the scheduled areas among nine districts in Andhra Pradesh. The criteria followed for declaring an area as "Scheduled Area" by the President of India are preponderance of tribal population; compactness and reasonable size of the area; under-developed nature of the area; and marked disparity in economic standard of the people[4]. The region comes under the sub-plan areas of tribal

[4] http://www.aptribes.gov.in/html/sch-areas.htm

development strategy. Paderu division represents fourteen predominant tribal groups and mostly live in the agency tracts of hills and forests.




The Agency Division consists of the hilly regions covered by the Eastern Ghats with an altitude of about 900 metres dotted by several peaks exceeding 1200 metres. Sankaram Forest block topping with 1615 metres embraces the mandals of project area - Paderu, Hukumpeta and Pedabayalu as shown in the map above. More than ninety percent of the agency region is dominated by tribals. The main tribals inhabiting this region are Bagata, Gadaba, Konda Kammara, Konda Dora, Kotiya, Khond, Mali, Manne Dora, Nooka Dora, Reddi Dora, Porja, Valmiki, Gond and Kulia.

The economy of these tribes is agro-forest based and is subsistence economy. Tribal communities in India largely occupy forested regions where for a long period in their history, they have lived in isolation but in harmony with nature. They draw their subsistence largely from the forest. The hill tribes in the Eastern Ghat region practice both shifting and settled cultivation, and also collect minor forest produces. Among the hill tribes living here, Khond, Porja and Gadaba are classified as primitive tribes. Their habitats are on hill tops and slopes. These tribes are largely depending on shifting cultivation and collection of minor

forest produces. The tribal groups of Khonds, Konda doras, Nooka doras, Kotiyas, Porjas, Gadabas, Bagatas and Valmikis practise Podu or shifting cultivation.

Large majority of the hill tribe's population are prone to malnutrition. According to a study, "Nutritional Status of Khond, Gadaba and Porja Tribes of Andhra Pradesh" (by U. Kupputhai and N. Mallika, Avinashilingam, Institute for Home Science and Higher Education for Women, Coimbatore) the tribal people of Andhra Pradesh's Paderu mandal are desperately poor**,** backward, and generally uneducated and lead hard and miserable lives[5]. The women are particularly disadvantaged and their diets are nutritionally deficient[6]. The interior forested zones in the Eastern Ghats are known for naxalite activities. These tribals still relatively lives in isolation. Only a section of the tribal families have lands of their own. Large majority of the tribal families in the Eastern Ghats own the banjar or waste lands of dry and podu categories. Very limited extent of plain land is available for cultivation. The landless tribal families are forced to depend on labour employment and minor forest produce collection for their subsistence purpose.

A survey of all the households in which the project will be implemented shows that the only mode of cooking is with traditional cook stove. In these circumstances, there will not be much change during the years of project implementation.

**Identification of Clusters in the project population**

Application of the methodology necessitates dividing the project population (all stove customers) into groups or clusters, to distinguish the characteristics which determine the emission reductions of each cluster. Based on the survey conducted for all the households in which the project will be implemented, only one group or cluster emerges, wherein all of the households use 100% fuelwood for cooking. Use of coal, crop residue is not a practice at all. Also kerosene stoves and LPG stoves have not made any penetration into these tribal families.

Thus the only cluster that is identified in the project area is Use of 100% fuel wood for cooking using traditional cook-stove which has a low efficiency of 10%.

**Conclusion**

- One cluster of cooking practice is established in the baseline scenario – the use of 100% fuel wood on traditional cook-stove
- A fixed baseline has been identified for the project area.

**Determination of Baseline emissions**

A Baseline study was conducted in the project area, in accordance with the procedure set out in the methodology as summarized below.

[5] Nutritional Status of Khond, Gadaba and Porja Tribes of Andhra Pradesh. U. Kupputhai and N. Mallika, Avinashilingam, Institute for Home Science and Higher Education for Women, Coimbatore

[6] http://www.hinduonnet.com/fline/fl2119/stories/20040924005901400.htm

- The surveys and tests to estimate and quantify baseline conditions are made in homes which are not using the improved stove.
- The surveys and tests aimed at comparing old stove and new stove conditions were done in the same houses to minimize variability due to external factors. During the first three days, the test was done on the traditional cook-stove. The SARALA improved cook-stove was built and left to dry. The test was conducted on the new stove subsequently for three days. The houses were asked to prepare the same set of food during the Kitchen Test. Thus the conditions indicated daily repetition of a set pattern. Thus a shorter test period was chosen for the survey.

**1. Determine customer groups or "clusters"**

**Step 1.1: Establish a Pilot Record**

LAYA Resource Centre, the NGO, established a record of 4051 households to get information on Baseline Scenario. These are the households in which the SARALA stoves will be built during the project activity after registration and procuring forward funding. Further, pilot records were collected of 116 SARALA cook stoves built for the tribal communities in Paderu division. The data collected were as follows:

- Unique Identification Number of the Household
- Details of Location – District, Mandal, Village
- Details of the Household
    - Name of the head of the family
    - Father's/Husband's Name
    - Number of adult men, women, children
    - Tribal Group
    - Address of the household
    - ID Proof Type and Number – Ration Card
    - Telephone number if existing – Being a tribal area and socio-economically very backward, none of the houses have telephones
- Agricultural Land Details
    - Type of land, Area, Crop Type
- Baseline Stove Details
    - Type of stoves
    - Mode of use of the stove: Domestic/commercial/Institutional
    - Number of stoves
    - Use of stove –
        - Domestic/Commercial
        - Cooking/Space heating
- Model/type of new stove – SARALA Type
- Number of stoves purchased – Only one stove will be constructed per household

**Step 1.2: Provisionally assess fuel types, fuel mix, and kitchen regimes**

A detailed house to house survey was conducted to assess the fuel type used throughout the year in the project kitchens for the baseline and project scenario in the following three categories:

a) Renewable and Non-Renewable Woody Biomass
   - Woody Biomass and Charcoal from forests, wastelands, agricultural lands etc.

b) Renewable energy fuels
   - Agricultural residues
   - Biogas, solar cookers, heat retention cookers, etc.

c) Alternative fuels
   - Animal dung, Fossil Fuels such as Kerosene, Coal, LPG, etc.

Based on the 4051 and 116 household data, an estimate was made of the fuels mix or fuel type ratio for an entire year for each family. The survey also included information as to whether the household kitchen cooked commercially or for domestic consumption only; use of stoves for cooking or for both cooking and space heaters; information on the frequency of fuelwood collection; and purchase/collection of fuelwood.

The only kitchen regime is domestic use for cooking and heating water.

**Step 1.3: Analyze renewability status of wood-fuels**

The EB 23 Annex 18 definition of "renewable biomass" has been used to deduce the share of renewable and accordingly the non-renewable woody biomass in the quantity the total biomass consumption using nationally approved methods, field survey, existing literature, resource/population studies. Quantitative approach has been used to deduce the availability of biomass supply and growth in the collection area.

The geographic area from which woody biomass fuel is being collected spans across 109 villages which is discretely located spread over 3 Mandals in Vishakhapatnam Division. Village level land use data is not available. The geographic level for which data is available for timber and fuel wood extraction by the Forest Department sustainably and other statistics is at the District level. Thus the analysis for renewability status of wood-fuels is done at the District level, i.e. Visakhapatnam.

Based on the methodology, non-renewable biomass (NRB) is determined as follows:

NRB = H – MAI

Where:

H = annual harvest of woody biomass, including forest clearance, timber extraction, consumption of wood-fuels, drawn from fuel collection area A.

MAI = sum of mean annual increments of the wood species or re-growth in area A

NRB = non renewing biomass or excess harvest over and above re-growth, which in the amount of woody biomass removed with attendant $CO_2$ emissions which are not absorbed by re-growth.

Xnrb = (NRB/H)

In Paderu region, the forestland is being converted for cultivation, with tress felling for housing, fuel and for cash income. The old and the new houses in the villages are constructed with good timber. Even now, men cut down trees that grow on the common property lands, forestlands or private land for these purposes. This is a major concern for the women, since they are the ones who traditionally collect firewood. Now, they spend more time and energy to meet their fuel requirement, as they have to spend a longer time searching for wood[7].

[7] http://www.aptribes.gov.in/html/itda-paderu/Introduction.pdf

**Baseline traditional cook-stoves**

**Women and Children collecting fuelwood from forests**

**Processing of fuelwood for cooking and water-heating**

**Renewable Biomass**

The area (A) for which the NRB analysis has been done, and the district in which the project will be implemented is Visakhapatnam District.

A = 1,116,100 ha

The land use pattern for Visakhapatnam district is as follows:

**Table 1 –District land use utilization pattern of Visakhapatnam for 2009[2] (ha)**

| Land Use Pattern | Area (ha) | % of geographic area |
|---|---|---|
| a. Forest | 441,166 | 39.5 |
| b. Barren & uncultivable land | 130,405 | 11.7 |
| c. Agricultual land | 102,891 | 9.2 |
| d. Permament pastures & other grazing lands | 2,849 | 0.3 |
| e. Misc. Tree crops & groves not included in net area sown | 34,605 | 3.1 |
| f. Cultivable waste | 10,863 | 1.0 |
| g. Other fallow lands | 28,325 | 2.5 |
| h. Current fallows | 56,881 | 5.1 |
| i. Net area sown | 307,872 | 27.6 |
| **Geographical area** | **1,116,100** | **100.0** |

Applying, EB 23 Annex 18 definition of "renewable biomass"

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

i. The land area remains a forest; and
ii. Sustainable management practices are undertaken on these land areas to ensure, in particular, that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and
iii. Any national or regional forestry and nature conservation regulations are complied with.

(a) The total area under forests in Visakhapatnam District is 441,166 ha which accounts for 39.5% of the geographic area (Table 1). This area will remain as forests.
(b) Undertaking sustainable management practices on these land areas to ensure that there is no systematic decrease of carbon stocks, the latest available data on extraction by the Forest Department for previous years has been considered. An average of 4 years of extraction rates is taken into account (Table 2).

**Table 2: Extraction of Timber and Fuelwood in Visakapatanam Year-Wise**

| Year | Timber (in Cum) | | | Total (in MT)* | Fuel Wood (in MT) | | | Grand Total |
|---|---|---|---|---|---|---|---|---|
| | From Coupes etc | From Plantations & Thinnings | Total | | From Coupes etc | From Plantations & Thinnings | Total | |
| 2003-04 | 0.00 | 23608.77 | 23608.77 | 18887.02 | 0.00 | 2530.00 | 2530.00 | **21417.02** |
| 2004-05 | 13730.40 | 3199.16 | 16929.56 | 13543.65 | 381.00 | 544.00 | 925.00 | **14468.65** |
| 2005-06 | 872.62 | 47.50 | 920.12 | 736.09 | 69.00 | 0.00 | 69.00 | **805.09** |
| 2006-07 | 447.00 | 265.00 | 712.00 | 569.60 | 93.00 | 0.00 | 93.00 | **662.60** |
| **Average** | **3762.51** | **6780.11** | **10542.61** | **8434.09** | **135.75** | **768.50** | **904.25** | **9338.34** |

*For conversion factor from Cum to Metric Tonnes the average wood density of 0.8 is considered[8]
Source: http://forest.ap.nic.in/Facts%20and%20Figures/facts_and_figures-2009.pdf

**(c)** Thus the renewable biomass originating from land areas that are forests = **9338.34 t/year.**

**II. The biomass is woody biomass and originates from croplands and/or grasslands where:**

a) The land area remains cropland and/or grasslands or is reverted to forest; and
b) Sustainable management practices are undertaken on these land areas to ensure in particular that the level of carbon stocks on these land areas does not systematically decrease over time (carbon stocks may temporarily decrease due to harvesting); and
c) Any national or regional forestry, agriculture and nature conservation regulations are complied with.

