CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM (CDM-SSC-PDD)
VERSION 03 - IN EFFECT AS OF: 22 DECEMBER 2006

CONTENTS

Annexes

Revision history of this document

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

SECTION A. General description of small-scale project activity

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

Accion Fraterna Biogas CDM project for rural communities in Anantapur, Andhra Pradesh
Version: 6
Date: 19th January 2012

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

Accion Fraterna Ecology Centre (AF Ecology Centre) is a Non-Governmental Organization (NGO) working in Anantapur district of Andhra Pradesh, India. The guiding principle of AF Ecology Centre is concern for the poor and reaching out to as many needy people as possible. The main mission of the NGO is to organize and strengthen distressed farmers and farm labour for their empowerment, self-reliance, food and nutritional security; promote Integrated Sustainable Farming Systems and sustainable healthy environment. The NGO also works with women and youth and promote diversified livelihoods including agri-processing, marketing and non-farm skill based employment. They also work for gender and social equality and human dignity. AF Ecology Centre are always working for people's well being and strives to positively influence the society and adapt itself to be relevant to the changing contexts[1]. Thus under the aegis of Clean Development Mechanism (CDM), AF Ecology Centre is taking up this project to provide biogas to the rural communities of the drought prone and biomass scarce Anantapur district of Andhra Pradesh, India.

Anantapur district is a resource-poor arid region. It has very low and erratic average rainfall of 522 mm annually. It witnesses droughts in 3 out of every 5 years. The district depends predominantly on rain fed farming. Ninety percent of the land and 80% of the farmers depend entirely on rain fed farming. The district has predominantly small and marginal farmers with 90% of the farmers owning less than 10 acres of dry land. Anantapur does not have any worthwhile forest area or vegetation, and biomass is very poor. The nature of forests is such that this does not contribute towards improving the arid climate in the region. The forests in the District are thin and scanty and there are numerous isolated peaks and rocky clusters which are devoid of any vegetation[2]. Thus the region is a drought prone, biomass deficient region, which requires climate mitigation measures.

The purpose of this Biogas CDM Project activity is to set up 15,000 biogas plants (digesters) of 2 m^3 capacity each for single households in 15 Mandals[3] of Anantapur District. Each household will install a 2 m^3 biogas plant and feed cattle dung and other organic waste into the anaerobic digester for the production of biogas for cooking purpose and water heating for bath. The aim of the project is to replace the commonly used inefficient wood fired mud stoves technology, with clean, sustainable and efficient biogas and in this way replace Non-Renewable Biomass with biogas for cooking and water heating for bath. The project activity will decrease the dependence of 15,000 families on forests in the region.

[1] http://www.af-ecologycentre.org/aboutus3.htm

[2] http://www.mssrf.org/fs/pub/Study-of-Anantapur-RR10-24.pdf

[3] Mandal is an administrative unit below the district consisting of a group of villages with administrative and local government functions.

By utilizing cattle dung in a controlled anaerobic digestion and combustion system, biogas will be available as thermal energy, which will be used for cooking and water heating for bath. The biogas will be used on a two-ring gas stove supplied as part of the project activity. Households having cattle or willing to collect cattle dung will participate in the project activity. A list of more than 15,000 suitable and interested households is given in Appendix 1. The project would be implemented upon registration of the project as a CDM project activity, as the project will be financed completely from carbon revenues. The project contributes to social, environmental, economic and technological benefits which contribute to sustainable development of the local environment and the country as follows:

Social benefits:

- ✓ Reduces drudgery to women who spend long hours and travel long distances in search of fuel wood
- ✓ Increases women and children's overall health situation by reducing indoor air pollution, thus eliminating health hazards.
- ✓ Security of energy supply
- ✓ Better management of dung and organic wastes
- ✓ Children will be able to attend school in time as food will be cooked in time.

Environmental benefits:

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

Economic benefits:

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

Technological benefits:

- ✓ Better technology for cooking
- ✓ Better biogas digester models.
- ✓ Training in chemistry of biogas for masons and users leading to improved scientific temper in community and more jobs.
- ✓ Demonstrations and training programs will be carried out for the masons and end users on maintenance and other related aspects of biogas units.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or/public entity(ies) Project participants (*) (as applicable)	Kindly indicate if the Party involved wishes to be considered as project participant (Yes/No)
India (host)	Accion Fraterna Ecology Centre – Private Entity	No

CDM – Executive Board

(*) In accordance with the CDM modalities and procedures, at the time of making the CDM-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.

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

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

507 villages situated across 15 Mandals namely Anantapur, Atmakur, Bathalapalli, Beluguppa, Brahmasamudram, Dharmavaram, Garladinne, Kalyandurg, Kambadur, Kanekal, Kudair, Kundurpi, Raptadu, Rayadurg and Settur of Anantapur district. The list of 507 villages and 15,000 participating households is given in Appendix 1.