Here along with cropland, all other land use categories that have woody biomass are considered. Accordingly the following land use classification as given in Table 1, are considered under this category:

(b) Barren & uncultivable land (c) Agricultural land; (d) Permanent Pastures and Grazing lands (f) Cultivable waste (g) Other fallow lands (h) Current fallows and (i) Net area sown

- The total area excluding forests is 6,40,329 ha.
- The total number of trees on non-forest areas (CNFA) is 11.2 trees/ha[9]. This is based on studies conducted by Andhra Pradesh Forest Department, 2008.
- Total Culturable Non-Forest land[10] (CNFA) is defined as the net geographical area lying outside recorded forest and forest cover, which can support tree vegetation (excluding areas under wetlands, riverbeds, perennial snow covered mountains, etc.). Thus this area includes all lands other than forests.
- Average standing biomass of CNFA in the project area is 4.59 t/ha. This is based on the following calculations:

[8] FSI, 1996. Fuelwood, Timber and Fodder from Forests of India. Forest Survey of India. Ministry of Environment and Forests, Government of India, 1996.

[9] State of Forest Report, Andhra Pradesh – 2008, Andhra Pradesh Forest Department.

[10] FSI, 2009. http://www.fsi.org.in/sfr2009/glossary.pdf

- Based on the area of CNFA and standing stock of trees outside forests (TOF), the standing biomass per tree is 0.41 t (FSI, 2009[Error! Bookmark not defined.]).
- Thus total standing biomass is 11.2 trees/ha x 0.41 t/tree = 4.59 t/ha

- The mean annual increment is 2.84% of the standing biomass (Shailaja and Sudha,1997[11]). Thus the mean annual increment is 0.13 t/ha/yr.
- The sustainable harvest = mean annual increment = 0.13 t/ha/yr
- Thus the renewable biomass component for CNFA is
  Area (ha) x sustainable harvest (t/ha/yr) = 6,40,329 ha x 0.13 t/ha/yr = 83,507 t/year.

(a) Misc. Tree crops & groves not included in net area sown

- The total area under tree crops is 34,605 ha.
- Sustainable extraction rate is 2 t/ha/hr (Ravindranath *et al*, 2001)[9].
- Total sustainable biomass is 34,605 ha x 2 t/ha/yr = 69,210 t/yr.

Thus summarizing the above steps, Table 3 below shows the renewable biomass available as woody biomass.

**Table 3: Renewable Biomass Calculations for the project area**

| NRB Calculations | | | |
|---|---|---|---|
| **Item** | **Value** | **Unit** | **Source** |
| **RENEWABLE BIOMASS IN THE PROJECT AREA** | | | |
| Total Geographical Area of Visakhapatnam | **11,16,100** | Ha | Hand Book of Statistics 2009, Vishakapatanam District, Chief Planning Officer, Vishakapatanam |
| **I. Renewable biomass from forests** | | | |
| Forest Land | 4,41,166 | Ha | Hand Book of Statistics 2009, Vishakapatanam District, Chief Planning Officer, Vishakapatanam |
| **Renewable biomass extraction from forests** | **9338.34** | **t/yr** | Andhra Pradesh Forest Department |
| **II. Renewable biomass from Culturable non-forest land** | | | |
| Total Culturable Non-Forest land | 6,40,329 | Ha | Hand Book of Statistics 2009, Vishakapatanam District, Chief Planning Officer, Vishakapatanam |
| No of trees/ha of Culturable Non Forest Area | 11.2 | trees/ha | State of Forest Report - 2008 Andhra Pradesh |
| Mean Annual Increment | 2.84% | of standing Biomass | Shailaja and Sudha, 1987 |

[11] 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 | 0.41 | Tonnes | Based on FSI, 2009 report - Indian State of Forest Report |
| Average Standing biomass/ha | 4.59 | Tonnes | Calculated |
| Mean Annual Increment | 0.130 | tonnes/ha | Calculated |
| **Sustainable extraction from trees on CNFA** | **83,507** | **Tonnes** | **Area x sustainable rate of extraction** |
| **III. Renewable biomass from Plantation** | | | |
| Total Plantation area including misc tree crops and groves | 34,605 | Ha | Hand Book of Statistics 2009, Vishakapatanam District, Chief Planning Officer, Vishakapatanam |
| sustainable extraction rate from plantations | 2.00 | t/ha/year | Ravindranath *et al*. 2001 |
| **Sustainable extraction from plantations** | **69,210** | **Tonnes** | **Calculated** |
| **Total Sustainable Biomass Available (MAI)** | **1,64,164** | **tonnes/year** | **From Forests, Plantations and CNFA.** |

Thus, MAI or sum of mean annual increments of the wood species or re-growth in area A is 1,64,164 t/yr.

MAI = 1,64,164 t/yr

The annual harvest of woody biomass has been calculated based on the requirement of fuelwood by the rural and urban population in the district. The actual harvest done by the communities for various purposes other than that sustainably extracted by the Forest Department are not documented. Hence the fuelwood extraction has been derived based on the need of the population. The population of Visakhapatnam (rural and urban) based on 2001 census is given in Table 4. The population of 2010 has been estimated based on the annual growth rate given for India (Table 5).

**Table 4: Population of Visakhapatnam District (Lakhs)**

| **Population 2001 (Lakhs)** | | | **Projected Population 2010 (Lakhs) Based on annual growth rate** | | | **Rural Adult Equivalent Using Fuelwood** | **Urban Adult Equivalent Using Fuelwood** | **Total Adult Equivalent Using Fuelwood** |
|---|---|---|---|---|---|---|---|---|
| **Rural** | **Urban** | **Combined** | **Rural** | **Urban** | **Combined** | | | |
| 23.01 | 15.31 | 38.32 | 26.26 | 17.47 | 43.73 | 19.57 | 11.68 | 31.25 |

Source: Directorate of Economics and Statistics, Visakhapatnam District[1].

**Table 5: Indian Population Growth rate**

| Year | Population growth rate (%) |
|---|---|
| 2001 | 1.55 |
| 2002 | 1.51 |
| 2003 | 1.47 |

| | |
|---|---|
| 2004 | 1.44 |
| 2005 | 1.4 |
| 2006 | 1.38 |
| 2007 | 1.606 |
| 2008 | 1.578 |
| 2009 | 1.548 |
| 2010 | 1.38 |
| Average | **1.479** |

Source: http://www.indexmundi.com/g/g.aspx?c=in&v=24
For 2010 - http://www.indexmundi.com/india/population_growth_rate.html

The adult equivalent for rural and urban population has been estimated based on age group census (Table 6) and standard adult equivalents of 1, 0.85 and 0.5 for male, female and children respectively based on PCIA guidelines (The Partnership For Clean Indoor Air)[12].

**Table 6: Adult and Children Population in Visakhapatnam District**

| **Rural Areas** | | **Urban Areas** | |
|---|---|---|---|
| Male Adult | 28.4% | Male Adult | 31.4% |
| Female Adult | 29.6% | Female Adult | 30.3% |
| Children | 42.1% | Children | 38.4% |

Source: Based on statistics of Hand book of statistics, Visakhapatnam District, 2009. Chief Planning Officer, Visakhapatnam District[1].

Based on a national study conducted by National Sample Survey Organization (NSSO Study), Government of India, 87.1% and 30% of rural and urban households use firewood as the primary source of energy.[13]

| **Household Type** | **% HH** | **Adult Equivalent Population using fuelwood** |
|---|---|---|
| Rural households using Fuelwood | 80.30% | 1,571,753 |
| Urban households using Fuelwood | 30.00% | 350,341 |
| **Total** | | **1,922,094** |

Accordingly, a total of 1,922,094 adult population use fuel wood for cooking and heating water. Based on fuel wood survey conducted for the project area, the fuel wood use/capita is 0.95 t/capita/yr. Accordingly the annual harvest of woody biomass for fuel wood is 1,825,989 t/yr (Table 7).

Thus H = 1,825,989 t/year.

[12] http://www.pciaonline.org/files/KPT_Version_3.0_0.pdf

[13] NSSO 2007. Energy Sources of Indian Households for Cooking and Lighting, 2004-05 National Sample Survey Organisation Ministry of Statistics and Programme Implementation Government of India, 2007

Table 7: Fuelwood requirement for Visakhapatnam District

| FUELWOOD REQUIREMENT FOR VISAKHTNAM DISTRICT | | | |
|---|---|---|---|
| Adult Equivalent using Fuelwood | 1,922,094 | Adult Equivalent | Hand Book of Statistics 2009, Vishakapatanam District, Chief Planning Officer, Visakhapatnam |
| Fuelwood requirement per adult | 0.95 | tonnes/year | Based on household survey |
| **Total fuelwood requirement (H)** | **1,825,989** | **tonnes/year** | **Calculated** |

The NRB or non renewing biomass or excess harvest over and above re-growth, which in the amount of woody biomass removed with attendant $CO_2$ emissions which are not absorbed by re-growth is

NRB = H - MAI = 1,825,989 – 162,055 = **16,63,934 t/yr**.

Xnrb = (NRB/H) =16,63,934/1,825,989 **= 0.91**

**Table 8: Fraction of Non-renewable Biomass used in the project area**

| Renewable Woody Biomass (DRB) | | | |
|---|---|---|---|
| Renewable Woody Biomass (MAI) | **162,055** | **tonnes/year** | **Calculated** |
| **Non Renewable Woody Biomass (NRB)** | | | |
| Non Renewable Woody Biomass (NRB) | **1,663,934** | **tonnes/year** | **Calculated** |
| **Fraction of non-renewable biomass ($f_{NRB,y}$)** | | | |
| Xnrb | **0.91** | | **Calculated** |

**The fraction of non-renewable woody biomass is 0.91.**

According to the methodology, the fraction of Xnrb has to be assessed for the different types of Reachable Collection Area. A qualitative approach has been taken, wherein it is assumed that renewable biomass is first harvested from all the land use and the Xnrb derived for the land use (A) at the district level. Thus this approach is conservative.

**Complementary studies for non-renewable biomass**

To complement the survey results, other national and local studies have been provided.

- According to the National Forestry Action-Programme India, Ministry of Environment and Forests, Govt. of India,[14] "the per capita availability of forestland in India is one of the lowest in the world, 0.08 hectares, against an average of 0.5 hectares for developing countries and 0.64 hectares for the world. The consumption of fuelwood in India is about five times higher than what can be sustainably removed from forests. The bulk of wood consumed in India is for burning.

[14] http://envfor.nic.in/nfap/pressure-forest.html

Woody biomass meets about 40 per cent energy needs of the country. The estimated fuelwood consumption in the country is about 380 million cum. About 70 percent of the fuel-wood is accounted for by households. Around 80 percent of the rural people and 48 per cent of urban people use fuel-wood."

- The Forest Survey of India, Ministry of Environment and Forests, Govt. of India conducted a study on demand and supply of fuelwood, timber and fodder in India"[15]. Projection of annual fuelwood and its sustainable availability has been determined at the state level. According to the study, in Andhra Pradesh State, the total annual consumption of woody biomass during 2006 is 13.7 million tonnes of which only 1.4 million tonnes is sustainably available. Thus at the state level, the non-renewable woody biomass accounts for 0.90.

- A study was conducted on the demand and supply of timber, poles and firewood in the state of Andhra Pradesh by Institute of Wood Science and Technology for the Andhra Pradesh Department[16]. According to the study, the demand and supply for the state is as follows:

| | **2000** | **2005** | **2010** | **2015** | **2020** |
|---|---|---|---|---|---|
| Projected total annual consumption in million tonnes | 13.37 | 13.78 | 14.20 | 14.63 | 15.07 |
| Annual availability of woody biomass (forests, farm forestry, plantations) | 1.28 | 1.29 | 1.30 | 1.30 | 1.30 |
| Non Sustainable Wood Use | 12.09 | 12.49 | 12.90 | 13.33 | 13.77 |
| **Fraction of Non renewable biomass Xnrb** | **0.90** | **0.91** | **0.91** | **0.91** | **0.91** |

- The Xnrb calculated for the District of the project area is in agreement with other studies.

**Conservativeness**

Based on Xnrb derived for the district and that derived for the state for 2010, the value of 0.91 has been considered for the project area.

**Step 1.4: Divide pilot Sales Record into customer groups or clusters**

Based on the baseline and project database, the population cluster shows only one type of cluster or group.

- One SARALA stove will be provided per family that will be used for domestic cooking and heating water. The fuel type used is ONLY Woody biomass.

**Step 1.5: Carry out a qualitative survey (Kitchen Survey)**

[15] FSI, 1996. Fuelwood, timber and fodder from forests of India: Demand and Supply of Fuelwood, Timber and Fodder in India. Forest Survey of India, MoEF, Govt. of India.

[16] Satanarayana Rao, K. et al., Study on demand and supply of Timber, Poles and Firewood in the State of Andhra Pradesh. Institute of Wood Science and Technology, Bangalore. Prepared for Andhra Pradesh Forest Department.

The purpose of the survey was to define clusters or groups with homogeneous emission reduction characteristics and to quantify the emission reduction which is achieved by the implementation of SARALA Improved Cook Stoves.

The KS, followed by KT surveys, observations and analysis were undertaken by staff of LAYA and the Technical Team of Fair Climate Network (FCN). The questionnaires for household surveys, demographic surveys, fuelwood usage were designed according to the requirement of the methodology and field tested. Based on the field tests, the questionnaires was modified and finalized for the survey.

**Sample Selection and Survey**

The survey was carried out in Paderu and Pedabayalu Mandals in Paderu division, Vishakhapatnam district, Andhra Pradesh, India, among the tribal people who use fuel wood collected from the nearby forests. Women, the main stakeholder were interviewed to collect household level information.

A simple random technique was employed to select the households from the data available in LAYA NGO. Here none of the households has telephone connections because they are all located in remote villages in hilly regions and far from the main telephone exchanges. Also they are too poor to have telephonic connections at homes. The homes only contain the basic minimum for a living. All the interviews were conducted face to face in the houses, which were part of the survey.

A kitchen Survey (KS) was carried out in 116 randomly selected households in the project area. In addition, 4051 households were identified and surveyed in which SARALA stoves will be built. The sample size is justifiable based on the methodology, wherein for a group size of greater than 1000, a minimum of 100 has to be sampled.

For the Kitchen Survey and Kitchen Test, 116 beneficiary households were selected, wherein SARALA improved cook-stove were constructed. The study was conducted in the project area from 4 representative villages of Boddaput, Donela and Jamadala from Paderu Mandal and Urrugunda from Pedabayalu Mandal (Table 9).

**Table 9: Details of the project area in which the Kitchen Survey and Tests was conducted**

| Mandal | Villages | | | | |
|---|---|---|---|---|---|
| | Boddaput | Donela | Jamadala | Urrugunda | Total |
| Paderu | 48 | 16 | | 34 | 98 |
| Pedabayalu | | | 18 | | 18 |
| **Total** | **48** | **16** | **18** | **34** | **116** |

The households were selected for their willingness and enthusiasm to cooperate for the tests. It was also based on the time frame, wherein qualitative and quantitative tests could be conducted during the chosen time. The households were selected based on the following criteria: the traditional cook-stove was replaced completed by SARALA stove; beneficiaries who fully completed their stoves and were using them for cooking and hot water bath on a daily basis. In fact, the houses are so small, that the traditional stoves were destroyed to be replaced with SARALA stoves. The survey was done jointly by the staff of

the NGO – LAYA Resource Centre, Fair Climate Network (FCN) Technical Team and village level volunteers.

The households were visited and interviewed by trained project staff from 12/11/2010 to 06/12/2010. The interview team consisted of 75 data collectors, 3 supervisors who were also involved in data collection and 1 coordinator.

For the interviews, the "Questionnaire for Kitchen Survey" (Annex 2) was designed, field tested and then finalized. It was compiled and translated into the local language Telugu for the data collectors/village volunteers so that they would be able to use them at the time of interview. Collected data was entered by LAYA staff into Microsoft Excel. The results of Kitchen Survey resulted in the following recommendations for delineation of the clusters.

***Clustering:*** The questionnaire was well designed to enquire about the use of different biomass for cooking during all seasons throughout the year. All households stated to use ONLY wood. It is not a practice among the tribals in this region to use agricultural residues, dung and/or agricultural residues or a combination of these fuel types. None of the fossil fuels i.e. Kerosene, LPG, Coal, etc. are also used for cooking. Thus 100% of all households use only wood throughout the year in all seasons for cooking and heating water. With the introduction of the improved SARALA cook-stove, they will continue to use only wood and there will be no shift in type of fuelwood use. This is also substantiated by Baseline Household Survey conducted for 4051 households.

Culturally, the tribes live amidst forests, using wood for cooking. The reason for not using agricultural residue is that the tribes predominantly practice Podu or shifting cultivation far off on the hill tops. On an average, each family has one hectare of land on all hill slopes for the purpose of shifting cultivation. The method of shifting cultivation includes four stages. In the first stage the tribal farmer select the field on the hill slope or on the hill top, where there is good growth of trees and bushes. Later, the area is cleared off the bushes, cutting off trees and undergrowth and left on the field for about ten to fifteen days to dry up. It is burnt and the ash remains on the field. During monsoon, in the month of May or June the tribal farmers prepare the podu plots for cultivation and sow the seeds in the field without adding any additional manure except the ash which remains in it. Generally the tribal farmers grow mixed crops like millets, pulses and oil seeds in podu plots without weeding. The tribal farmers get very low yields from the crops which they raise in the podu plots. Podu plots are cultivated for one or two years and then it left fallow for another two or three years. Then a new plot shall be selected on the hill slope of forested zone. The rotation of podu plots is a common feature, in the methods of shifting cultivation. Some of the tribal families take up settled cultivation also, simultaneously in addition to podu cultivation. Thus crop residues are used as fodder, manure and burnt on field. It is not at all used as fuelwood.

***Conclusion:*** Only one cluster is demarcated covering fuel consumption patterns of the project population. The cluster is defined as a household using wood for cooking.

***Adjustment factor for seasonal and weekend variations:*** The survey was done on days, wherein normal cooking was done for the family members. Days of festival, cooking for guests, etc. have not been included. The survey also does not include the special days wherein extra meals would be cooked for festivals and guests. Space heating is done separately. The stove is not used for space heating and hence

there will not be large variation in fuel wood use between seasons for space heating. Thus no adjustment factor has been applied for seasonal and weekend variations.

***Conclusion:*** The adjustment factor would need to consider the reduction of fuel wood use in summer. We do not expect a large variation in fuel wood consumption, as SARALA will continue to be used for cooking and water heating and is not used for space heating. Also we will have to take into consideration the extra fuelwood that will be used during festivals and guests at home. Nearly there are 47 festival days[17] in a year during which, the fuelwood consumption would be more. Thus considering these issues, no adjustment factor has been applied. But, to verify season variation in fuel wood consumption, Kitchen Test for fuel wood use will be done during the first Verification Period during monsoon and summer in sample households. This will be included in the First Verification Report.

***Leakage effects:*** Potential leakage effects may arise from use of the old stove instead of improved stove, cooking more food on the new stove, and from use of stove for space heating or lighting purposes. In all the households, SARALA was constructed after destroying the old traditional cook stove. It is constructed at the same place of the old cook-stove. Furthermore, the cooking pattern is not changing with the SARALA cook-stove.

***Conclusion:*** Thus it can be concluded leakage is negligible.

Different forms of leakage as outlined in the methodology are discussed in details in the following section.

**Step 1.6: Refine demarcation of clusters and populate Project Database**

Based on the results of the Kitchen Survey and the demographic survey of 4051 identified households, there was no need to define additional clusters for the project. The original cluster as described in Step 1.4 is therefore chosen as the appropriate cluster for the project activity.

**2. Calculate baseline emissions**

The fuelwood use was converted to GHG emissions using emission factors derived from the Good Practice Guidance of the IPCC, 2006. This is based on the actual kitchen tests done in the project area. The baseline emissions are estimated by multiplying the average fuel usage found by the KT's for the cluster with emission factors.

Based on the KS;

1. Fuel Type: The primary fuel is woody biomass. No other secondary fuel is used by the tribal communities.
2. All cooking during the tests were done with woody biomass. Since no other secondary fuel is being used by the tribal people throughout the year, the fraction of secondary fuels is zero and kept so throughout the project period.

[17] http://festivals.tajonline.com/

3. There are no fuel and stove-type mixing in the project area.

There are no other emissions directly or indirectly being resulted due to wood fuel combustion which will be avoided or introduced by the project activity.

Thus approach 2 is used for baseline calculations for the project activity, which is specific to only one major fuel type. No other fuel type has been attributed as fractions to wood use as secondary fuels are nil.

**Step 2.1: Estimate expected variation and improvement in emission reductions**

Based on the methodology, the sample size was determined as 100. Since the project area encompasses a single cluster, the sample survey was done on 116 households. Paired sampling for fuel wood use was conducted, for pre- and post-SARALA improved cook-stove cooking regimes. A confidence interval of ±10% from the sample mean was considered.

**Step 2.2: Specify the Units of emission reduction or fuel consumption**

- The unit of fuelwood consumption is t/family/yr.
- The unit of emission reduction is $tCO_2$/family/yr.

**Step 2.3: Make quantitative measurements (Kitchen Tests)**

The Kitchen Tests was targeted at the people who are Tribal Communities who use fuel wood for cooking food, heating water which is collected from the forests under both cooking regimes i.e. traditional and Improved Cook Stove (SARALA Model).

The survey revealed that no clustering was required since the project is implemented in a homogeneous environment where there is no deviation in the pattern of using the stoves as well as collection of fuel wood from forests.

Based on the quantitative KS and also the survey of all the households in which the project will be implemented, only one cluster was identified – SARALA stove of a single model for domestic use using wood as the fuel.

Thus baseline emissions were measured for the identified cluster in 116 sample households. The Kitchen Test measurements were applied to both the baseline and project scenarios.

With the data collected, an expert statistical analysis of the GHG emission reductions of each household was conducted to determine at a 90% confidence level the range of values within which the mean reduction lies. Paired samples were taken, that is, pre- and post-installation consumption was compared in the same houses to reduce variability due to external factors other than stove installation and result in a narrower 90% confidence interval than when non-paired samples are taken. Based on the KS, there are no seasonal changes in fuel mix. Space heating is done separately. The traditional stove is not used for space heating.

The quantitative KS or Kitchen Test measurements were conducted to assess factors that affect the quantity of GHG emissions.