A.4.1.1. Host Party(ies):

India

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

Andhra Pradesh

A.4.1.3. City/Town/Community etc:

507 villages in 15 Mandals of Anantapur District – Appendix 1

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

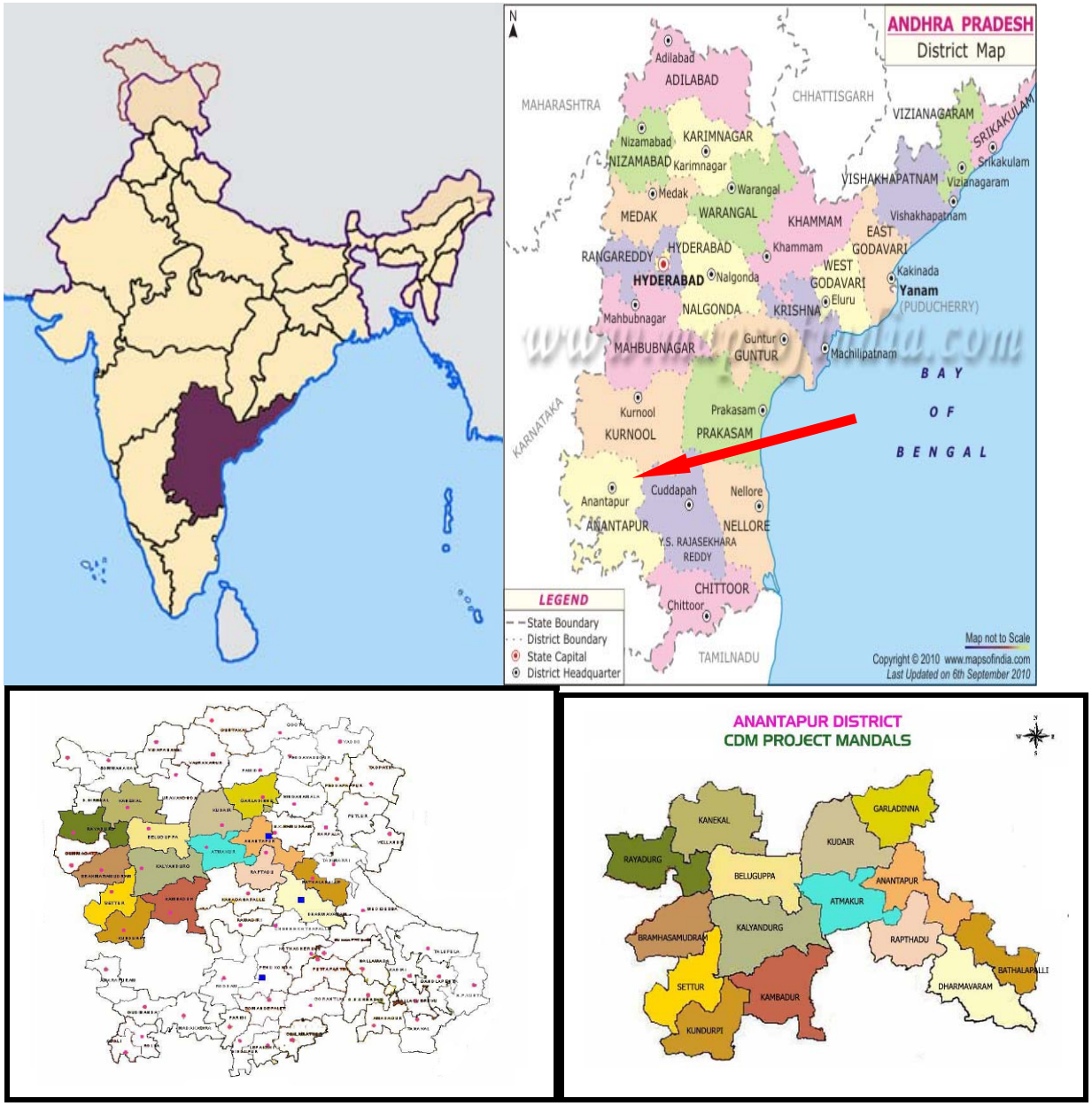


Figure 1: Map of Andhra Pradesh, Anantapur district and the selected Mandals in which the project will be implemented

Anantapur district lies between 13'- 40' and 15'-15' Northern Latitude and 76'-50' and 78'-30' Eastern Longitude. It is bound by Bellary, Kurnool District on the North, Cuddapah and Kolar Districts of Karnataka on South East and North respectively. The coordinates of the Mandals are as follows:

Mandals	Co-ordinates (Deg-Min-Sec)	
	Long-E	**Lat-N**
Anantapur	77-36 - 26.88	14-40-50
Atmakur	77-21-28.23	14-38-45
Bathalapalli	77-46-7.87	14-30-57.89

Beluguppa	77-8-16.83	14-42-45.79
Brahmasamudram	76-56-56.74	14-32-11.58
Dharmavaram	77-43-37.19	14-24-44.21
Garladinne	77-36-5.16	14-49-12.63
Kalyandurg	77-6-48.60	14-32-56.31
Kambadur	77-13-58.91	14-20-42.10
Kanekal	77-4-47.78	14-48-21.31
Kudair	77-25-48.87	14-43-48.95
Kundurpi	77-2-10.32	14-17-27.37
Raptadu	77-36-21.45	14-37-3.68
Rayadurg	76-51-5.16	14-41-58.42
Settur	76-58-56.20	14-26-50.53

Source: Handbook of Statistics 2010[4].