From the results of KTs, the expected emissions reductions and variations were calculated as follows:

- Based on the 3 days KT tests in the baseline and after construction of SARALA cook-stove, the yearly fuel wood usage in the baseline and project scenario for the 116 households was calculated at household level.
- Based on the survey, the fuel wood consumption/HH/yr is as follows:

| **Activity Data** | **Value** |
|---|---|
| $B_{gross,bl}$ (t/household /yr) | 3.23±0.18 |
| $B_{pj,y}$ (t/household/yr) | 2.42±0.14 |
| Mean Change @ 90% lower bound | 0.77 |
| **% Reduction** | **25.18%** |

This KT result is in agreement with a study conducted by Jagadish (2004), wherein it SARALA Improved cook-stove has an efficiency varying from 25-30%.[18]

**Step 2.4: Calculate baseline**

For calculations of the baseline emissions, approach 2 was chosen wherein

$$BEy = X_{nrb,bl,y} \cdot B_{gross.bl} \cdot (1 - \Sigma X_{re,bl,i,y} - \Sigma X_{af,bl,i,y}) \cdot EF_{bl,bio,co2} + \Sigma(X_{af,bl,i,y} \cdot (CEU/\varepsilon_{af,bl,i}) \cdot EF_{af,co2,i(ebasis)}) + \Sigma(\text{Non-}CO_2 \text{ emissions during cooking}) + \Sigma(\text{GHG emissions during production of the fuels}) \text{ .....Eqn B.2a}$$

Non-$CO_2$ emissions during cooking

$$= \Sigma (B_{gross.bl} \cdot (1-\Sigma X_{re,bl,i,y} - \Sigma X_{af,bl,i,y}) \cdot EF_{bl,bio,non-co2} + \Sigma(X_{af,bl,i,y} \cdot (CEU/\varepsilon_{af,bl,i}) \cdot EF_{af,non-co2,i(ebasis)}) \text{ ..... .Eqn B.2b}$$

GHG emissions during production of the fuels

$$= X_{nrb} \cdot B_{gross.bl} \cdot (1 - \Sigma X_{re,bl,i,y} - \Sigma X_{af,bl,i,y}) \cdot EF_{bl,bio,prod,co2} + \Sigma(X_{af,bl,i,y} \cdot (CEU/\varepsilon_{af,bl,i}) \cdot EF_{af,prod,co2,i}) + \Sigma(B_{gross.bl} , (1- X_{re,bl,i,y} - X_{af,bl,i,y}) \cdot EF_{bio,prod,non-co2,i}) + \Sigma(X_{af,bl,i,y} \cdot (CEU/\varepsilon_{af,bl,i}) \cdot EF_{af,prod,i}) \text{.....Eqn B.2c}$$

[18] Jagadish, 2004. The development and dissemination of efficient domestic cook stoves and other devices in Karnataka. Current Science, Vol. 87, No. 7, 10, October 2004. http://www.ias.ac.in/currsci/oct102004/926.pdf

Where:

$BE_y$ = baseline emissions in year y (in tonnes $CO_{2e}$ per year) specific to cluster and Unit Chosen

$X_{nrb,bl,y}$ = the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the baseline scenario

$B_{gross,bl}$ = the annual mass of woody biomass consumed during cooking in the baseline (in tones wood per year) in conditions where no other fuel is used for cooking (ie this mass provides the gross amount of energy utilized for cooking)

$X_{re,bl,i,\ y}$ = percentage of woody biomass combustion avoided due to a renewable energy form i identified as part of the baseline scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2.

$EF_{bl.bio,co2}$ = the $CO_2$ emission factor for use of the biomass fuel in the baseline scenario in tonnes $CO_2$ per tonne fuel

$X_{af,bl,i,y}$ = percentage of woody biomass avoided due to alternative fuels i (such as fossil fuels and dung) identified as part of the baseline scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels (approach 3). Otherwise this percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2.

$CEU = B_{gross,bl} \cdot NCV_{bio} \cdot \varepsilon_{tradbiomass}$ = The cooking energy utilized, in GJ…. Eqn B.2d

Where

$NCV_{bio}$ = Net calorific value of woody biomass in MJ/kg or GJ/tonne

$\varepsilon_{tradbiomass}$ = efficiency of a traditional biomass stove in the baseline scenario (measured by baseline study or default 20%) / alternative fuel stove efficiency (in absence of specific baseline data the default values of 20% for traditional biomass cook-stoves and 50% for fossil fuel stoves may be taken)

$EF_{af,co2,i(basis)}$ = The $CO_2$ emission factor for use of the alternative fuel i in the project in tonnes of $CO_2$ per GJ fuel

$\varepsilon_{af,bl,i}$ = efficiency of the stove burning alternative fuel i in the baseline scenario (measured by baseline study or default 50% for fossil fuels)

$EF_{bl.bio,non\text{-}co2,i}$ = Emission factor for GHG gas i in the baseline scenario in units of tones gas per tonne wood-fuel

$EF_{af,i,non\text{-}co2\ gas,i}$ = Non-$CO_2$ emission factor during cooking for alternative fuel i for GHG gas i in tonnes gas per tonnes fuel

$Ef_{bio,prod,co2}$ = $CO_2$ Emission factor for wood-fuel during production in tonnes gas per tonnes fuel

$Ef_{af,prod,co2,I}$ = $CO_2$ Emission factor for fuel i during production in tonnes gas per tonnes fuel

$EF_{bio,prod,non\text{-}co2\ gas\ i}$= Non-$CO_2$ Emission factor for wood-fuel during production in tonnes gas per tonne fuel

$Ef_{af,i,prod,non\text{-}co2\ gas,i}$ = Non-$CO_2$ Emission factor alternative fuel i for GHG gas i during production in tonnes gas per tonnes fuel

**5. Project Emissions**

The 3750 SARALA improved cook-stoves will be installed progressively over a project period of 12 months, thus within a short start-up period.

Data relating to project emissions are collected following the baseline procedure described in the previous section. But the KS and KT are applied to improved cook-stove users.

Approach 2 is applied for the single cluster as described in the baseline scenario.

$$PE_y = X_{nrb} \cdot B_{gross,pj} \cdot (1 - \Sigma X_{re,pj,i,y} - \Sigma X_{af,pj,i,y}) \cdot EF_{pj.bio,co2}$$
$$+ \Sigma\ (X_{af,pj,i,y} \cdot (CEU / \varepsilon_{af,pj,i}) \cdot EF_{af,co2,,i(ebasis)})$$
$$+ \Sigma\ (\text{Non-}CO_2 \text{ emissions during cooking})$$
$$+ \Sigma\ (\text{GHG emissions during production of the fuels}) \quad \ldots\ldots\ldots \text{Eqn P.2a}$$

Non-$CO_2$ emissions during cooking

$$= \Sigma\ (B_{gross,pj} \cdot (1 - \Sigma X_{re,pj,i,y} - \Sigma X_{af,pj,i,y}) \cdot EF_{pj.bio,non\text{-}co2,i})$$
$$+ \Sigma\ (X_{af,pj,i,y} \cdot (CEU / \varepsilon_{af,pj,i}) \cdot EF_{af,i,non\text{-}co2\ gas\ i}) \quad \ldots\ldots\ldots \text{Eqn P.2b}$$

GHG emissions during production of the fuels

$$= X_{nrb} \cdot B_{gross,pj} \cdot (1 - \Sigma X_{re,pj,i,y} - \Sigma X_{af,pj,i,y}) \cdot EF_{bio,prod,co2}$$
$$+ \Sigma (X_{af,pj,i,y} \cdot (CEU / \varepsilon_{af,pj,i}) \cdot EF_{af,prod,co2,i})$$
$$+ \Sigma\ (B_{gross,pj} \cdot (1 - \Sigma X_{re,pj,i,y} - \Sigma X_{af,pj,i,y}) \cdot EF_{bio,prod,non\text{-}co2,i})$$
$$+ \Sigma (X_{af,pj,i,y} \cdot (CEU / \varepsilon_{af,pj,i}) \cdot EF_{af,prod,non\text{-}co2,i}) \quad \ldots\ldots\ldots \text{Eqn P.2c}$$

Where (noting that parameters common to baseline equations are not repeated):

$B_{gross,pj}$ = the annual mass of woody biomass consumed during cooking in the project (in tonnes wood per year) in conditions where no other fuel is used for cooking (ie this mass provides the gross amount of energy utilized for cooking)

$X_{re,pj,i,y}$ = percentage of woody biomass combustion avoided due to a renewable energy form i identified as part of the project scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart)/2.

$X_{af,pj,i,y}$ = percentage of woody biomass combustion avoided due to alternative fuels i (such as fossil fuels and dung) identified as part of the project scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2. This percentage can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels and it is shown that the effect is a conservative estimate of emission reductions.

$EF_{af,co2j,i\ (ebasis)}$ = The $CO_2$ emission factor for use of the alternative fuel i in the project in tones of $CO_2$ per GJ fuel

CEU = The cooking energy utilized, in GJ, as calculated in baseline calculation.

**6. Leakage**

a) One of the pre-condition for installation of SARALA cook-stove will be that the traditional cook-stove will be destroyed before installation of SARALA cook-stove. The users will not use the traditional cook-stoves any more after the installation of SARALA cook-stove. Thus the inefficient stoves will not be used any more. Leakage due to rebound effect will not be applicable.
b) The project activity will not stimulate increased use of a high emission fuel either for cooking or for other purposes outside the project boundary. The traditional cook-stoves that are being replaced are being used only for domestic purposes and will continue to do so in the project scenario. There will not be an increase in the NRB consumption.
c) The project activity does not stimulate substitution of a cooking fuel or stove type with relatively higher emissions by households commonly using cooking fuel or stove type with relatively lower emissions.
d) The project population will not introduce any new device or any form of heating or use of inefficient for space heating. The previous practices will continue as it is with only change in the stove type.
e) The traditional cook-stove will be completely destroyed and will not be reused outside the boundary.
f) The SARALA cook-stove will be built from clay and mud available locally. It will not involve transportation. The chimneys and grate will be transported from near-by town to the project area. These emissions are very small and negligible.
g) The non-renewable biomass saved will not be used by non-project households/users. Similar pattern of fuel wood use is followed in the tribal region, as fuel wood is the only source of biomass for cooking and heating water.

h) The non-renewable biomass saved under the project activity will not be used to justify the baseline of other project activities.

Thus leakage is considered to be insignificant is this project activity.

Thus $LE_{i,y} = 0$

## 7. Emission reduction

The overall reductions of GHG induced by the project are calculated as follows:

$$ER_y = \Sigma BE_{i,y} - \Sigma PE_{i,y} - \Sigma LE_{i,y} \text{.....Eqn ER.1a}$$

Where:

$ER_y$ = Emission reduction in total project population in year y ($tCO_{2e}$/yr)
$BE_{i,y}$ = Baseline emissions of cluster i in year y ($tCO_{2e}$/yr)
$PE_{i,y}$ = Project emissions of cluster i in year y ($tCO_{2e}$/yr)
$LE_{i,y}$ = Leakage of cluster i in year y ($tCO_{2e}$/yr)

Within each cluster the emissions are calculated thus:

$BE_{i,y} = N_{i,y} . PE_y$ ……Eqn ER.1b
$PE_{i,y} = N_{i,y} . BE_y$ ……Eqn ER.1c

Where $PE_y$ and $BE_y$ are calculated as set out in equations 1 to 4 above, and:

$N_{i,y}$ = the number of Units in cluster i

## B.5 Emission reductions:

### B.5.1. Explanation of methodological options or description of new proposed approach:

Gold Standard Methodology for Improved Cook-stoves and Kitchen Regimes V.02 – 08/02/2010 Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes is applicable to the proposed project, because the following conditions apply:

- Low emission cook-stove SARALA will replace the traditional high-emission baseline scenario. Here the emphasis will be to replace the old stove will the new SARALA stove and not to be used in parallel with the new stoves. This will be one of the pre-condition for the construction of SARALA in the place of old stoves.
- The project boundary is clearly defined as shown in Appendix 1. This will not be included in any other voluntary market of CDM project. Thus no double counting will take place from the project activity.
- The project is located in a single country – INDIA
- The SARALA stove will be only one number per family. Thus 3,750 SARALA stoves will be built for 3,750 families in the project boundary. Thus it does not number more than ten per kitchen. The continuous useful energy output is less than 50 kW as shown in section A (defined as total energy delivered usefully from start to end of operation divided by time of operation).

**B.5.2. Data and parameters that are available at validation:**

| **Data / Parameter:** | $X_{nrb,bl,y}$ |
|---|---|
| Data unit: | Fraction |
| Description: | the non-renewable fraction of the woody biomass harvested in the project collection area in year y in the baseline scenario |
| Source of data to be used: | Calculated in the PDD |
| Value of data | 0.91 |
| Description of measurement methods and procedures to be applied, inc. frequency: | The factor of non-renewable biomass was calculated based on secondary sources of data using EB 23 Annex 18 definition of "renewable biomass". |
| QA/QC procedures to be applied: | This is substantiated by a state level study wherein the non-renewable biomass is estimated to be 0.91. |
| Any comment: | Though a value of 0.92 was derived at the district level, for conservativeness, the state level fraction of 0.91 is considered for the PDD. According to the methodology, this will be reassessed two years once. |

| **Data / Parameter:** | $EF_{bl,bio,co2}$, $EF_{pj.bio,co2}$ |
|---|---|
| Data unit: | tonnes $CO_2$ per tonne fuel |
| Description: | the $CO_2$ emission factor for use of the biomass fuel in the baseline scenario and project scenario respectively |
| Source of data to be used: | 2006 IPCC guidelines for National Greenhouse Gas Inventories |
| Value of data | 1.7472 $tCO_2$/t of wood |
| Description of measurement methods and procedures to be applied, inc. frequency: | Default IPCC values for wood/wood waste are applied to calculate the emission factor. |
| QA/QC procedures to | |

| | |
|---|---|
| be applied: | |
| Any comment: | Fixed for the crediting period |

| | |
|---|---|
| **Data / Parameter:** | $EF_{bl.bio,non-co2,i}$ , $EF_{pj.bio,non-co2,i}$ |
| Data unit: | tonnes $CO_{2e}$ gas per tonne wood-fuel |
| Description: | Emission factor for GHG gas i in the baseline scenario and project scenario respectively |
| Source of data to be used: | 2006 IPCC guidelines for National Greenhouse Gas Inventories |
| Value of data | 0.1176 $tCO_2$/t of wood |
| Description of measurement methods and procedures to be applied, inc. frequency: | Default IPCC values for $CH_4$ and $N_2O$ emissions for wood/wood waste are applied to calculate the emission factor. The Global Warming Potential (GWP) value of 21 and 310 are applied for $CH_4$ and $N_2O$ respectively to attain $CO_2$ equivalent or $CO_{2e}$. |
| QA/QC procedures to be applied: | |
| Any comment: | Fixed for the crediting period |

| | |
|---|---|
| **Data / Parameter:** | $B_{gross,bl}$ |
| Data unit: | tonnes/family/yr |
| Description: | the annual mass of woody biomass consumed during cooking in the baseline (in tonnes wood per year) in conditions where no other fuel is used for cooking (i.e this mass provides the gross amount of energy utilized for cooking) |
| Source of data to be used: | Kitchen Test in 116 households |
| Value of data | Based on the Kitchen Tests for 116 families. See Table 10 for the values used for each of the family. |
| Description of measurement methods and procedures to be applied, inc. frequency: | Based on Kitchen Test. |
| QA/QC procedures to be applied: | |
| Any comment: | Fixed for the crediting period |

| | |
|---|---|
| **Data / Parameter:** | $X_{re,bl,i,y}$ |
| Data unit: | % |
| Description: | Percentage of woody biomass combustion avoided due to a renewable energy form i identified as part of the baseline scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2. |
| Source of data to be | Based on Kitchen Test and Baseline Survey for 4051 families in the project area. |

| | |
|---|---|
| used: | |
| Value of data | 0 |
| Description of measurement methods and procedures to be applied, inc. frequency: | Based on Kitchen Test. |
| QA/QC procedures to be applied: | |
| Any comment: | Set for the entire crediting period |

| **Data / Parameter:** | $X_{af,bl,i,y}$ |
|---|---|
| Data unit: | % |
| Description: | percentage of woody biomass avoided due to alternative fuels i (such as fossil fuels and dung) identified as part of the baseline scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels (approach 3). Otherwise this percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2. |
| Source of data to be used: | Based on Kitchen Test |
| Value of data | 0 |
| Description of measurement methods and procedures to be applied, inc. frequency: | |
| QA/QC procedures to be applied: | |
| Any comment: | Set for the entire crediting period |

| **Data / Parameter:** | CEU |
|---|---|
| Data unit: | GJ |
| Description: | The cooking energy utilized |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |

| | |
|---|---|
| Any comment: | |

| | |
|---|---|
| **Data / Parameter:** | $\varepsilon_{af,bl,,i}$ |
| Data unit: | % |
| Description: | efficiency of the stove burning alternative fuel i in the baseline scenario (measured by baseline study or default 50% for fossil fuels) |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| | |
|---|---|
| **Data / Parameter:** | $EF_{af,co2,i(ebasis)}$ |
| Data unit: | tonnes of $CO_2$ per GJ fuel |
| Description: | The $CO_2$ emission factor for use of the alternative fuel i in the project in tonnes of $CO_2$ per GJ fuel |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| | |
|---|---|
| **Data / Parameter:** | $EF_{af,i,non-co2,i(ebasis)}$ |
| Data unit: | tonnes of $CO_2$ per GJ fuel |
| Description: | The non-$CO_2$ emission factor for use of the alternative fuel i in the project in tonnes of $CO_2$ per GJ fuel |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods | N/A |

| | |
|---|---|
| and procedures to be applied, inc. frequency: | |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $EF_{bl,bio,prod,co2}$ |
|---|---|
| Data unit: | tonnes gas per tonnes fuel |
| Description: | $CO_2$ Emission factor for wood-fuel during production in tonnes gas per tonnes fuel |
| Source of data to be used: | N/A |
| Value of data | Not considered as there is no GHG emission during production of wood fuel. |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $EF_{af,prod,co2,i}$ |
|---|---|
| Data unit: | tonnes gas per tonnes fuel |
| Description: | $CO_2$ Emission factor for fuel i during production in tonnes gas per tonnes fuel |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $EF_{bio,prod,non-co2,i}$ |
|---|---|
| Data unit: | tonnes gas per tonnes fuel |
| Description: | Non-$CO_2$ Emission factor for wood-fuel during production in tonnes gas per tonne fuel |
| Source of data to be used: | N/A |
| Value of data | Not considered as there is no GHG emission during production of wood fuel. |

| | |
|---|---|
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $EF_{af,prod,non-co2,i}$ |
|---|---|
| Data unit: | tonnes gas per tonnes fuel |
| Description: | Non-$CO_2$ Emission factor alternative fuel i for GHG gas i during production in tonnes gas per tonnes fuel |
| Source of data to be used: | N/A |
| Value of data | Not considered as there is no GHG emission during production of wood fuel. |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $B_{gross,pj}$ |
|---|---|
| Data unit: | Tonnes of wood/year |
| Description: | the annual mass of woody biomass consumed during cooking in the project (in tonnes wood per year) in conditions where no other fuel is used for cooking (ie this mass provides the gross amount of energy utilized for cooking) |
| Source of data to be used: | Kitchen Test on 116 households. |
| Value of data | Based on the kitchen test for 116 families. See Table 10 for the values used. |
| Description of measurement methods and procedures to be applied, inc. frequency: | Based on Kitchen Test. |
| QA/QC procedures to be applied: | |
| Any comment: | Fixed for the crediting period. Will be adjusted based on aging stove Kitchen Test |

| **Data / Parameter:** | $X_{re,pj,i,y}$ |
|---|---|
| Data unit: | % |
| Description: | percentage of woody biomass combustion avoided due to a renewable energy form i identified as part of the project scenario, allowing that the sum of Xre and |

| | |
|---|---|
| | Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart)/2. |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $X_{af,pj,i,y}$ |
|---|---|
| Data unit: | % |
| Description: | percentage of woody biomass combustion avoided due to alternative fuels i (such as fossil fuels and dung) identified as part of the project scenario, allowing that the sum of Xre and Xaf cannot exceed 100%. This percentage should be provided for each year of the project in order to reflect trends. In cases where the trend throughout the project period is less than 20%, a single average value can be given calculated as X = (Xend – Xstart) / 2. This percentage can be set to zero in cases where the KT is appropriately designed to subsume alternative fuels and it is shown that the effect is a conservative estimate of emission reductions |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $\varepsilon_{af,pj,i}$ |
|---|---|
| Data unit: | % |
| Description: | efficiency of the stove burning alternative fuel i in the project scenario (measured by baseline study or default 50% for fossil fuels) |
| Source of data to be used: | N/A |

| | |
|---|---|
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $EF_{af,co2,,i(ebasis)}$ |
|---|---|
| Data unit: | tonnes of CO2 per GJ fuel |
| Description: | The CO2 emission factor for use of the alternative fuel i in the project in tonnes of CO2 per GJ fuel |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

| **Data / Parameter:** | $EF_{af,i,non-co2\ gas\ i}$ |
|---|---|
| Data unit: | tonnes of CO2 per GJ fuel |
| Description: | Non-CO2 Emission factor during cooking for alternative fuel i for GHG gas i in tonnes gas per tonnes fuel |
| Source of data to be used: | N/A |
| Value of data | Not considered as alternative fuel in not used in the project area. Wood is the only fuel used in the project area |
| Description of measurement methods and procedures to be applied, inc. frequency: | N/A |
| QA/QC procedures to be applied: | |
| Any comment: | |

## B.5.3 Ex-ante calculation of emission reductions:

**Determination of Emission Factors**

| Activity Data | Value | Source of Data | Units |
|---|---|---|---|
| Emission Factor for Wood | 112000 | GPG, IPCC 2006 | kg $CO_2$/TJ NCV |
| NCV | 15.6 | GPG, IPCC 2006 | TJ/Gg |
| Emission Factor for Wood | 1747200 | Calculated | kg$CO_2$/Gg |
| **Emission Factor for Wood** | **1.7472** | **Calculated** | **t$CO_2$/t** |

| Activity Data | IPCC Values | Source of data | Units |
|---|---|---|---|
| Emission Factor ($CH_4$) | 300 | GPG, IPCC 2006 | kg$CH_4$/TJ NCV |
| Emission Factor ($N_2O$) | 4 | GPG, IPCC 2006 | kg$N_2O$/TJ NCV |
| NCV | 15.6 | GPG, IPCC 2006 | TJ/Gg |
| Emission Factor ($CH_4$) | 0.0983 | Calculated (GWP = 21) | t$CO_2$eq/t |
| Emission Factor ($N_2O$) | 0.0193 | Calculated (GWP = 310) | t$CO_2$eq/t |
| **Emission Factor (non-$CO_2$)** | **0.1176** | **Calculated** | **t$CO_2$eq/t** |

Based on the guidance of the methodology, the emission reduction values were derived on a per unit basis directly from KT tests based on the paired kitchen data. The values of BE and PE for each of the kitchen is as follows:

**Table 10: Emission Reduction Calculations at the family level based on Kitchen Test.**

| Sl No | Mandal | Village | Name | Adult equivalent | Bgross,bl (t/year/HH) | BEy | Bpj,y (t/year/yr) | PEy | ERy |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Paderu | Donela | Koda. Lingannadora | 3.35 | 2.31 | 3.95 | 1.70 | 2.91 | 1.04 |
| 2 | Paderu | Donela | K.Subbarao | 3.85 | 2.37 | 4.05 | 1.70 | 2.91 | 1.14 |
| 3 | Paderu | Donela | K.Kothanndora | 3.35 | 2.74 | 4.67 | 1.95 | 3.32 | 1.35 |
| 4 | Paderu | Donela | K.Devannadora | 2.85 | 2.07 | 3.53 | 1.46 | 2.49 | 1.04 |
| 5 | Paderu | Donela | K.ChinnaBalayya | 3.35 | 1.95 | 3.32 | 1.46 | 2.49 | 0.83 |
| 6 | Paderu | Donela | V.Bonjubabu | 2.85 | 2.98 | 5.09 | 2.56 | 4.36 | 0.73 |
| 7 | Paderu | Donela | K.Thulasamma | 4.20 | 1.83 | 3.12 | 1.34 | 2.29 | 0.83 |
| 8 | Paderu | Donela | K.Appannadora | 3.35 | 1.89 | 3.22 | 1.34 | 2.29 | 0.93 |
| 9 | Paderu | Donela | Killo.Chinnnarao | 2.85 | 2.25 | 3.84 | 1.95 | 3.32 | 0.52 |
| 10 | Paderu | Donela | K.Suribabu | 2.85 | 2.62 | 4.47 | 1.95 | 3.32 | 1.14 |
| 11 | Paderu | Donela | K.Krishna Murthy | 2.35 | 1.70 | 2.91 | 1.46 | 2.49 | 0.42 |
| 13 | Paderu | Donela | K.Chittibabu | 2.35 | 2.01 | 3.43 | 1.46 | 2.49 | 0.93 |
| 14 | Paderu | Donela | K.Sanyasi Dora | 2.85 | 2.07 | 3.53 | 1.58 | 2.70 | 0.83 |
| 15 | Paderu | Donela | K.Nelakantham Dora | 3.35 | 2.86 | 4.88 | 2.07 | 3.53 | 1.35 |
| 16 | Paderu | Donela | K.Krishnam Dora | 2.85 | 2.07 | 3.53 | 1.46 | 2.49 | 1.04 |
| 17 | Pedabayalu | Jamadala | Killo.Musuri | 3.85 | 3.77 | 6.44 | 2.80 | 4.78 | 1.66 |
| 18 | Pedabayalu | Jamadala | Killo.Tilusu | 3.7 | 3.71 | 6.34 | 2.80 | 4.78 | 1.56 |
| 19 | Pedabayalu | Jamadala | Sedari.Apparao | 4.2 | 3.83 | 6.54 | 2.92 | 4.99 | 1.56 |
| 20 | Pedabayalu | Jamadala | Killo.Suri Babu | 4.2 | 3.10 | 5.30 | 2.31 | 3.95 | 1.35 |

| Sl No | Mandal | Village | Name | Adult equivalent | Bgross,bl (t/year/HH) | BEy | Bpj,y (t/year/yr) | PEy | ERy |
|---|---|---|---|---|---|---|---|---|---|
| 21 | Pedabayalu | Jamadala | Sedari.Rangarao | 4.2 | 2.62 | 4.47 | 2.07 | 3.53 | 0.93 |
| 22 | Pedabayalu | Jamadala | Vanthala.Ramarao | 2.85 | 4.14 | 7.06 | 2.92 | 4.99 | 2.08 |
| 23 | Pedabayalu | Jamadala | Sedari.Lakshmi | 4.7 | 3.59 | 6.13 | 2.56 | 4.36 | 1.77 |
| 24 | Pedabayalu | Jamadala | Vanthala.Chalapathi | 3.7 | 4.26 | 7.27 | 2.92 | 4.99 | 2.29 |
| 25 | Pedabayalu | Jamadala | Killo.Birsu | 5.4 | 4.56 | 7.79 | 3.29 | 5.61 | 2.18 |
| 26 | Pedabayalu | Jamadala | Sedari.Narayana | 2.85 | 2.25 | 3.84 | 1.83 | 3.12 | 0.73 |
| 27 | Pedabayalu | Jamadala | Killo.Mugiri | 2.35 | 3.95 | 6.75 | 2.92 | 4.99 | 1.77 |
| 28 | Pedabayalu | Jamadala | Killo.Lakshmanrao | 4.7 | 4.50 | 7.69 | 3.41 | 5.82 | 1.87 |
| 29 | Pedabayalu | Jamadala | Killo.Lakshmyya | 4.7 | 4.62 | 7.89 | 3.65 | 6.23 | 1.66 |
| 30 | Pedabayalu | Jamadala | Killo.Mathya Raju | 3.85 | 4.75 | 8.10 | 3.41 | 5.82 | 2.29 |
| 31 | Pedabayalu | Jamadala | Killo.Nukaraju | 3.85 | 4.38 | 7.48 | 3.04 | 5.19 | 2.29 |
| 32 | Pedabayalu | Jamadala | Killo.VerabaBu | 2.35 | 2.98 | 5.09 | 2.43 | 4.16 | 0.93 |
| 33 | Pedabayalu | Jamadala | Vanthala.Setharam | 2.35 | 4.56 | 7.79 | 3.16 | 5.40 | 2.39 |
| 34 | Pedabayalu | Jamadala | Killo.Daru | 1.85 | 3.29 | 5.61 | 2.31 | 3.95 | 1.66 |
| 35 | Paderu | Urrugunda | A.Sanyasi Naidu | 2.85 | 3.16 | 5.40 | 2.43 | 4.16 | 1.25 |
| 36 | Paderu | Urrugunda | K.Baleyanna | 4.7 | 4.99 | 8.52 | 3.41 | 5.82 | 2.70 |
| 37 | Paderu | Urrugunda | S.Krishna Murthy | 3.2 | 3.04 | 5.19 | 2.07 | 3.53 | 1.66 |
| 38 | Paderu | Urrugunda | V.Venkata Rao | 2.35 | 3.35 | 5.71 | 2.43 | 4.16 | 1.56 |
| 39 | Paderu | Urrugunda | K.Konda Babu | 3.7 | 4.02 | 6.86 | 3.04 | 5.19 | 1.66 |
| 40 | Paderu | Urrugunda | S.Manekyam | 2.7 | 3.16 | 5.40 | 2.43 | 4.16 | 1.25 |
| 41 | Paderu | Urrugunda | S.Gangulayya | 3.55 | 3.77 | 6.44 | 2.80 | 4.78 | 1.66 |
| 42 | Paderu | Urrugunda | A.Rajulamma | 4.7 | 4.99 | 8.52 | 3.77 | 6.44 | 2.08 |
| 43 | Paderu | Urrugunda | P.Bonju Babu | 1.85 | 1.83 | 3.12 | 1.28 | 2.18 | 0.93 |
| 44 | Paderu | Urrugunda | K.Loeson | 2.85 | 3.65 | 6.23 | 2.92 | 4.99 | 1.25 |
| 45 | Paderu | Urrugunda | K.Lakshmayya | 4.2 | 4.87 | 8.31 | 3.65 | 6.23 | 2.08 |
| 46 | Paderu | Urrugunda | K.Venkateswara Rao | 1.85 | 2.92 | 4.99 | 2.31 | 3.95 | 1.04 |
| 47 | Paderu | Urrugunda | K.Babu Rao | 2.7 | 3.29 | 5.61 | 2.43 | 4.16 | 1.45 |
| 48 | Paderu | Urrugunda | S.Konda Babu | 2.85 | 3.53 | 6.02 | 2.80 | 4.78 | 1.25 |
| 49 | Paderu | Urrugunda | K.Pandanna | 5.25 | 4.75 | 8.10 | 3.65 | 6.23 | 1.87 |
| 50 | Paderu | Urrugunda | S.Bulammi | 1.85 | 3.29 | 5.61 | 2.56 | 4.36 | 1.25 |
| 51 | Paderu | Urrugunda | L.Bodam Dora | 3.85 | 3.89 | 6.65 | 2.80 | 4.78 | 1.87 |
| 52 | Paderu | Urrugunda | K.Pinam Naidu | 4.85 | 5.48 | 9.35 | 4.14 | 7.06 | 2.29 |
| 53 | Paderu | Urrugunda | A.Purusotham | 1.85 | 1.70 | 2.91 | 1.34 | 2.29 | 0.62 |
| 54 | Paderu | Urrugunda | K.Gundamma | 2.7 | 3.29 | 5.61 | 2.43 | 4.16 | 1.45 |
| 55 | Paderu | Urrugunda | A.Eswaramma | 4.7 | 4.99 | 8.52 | 3.77 | 6.44 | 2.08 |
| 56 | Paderu | Urrugunda | V.Venkata Rao | 3.2 | 4.02 | 6.86 | 2.80 | 4.78 | 2.08 |
| 57 | Paderu | Urrugunda | K.Ramachandrulu | 7.85 | 5.60 | 9.56 | 4.02 | 6.86 | 2.70 |
| 58 | Paderu | Urrugunda | K.Shajan Rao | 3 | 3.29 | 5.61 | 2.43 | 4.16 | 1.45 |
| 59 | Paderu | Urrugunda | V.Naga raju | 2.35 | 3.29 | 5.61 | 2.56 | 4.36 | 1.25 |
| 60 | Paderu | Urrugunda | K.Raja Babu | 7.55 | 5.72 | 9.76 | 4.50 | 7.69 | 2.08 |
| 61 | Paderu | Urrugunda | K.Mallayya | 7.4 | 5.60 | 9.56 | 4.14 | 7.06 | 2.49 |
| 62 | Paderu | Urrugunda | V.Dombanna | 5.7 | 5.35 | 9.14 | 3.83 | 6.54 | 2.60 |
| 63 | Paderu | Urrugunda | V.Ganapathi | 2.85 | 3.89 | 6.65 | 2.80 | 4.78 | 1.87 |

| Sl No | Mandal | Village | Name | Adult equivalent | Bgross,bl (t/year/HH) | BEy | Bpj,y (t/year/yr) | PEy | ERy |
|---|---|---|---|---|---|---|---|---|---|
| 64 | Paderu | Urrugunda | K.Gurumurthy | 3.55 | 2.43 | 4.16 | 1.83 | 3.12 | 1.04 |
| 65 | Paderu | Urrugunda | L.Anasuya | 1 | 0.85 | 1.45 | 0.73 | 1.25 | 0.21 |
| 66 | Paderu | Urrugunda | K.Magganna | 6.25 | 5.72 | 9.76 | 4.26 | 7.27 | 2.49 |
| 67 | Paderu | Urrugunda | V.Machanna | 5.2 | 5.23 | 8.93 | 3.89 | 6.65 | 2.29 |
| 68 | Paderu | Urrugunda | G.Pongu Ram | 4.05 | 4.02 | 6.86 | 2.80 | 4.78 | 2.08 |
| 69 | Paderu | Boddaput | K.Gopi | 2.85 | 2.56 | 4.36 | 1.83 | 3.12 | 1.25 |
| 70 | Paderu | Boddaput | K.Ramana | 3.35 | 2.80 | 4.78 | 2.07 | 3.53 | 1.25 |
| 71 | Paderu | Boddaput | V.Bala raju | 3.85 | 3.41 | 5.82 | 2.56 | 4.36 | 1.45 |
| 72 | Paderu | Boddaput | K.Sundara rao | 2.35 | 1.83 | 3.12 | 1.34 | 2.29 | 0.83 |
| 73 | Paderu | Boddaput | V.Vaga rao | 3.35 | 2.80 | 4.78 | 2.07 | 3.53 | 1.25 |
| 74 | Paderu | Boddaput | V.Baskhar rao | 3.85 | 3.04 | 5.19 | 2.31 | 3.95 | 1.25 |
| 75 | Paderu | Boddaput | V.Naga raju | 2.85 | 2.98 | 5.09 | 2.31 | 3.95 | 1.14 |
| 76 | Paderu | Boddaput | V.Ratnam | 1.85 | 1.40 | 2.39 | 0.97 | 1.66 | 0.73 |
| 77 | Paderu | Boddaput | V.Naryana | 2.35 | 1.95 | 3.32 | 1.58 | 2.70 | 0.62 |
| 78 | Paderu | Boddaput | K.Rajan | 3 | 2.80 | 4.78 | 2.07 | 3.53 | 1.25 |
| 79 | Paderu | Boddaput | K.Raja Rao | 3.35 | 2.56 | 4.36 | 1.95 | 3.32 | 1.04 |
| 80 | Paderu | Boddaput | K.Ganga Rao | 2.85 | 2.13 | 3.64 | 1.70 | 2.91 | 0.73 |
| 81 | Paderu | Boddaput | K.Nagaswarao | 3.35 | 3.16 | 5.40 | 2.56 | 4.36 | 1.04 |
| 82 | Paderu | Boddaput | K.Rajudu | 2.35 | 2.86 | 4.88 | 2.07 | 3.53 | 1.35 |
| 83 | Paderu | Boddaput | K.Kondhu | 2.35 | 2.80 | 4.78 | 1.95 | 3.32 | 1.45 |
| 84 | Paderu | Boddaput | K.Dhonavan rao | 4 | 4.26 | 7.27 | 3.41 | 5.82 | 1.45 |
| 85 | Paderu | Boddaput | K.Paru Pathi | 1.85 | 1.52 | 2.60 | 1.10 | 1.87 | 0.73 |
| 86 | Paderu | Boddaput | K.Milku | 2.85 | 2.31 | 3.95 | 1.70 | 2.91 | 1.04 |
| 87 | Paderu | Boddaput | K.Kondamma | 3.35 | 3.29 | 5.61 | 2.56 | 4.36 | 1.25 |
| 88 | Paderu | Boddaput | K.Venkata Rao | 2.85 | 2.43 | 4.16 | 1.83 | 3.12 | 1.04 |
| 89 | Paderu | Boddaput | V.Babu Rao | 3.85 | 3.41 | 5.82 | 2.68 | 4.57 | 1.25 |
| 90 | Paderu | Boddaput | V.Nooka Raju | 5.35 | 6.69 | 11.43 | 4.99 | 8.52 | 2.91 |
| 91 | Paderu | Boddaput | K.Seetamma | 2.35 | 1.22 | 2.08 | 0.61 | 1.04 | 1.04 |
| 92 | Paderu | Boddaput | K.Jagga Rao | 3.85 | 3.89 | 6.65 | 2.80 | 4.78 | 1.87 |
| 93 | Paderu | Boddaput | K.Naga Raju | 2.85 | 0.85 | 1.45 | 0.61 | 1.04 | 0.42 |
| 94 | Paderu | Boddaput | K.Appala Raju | 3.35 | 3.53 | 6.02 | 2.68 | 4.57 | 1.45 |
| 95 | Paderu | Boddaput | K.Chandarao | 2.35 | 1.83 | 3.12 | 1.34 | 2.29 | 0.83 |
| 96 | Paderu | Boddaput | K.Satya Rao | 3.85 | 3.53 | 6.02 | 2.68 | 4.57 | 1.45 |
| 97 | Paderu | Boddaput | V.Sreenu | 2.35 | 2.13 | 3.64 | 1.70 | 2.91 | 0.73 |
| 98 | Paderu | Boddaput | K.Google | 1.85 | 1.40 | 2.39 | 1.10 | 1.87 | 0.52 |
| 99 | Paderu | Boddaput | K.Lakshmi | 1.35 | 1.52 | 2.60 | 1.10 | 1.87 | 0.73 |
| 100 | Paderu | Boddaput | K.Sundara rao | 3.35 | 2.80 | 4.78 | 2.07 | 3.53 | 1.25 |
| 101 | Paderu | Boddaput | K.Kanthamma | 2.35 | 1.83 | 3.12 | 1.34 | 2.29 | 0.83 |
| 102 | Paderu | Boddaput | V.Sanyasayya | 4.35 | 3.95 | 6.75 | 3.16 | 5.40 | 1.35 |
| 103 | Paderu | Boddaput | K.Mohana Rao | 3.35 | 3.16 | 5.40 | 2.68 | 4.57 | 0.83 |
| 104 | Paderu | Boddaput | K.Ganga Rao | 2.85 | 2.74 | 4.67 | 1.95 | 3.32 | 1.35 |

| Sl No | Mandal | Village | Name | Adult equivalent | Bgross,bl (t/year/HH) | BEy | Bpj,y (t/year/yr) | PEy | ERy |
|---|---|---|---|---|---|---|---|---|---|
| 105 | Paderu | Boddaput | K.Bangaru Rao | 4.85 | 4.26 | 7.27 | 3.16 | 5.40 | 1.87 |
| 106 | Paderu | Boddaput | K.Jalo | 2.85 | 3.04 | 5.19 | 2.07 | 3.53 | 1.66 |
| 107 | Paderu | Boddaput | K.Pandee Rao | 5.35 | 4.75 | 8.10 | 3.53 | 6.02 | 2.08 |
| 108 | Paderu | Boddaput | K.Segudu | 4.85 | 4.87 | 8.31 | 3.53 | 6.02 | 2.29 |
| 109 | Paderu | Boddaput | K.Sanyasi Rao | 3.85 | 3.83 | 6.54 | 2.92 | 4.99 | 1.56 |
| 110 | Paderu | Boddaput | K.Rama Rao | 3.35 | 3.04 | 5.19 | 2.07 | 3.53 | 1.66 |
| 111 | Paderu | Boddaput | V.Sanjan Rao | 4.35 | 3.89 | 6.65 | 2.80 | 4.78 | 1.87 |
| 112 | Paderu | Boddaput | K.Appa Rao | 2.5 | 2.86 | 4.88 | 2.07 | 3.53 | 1.35 |
| 113 | Paderu | Boddaput | K.Chinna Rao | 2.35 | 2.31 | 3.95 | 1.70 | 2.91 | 1.04 |
| 114 | Paderu | Boddaput | K.Chitti Babu | 3.5 | 1.95 | 3.32 | 1.46 | 2.49 | 0.83 |
| 115 | Paderu | Boddaput | K.Babu Rao | 1.85 | 1.34 | 2.29 | 0.97 | 1.66 | 0.62 |
| 116 | Paderu | Boddaput | K.Chitti Babu | 2.85 | 2.80 | 4.78 | 2.19 | 3.74 | 1.04 |

**Table 11: Mean value of Emission Reduction/family/yr from the Kitchen Tests conducted**

| ERy/family/yr | |
|---|---|
| **Mean** | **1.41** |
| Standard Error | 0.05 |
| Standard Deviation | 0.57 |
| Range | 2.70 |
| Count | 115 |
| Confidence Level (90.0%) | 0.09 |

**Table 12: The statistical analysis for baseline and project emission reduction from the Kitchen Tests**

| F-Test Two-Sample for Variances | | | t-Test: Two-Sample Assuming Unequal Variances | | |
|---|---|---|---|---|---|
| | *BEy* | *PEy* | | *BEy* | *PEy* |
| Mean | 5.52 | 4.11 | Mean | 5.52 | 4.11 |
| Variance | 4.12 | 2.29 | Variance | 4.12 | 2.29 |
| Observations | 115 | 115 | Observations | 115 | 115 |
| df | 114 | 114 | Hypothesized Mean Difference | | 0 |
| F | 1.80 | | Df | | 211 |
| P(F<=f) one-tail | 0.0009 | | t Stat | | 5.96 |
| F Critical one-tail | 1.27 | | P(T<=t) one-tail | | 0.00000001 |
| | | | t Critical one-tail | | 1.29 |

A preliminary test for the equality of variances indicates that the variances of the two groups were significantly difference F=1.8, p=.0009. Therefore, a two-sample t-test was performed that does not

assume equal variances. The mean emission reduction for $BE_y$ of 5.52, N-115 was significantly greater than the emission reduction for $PE_y$ of 4.41, N-115 using the two-sample t-test for unequal variances for P(T<=t) one-tail, t(115) = 5.96, p <= 0.00000001.

**Thus ER/family/yr is 1.41 – 0.09 = 1.32 $tCO_2$**, considering the lower bound of the 90% confidence level.

**Table 13: Projection of emission reductions**

| Year | Number of stoves that will be installed | Cumulative stoves installed | Stoves used | BE | PE | ER** |
|---|---|---|---|---|---|---|
| 1. 2012* | 3750 | 3750 | 3750 | 11,228 | 8,367 | 2,861 |
| 2. 2013 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| 3. 2014 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| 4. 2015 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| 5. 2016 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| 6. 2017 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| 7. 2018 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| 8. 2019 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| 9. 2020 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| 10. 2021 | 3750 | 3750 | 3750 | 20,700 | 15,426 | 4,950 |
| **Total** | **3750** | **3750** | **3750** | **1,97,528** | **1,47,201** | **47,411** |

*During Year 1, 3750 units will be built staggered over one year period averaging 313/month
****** Considering 90% lower bound emission reduction@ 1.32 t/family/yr

### B.5.4 Summary of the ex-ante estimation of emission reductions:

| Year | Estimation of Baseline Emissions (tonnes $CO_{2e}$) | Estimation of Project Emissions (tonnes $CO_{2e}$) | Estimation of Leakage Emissions (tonnes $CO_{2e}$) | Estimation of Emission Reductions (tonnes $CO_{2e}$)* |
|---|---|---|---|---|
| **1. 2011-12** | 11,228 | 8,367 | 0 | **2,861** |
| **2. 2012-13** | 20,700 | 15,426 | 0 | **4,950** |
| **3. 2013-14** | 20,700 | 15,426 | 0 | **4,950** |
| **4. 2014-15** | 20,700 | 15,426 | 0 | **4,950** |
| **5. 2015-16** | 20,700 | 15,426 | 0 | **4,950** |
| **6. 2016-17** | 20,700 | 15,426 | 0 | **4,950** |
| **7. 2017-18** | 20,700 | 15,426 | 0 | **4,950** |
| **8. 2018-19** | 20,700 | 15,426 | 0 | **4,950** |
| **9. 2019-20** | 20,700 | 15,426 | 0 | **4,950** |
| **10.2020-21** | 20,700 | 15,426 | 0 | **4,950** |
| **Total** | **1,97,528** | **1,47,201** | **0** | **47,411** |

*Considering 90% lower bound emission reduction@ 1.32 t/family/yr

## B.6 Application of a monitoring methodology and description of the monitoring plan as per the existing or new methodology applied to the micro-scale project activity:

Applied monitoring methodology:

Section III of the Gold Standard Methodology for Improved Cook-stoves and Kitchen Regimes V.02 – 08/02/2010 Indicative Programme, Baseline, and Monitoring Methodology for Improved Cook-Stoves and Kitchen Regimes

### B.6.1 Data and parameters monitored:

Since fixed baseline scenario is chosen, baseline parameters will not be monitored.

| **Data / Parameter:** | $X_{nrb,pj,y}$ |
|---|---|
| Data unit: | % |
| Description: | Non-renewability of woody biomass fuel in year y in project scenario |
| Source of data: | Study and other public sources as shown in section B.4 |
| Monitoring frequency | Once in two years |
| QA/QC procedures: | Third party review of calculation |
| Any comment: | |

| **Data / Parameter:** | Leakage |
|---|---|
| Data unit: | $tCO_{2e}$ per year |
| Description: | Potential GHG emissions outside project boundary caused by project activity |
| Source of data: | Monitoring Kitchen Surveys |
| Monitoring frequency | Once in two years |
| QA/QC procedures: | Third party study and report |
| Any comment: | |

| **Data / Parameter:** | Usage in year y |
|---|---|
| Data unit: | Fraction |
| Description: | Percentage of stoves of age x remaining in use in year y |
| Source of data: | Stove-Usage Survey |
| Monitoring frequency | Bi-annual |
| QA/QC procedures: | Survey of stoves sold in the first year of the project to establish the drop-off rate in stove usage over time |
| Any comment: | |
| | |

| **Data / Parameter:** | Age |
|---|---|
| Data unit: | % |
| Description: | Adjustment to values of $B_{pj,,y}$ for stoves of age x |

| | |
|---|---|
| Source of data: | Aging –Stove Kitchen Test |
| Monitoring frequency | Bi-annual |
| QA/QC procedures: | Kitchen Test for stoves sold in the first year to measure fuel reduction performance in successive years of stoves of Age x, Age y years, and so on |
| Any comment: | Conducted by LAYA in collaboration with and under surveillance of the FCN Technical Team |
| | |

| | |
|---|---|
| **Data / Parameter:** | New Stove |
| Data unit: | Fraction |
| Description: | Adjustment to values of $B_{pj,y}$ for new stove models |
| Source of data: | New-Stove Kitchen Test: Measurement of sample of whole of cluster population Water boiling test will be done for adjustment of values to $B_{pj,y}$ |
| Monitoring frequency | Bi-annual |
| QA/QC procedures: | In case when new stove models are introduced |
| Any comment: | |

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| | |
|---|---|
| **Data / Parameter:** | Indoor air quality |
| Data unit: | % |
| Description: | 1. Percentage of stove users stating an improvement of indoor air quality<br>2. Percentage of stove users stating better health condition due to improved indoor air quality |
| Source of data: | Monitoring Kitchen Survey |
| Monitoring frequency | Two years once |
| QA/QC procedures: | Conducted by LAYA in collaboration with and under surveillance of the FCN Technical Team |
| Any comment: | |

| | |
|---|---|
| **Data / Parameter:** | Livelihood of the poor / poverty alleviation |
| Data unit: | 1. Hours/month |
| Description: | 1. Reduced time for fuel procurement compared to baseline |
| Source of data: | Monitoring Kitchen Survey |
| Monitoring frequency | Two years once |
| QA/QC procedures: | Conducted by LAYA in collaboration with and under surveillance of the FCN Technical Team |
| Any comment: | |

| | |
|---|---|
| **Data / Parameter:** | Access to affordable and clean energy services |
| Data unit: | 1. Number of households/persons<br>2. t of fuels saved/year |
| Description: | 1. Number of households and number of persons benefiting from cleaner combustion with improved stoves. |

| | |
|---|---|
| | 2. Overall amount of fuels (t) saved per year due to the project activity |
| Source of data: | - Sales Record<br>- Monitoring Kitchen Surveys<br>- Aging-Stove Kitchen Tests |
| Monitoring frequency | Every year |
| QA/QC procedures: | Conducted by LAYA in collaboration with and under surveillance of the FCN Technical Team |
| Any comment: | |
| | |

| **Data / Parameter:** | Human and institutional capacity |
|---|---|
| Data unit: | Number of persons trained |
| Description: | 1. Number of women stove promoters trained<br>2. Number of women stove owners trained in stove usage |
| Source of data: | Records from LAYA & Sales Record |
| Monitoring frequency | Sales record is continuously updated<br>Training records are reported annually |
| QA/QC procedures: | Conducted by LAYA in collaboration with and under surveillance of the FCN Technical Team |
| Any comment: | |

| **Data / Parameter:** | Quantitative employment and income generation |
|---|---|
| Data unit: | Number of persons employed |
| Description: | Number of jobs created for the implementation of the project activity |
| Source of data: | Records |
| Monitoring frequency | Every Year |
| QA/QC procedures: | Conducted by LAYA in collaboration with and under surveillance of the FCN Technical Team |
| Any comment: | |

| **Data / Parameter:** | Technology transfer and technological self-reliance |
|---|---|
| Data unit: | Number |
| Description: | This capacity building enables spill-over effects to the area by replicating similar or different projects |
| Source of data: | Number of workshops, seminars organized, and training-related opportunities held; Number of participants who attend those capacity building activities; R&D Expenditures |
| Monitoring frequency | Every year |
| QA/QC procedures: | Conducted by LAYA |
| Any comment: | |

## B.6.2 Description of the monitoring plan:

**1. Monitoring Procedure**

Monitoring Procedure: The monitoring procedure will be as set out in the methodology in section II 4-6.

A total sales record, detailed Customer Database and Project database will be maintained continuously, while periodic KT's will be measured or estimated. The data for all the 3750 households were collected. As shown in the database, a single cluster is identified. Thus, the clustering will not be revisited.

The emission reduction calculations will be carried out on the basis of the KT results most applicable to each stove according to its age.

A. The monitoring tasks that will be undertaken continuously are:

**1. Maintenance of Records.**

The Project Co-ordinator will be responsible to maintain and make available accurate records. The Project Coordinator will collate a composite record and keep paper records also.

All records will comprise the following data:

- Date of Construction
- Start date of use
- Location of stove Construction
- Mode of use: Domestic
- Model/type of stoves constructed
- Number of stoves constructed
- Name and telephone number:
    - Unique Identification Number: Ration Card/ID Card
    - Details of the domestic end users
- Address:

**2. Maintenance of a Detailed Customer Database, and Monitoring KS's**

The project co-ordinator will place the results of Kitchen Surveys into a Detailed Customer Database (DCD). The DCD is initially filled with the results of the Baseline KS collected. This will be supplemented with additional data collected during construction of the stoves. It will further be populated by data collected during the course of the project. Since KS has been conducted for all the identified households, it will be updated periodically as and when construction has been made. All the data in the DCD will be derived from interviews in the homes of the customers as none of the households have telephone (being very poor tribal communities). Since substantial data has been collected for each of the household, it will be authenticated during the construction. The data that will be collected will be as follows:

a) Mobile telephone number and/or address with land-line telephone number if acquired in the future
b) Type of stoves. Fuel used in Wood by all the households.
c) Place of use, location. A few households cook outdoor for a month during summer. In such cases, SARALA will also be constructed outdoors. If not constructed outdoors, emission reductions during this time of outdoor cooking will not be accounted.

**3. Continuous updating of the Project Database**

The Project Co-ordinator will be responsible for the following to continuously update the Project Database:

- Total Construction Record
- Dividing into groups according to the most recent definition of clusters. Only one cluster has been identified for all the households. This will further be authenticated during construction.
- Listing under separate headings any household which do not fall into the cluster categories.
- Description of conclusions of KS's and KTs with regard to clustering, factors effecting emission reductions
- Adjustments for emission reduction calculations and it will include within it the emission reduction calculations for the project.
- Every three-four months once, all the houses will be visited to check if the new stoves are being used and they do not revert back to traditional stoves. Also if any maintenance or repairs are required, it will be taken up.

**4. Strategy for Monitoring**

1. A team of stove builders from the community will be identified. They will be trained by group of master trainers from the community.
2. The team will be assigned the task of building 3750 stoves. The material cost and cost of construction will be through VER forward funding. They will claim a small fee from the community as incentive, i.e not more than Rs 50/- per stove. This is also the amount usually paid to build a conventional stove. This will ensure ownership of the new energy efficient stove.
3. The team of stove builders will be under the direct supervision of a field coordinator based at LAYA, Paderu who will report to the Project Coordinator based at LAYA Resource Centre. Visakhapatnam. The Project Coordinator will essentially supervise the implementation, monitoring and documentation of the stoves being built.
4. The building of stoves is expected to be completed in 1 year. An end user agreement will be signed with the stove beneficiary after satisfactory use of the stove for a period of 7 days.
5. After the stoves are built, a 15 member team will be selected from the trained stove builders to form the stove maintenance team. They will be required to collect data as to the functioning of the built stoves. They will be responsible for the maintenance of the stoves. Strategically the selection of this team will also be based in various regions so that they may be accessible to the community easily.
6. The project coordinator and field coordinator will together be responsible for collection of data and processing of data every year to determine the status of the 3750 stoves and its operation.

7. More stoves will be built in subsequent years falling under the same cluster. But the emission reductions will be maintained below 5,000 $tCO_2$.

## 5. Calculation of emission reductions

Emission reductions will be calculated using the results of surveys and tests that will provide updated values for NRB fraction, Leakage, and also values for Usage, Age, and New-stove factors, always specific to a cluster. The Age factor is particular to stove vintages and will be used to adjust the fuel savings performance and any other relevant factors applied in the emission reduction equation. The Usage factor is also particular to stove vintage and adjusts the emission reduction value for each age group. The updated NRB and Leakage values adjust all emission reduction results for the year monitored.

**B. The monitoring tasks undertaken periodically will be:**

1. The NRB fraction will be re-assessed (as described in B.4), not less frequently than bi-annually as shown in Section B.6.1.
2. No leakage is anticipated during the project activity. If any new leakage is anticipated, it will be surveyed, and an investigation made into the possibility of new leakage effects, not less frequently than bi-annually.
3. A Usage Survey will be undertaken not less frequently than yearly once for construction made in the first year of the project, to establish the drop-off rates in stove usage (or new regime application) over time. The sample size is as defined for the baseline KS, selected randomly from users having made their construction in the first year of the project.
4. An "Aging-Stove KT" will be undertaken not less frequently than bi-annually for construction made in first year, to measure fuel reduction performance and other relevant factors in successive years of stoves of Age x years, Age y years, and so on though water boiling tests. A linear extrapolation will be applied to all stoves of intermediate age and extended age, when calculating overall project GHG reductions. The mean performance of the aging stoves will be applied to the lower bound of the fuel savings as determined in the baseline study. Thus according to the methodology, it is not necessary to apply a lower bound adjustment to the aging stove test data. The sample size will be such that a sufficient number of aging stoves will be considered to ensure that the typical levels and types of degradation are represented. According to the methodology, it is not necessary to measure baseline fuel use and the tests therefore will only involve measurements of the performance of the improved stove. The mean fuel use of the aging stoves will be ratio-ed to the mean fuel use of the stoves as measured in the baseline study. This ratio is then multiplied by the lower bound of the baseline fuel savings to yield the fuel savings of the aging stoves.
5. Baseline Monitoring KT. If the KS reveals that baseline parameters of the type measured by KTs may have changed significantly and no New-Stove KT is taking place to perform this function, then a Baseline Monitoring KT will be carried out not less frequently than bi-annually amongst new customers to update baseline parameters.
6. The wider social and economic impact of the project will be investigated biannually and an assessment made of its contribution, positive or otherwise, to sustainable development in the area.

**2. Quality Assurance and Quality Control**

The FCN Technical Team will be appointed to accomplish or reinforce some or all of the monitoring tasks. This will be done in relation to specific cross-checks, for example between material purchase, financial accounts, and also through End User agreements signed with the beneficiaries. Identification of stoves will be facilitated to prevent double counting.

**B.7 Date of completion of the application of the existing or new baseline and monitoring methodology and name of the responsible person(s)/entity(ies)**

Date of completion of baseline and monitoring methodology: 14th January 2011

Name of the responsible Person/Entities:
Dr. Sudha Padmanabha
Fair Climate Network,
19/1, Alexandria Street, Richmond Town,
Bangalore 560025, Karnataka, India.

## SECTION C. Duration of the project activity / crediting period

### C.1 Duration of the project activity:

#### C.1.1. Starting date of the project activity:

01/08/2011 or date of registration whichever is later.

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

10 years.

Improved Cook stoves usually last for 3-4 years. The stoves will be monitored for their usage. If the stoves fall to despair, they will be re-constructed. Thus there would be continuous use of SARALA cook-stoves for the next 10 years.

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

#### C.2.1. Renewable crediting period

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

NA

##### C.2.1.2. Length of the first crediting period:

NA

#### C.2.2. Fixed crediting period:

##### C.2.2.1. Starting date:

01/08/2011

##### C.2.2.2. Length:

10 years

## SECTION D. Stakeholders' comments

### D.1. Brief description of the means used to invite local stakeholders for comments:

The local stakeholders' meeting was conducted at Laya Resource Centre Office, Opp. Teachers Quarters, Talar Singhi, Paderu – 531 024, Visakhapatnam District, Andhra Pradesh, India on the 11th February 2011 between 2.00 – 5.00 PM.

Notification was sent to various categories of stakeholders to attend the stakeholders meeting through hand delivery of letters, emails, personally invitation and phone. A non-technical summary was also enclosed along with an agenda for the meeting. The meeting was conducted in the local language - Telugu.

The agenda of the meeting included discussion on the purpose of the consultation, description of the project activity, description of the improved cook stove, answering and clarification on the project activity.


The meeting was attended by 65 members comprising of 28 male and 26 female members. The various stakeholders attending the meeting were:

- Representatives of Village Communities from Self Help Groups, Village level community organization, Farmers, Traditional Health Practitioners (THP), and Social activist.
- Representative of local authorities were from Mandal Parisath Territorial Council (MPTC), the Sarpanch and Ward Members
- Government officials from Forest Department represented by Divisional Forest Officer (DFO) and from Integrated Child Development Society (ICDS)
- Local NGO's were represented by three groups namely, Naandhi, Adivasi Mithra and Andhra Vanavasi Kalyan Asharam
- GS NGO supporter from Fair Climate Network (FCN)
- LAYA Staff
- Objective Observer for the project activity

## D.2. Summary of the comments received:

Evaluation forms were given to the participants to express their views on the project activity. The project activity was welcomed by the communities and the government officials. They want the project to be implemented at the earliest. The local communities were happy of the fact that there would be a decrease in fuel wood use, which will reduce their drudgery of collecting wood. The stoves would provide soot- and smoke-free indoors, improving the health of women and children. Provision of regular repair and maintenance of SARALA stove under the project activity was also appreciated.

There were no negative comments.

The project does not lead to any adverse environmental effects. In fact, there are positive impacts of the project in reduction of indoor air pollution.

**D.3. Report on how due account was taken of any comments received and on measures taken to address concerns raised:**

Based on the comments received during the meeting, the measures that will be taken are as follows:

- Construction will be avoided during rainy seasons
- Modification of the SARALA stove will be taken up based on community feedback.
- A maintenance team will be set up, which will visit each of the household periodically to check on the stove's performance. If any repairs are required, it will be taken up immediately.

**D.4. Report on stakeholder consultation feedback round, if deemed necessary by Objective Observer(s):**

No feedback round is required based on the report of the Objective Observer.

## Annex 1

## CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

| | |
|---|---|
| Organization: | LAYA Resource Centre |
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