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

The chosen type and category is TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, EB 60. The chosen technology is a domestic biogas plant. It is a small thermal appliance that displaces the use of non-renewable biomass by introducing a system for utilising dung and converting it into renewable energy by means of a digester in which the substrate undergoes acidification and methanation. This end-user technology involves the switch from non-renewable biomass to a renewable source of energy. Biogas is included in the specified methodology as an example of a suitable end user technology.

Technology/measure

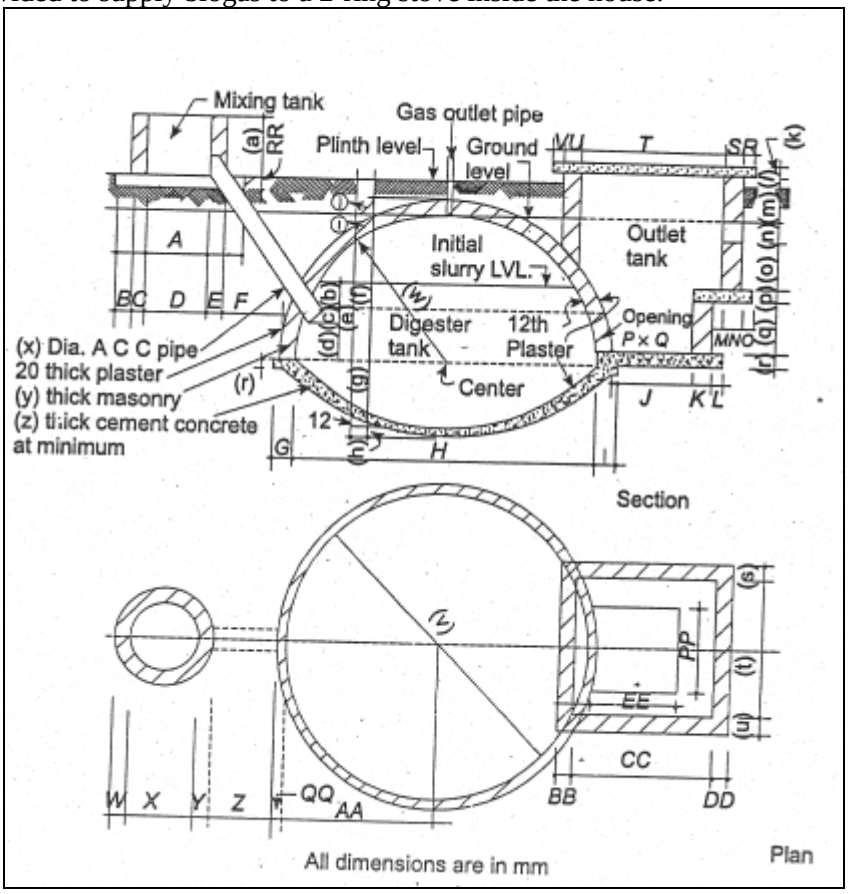
Biogas is a mixture of methane and carbon dioxide. It also has traces of hydrogen sulphide (3%), ammonia, oxygen, hydrogen, water vapour etc., depending upon feed materials and other conditions. Biogas is generated by fermentation of cellulose rich organic matter under anaerobic conditions. In anaerobic conditions, the methane-producing bacteria become more active. Thus, the gas produced becomes rich in methane. The optimum utilization depends upon the successful physical installations, which in turn depend upon plant design and its selection. The basic conversion principle is that when a non-ligneous biomass is kept in a closed chamber for a few days, it ferments and produces an inflammable gas. The anaerobic digestion consists of three stages: I Hydrolysis; II Acid formation and III Methane fermentation.

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

Users prepare batches of slurry in the mixing tank, before allowing the final mixture to flow into the digester for methane formation phase. After digestion, evacuated slurry may be re-used in the process. The recovered gas is combusted and used for cooking and water heating. The chosen methane recovery

[4] Handbook of Statistics, Ananthpur District, Chief Planning Officer, Anantapur. 2010.

and combustion system is the time tested Deenabandhu model biogas technology which is well-known in India[5]. The project activity will organize the 15,000 users to use cattle dung and organic wastes in individual household methane recovery systems of biogas for cooking and water heating. The 15,000 individual plants consist of a mixing chamber where waste water and cow dung are mixed, an inlet pipe to feed the slurry into the reactor, the main biogas reactor / digester where methane formation / recovery takes place, a slurry outlet pipe, an outlet chamber, and a slurry platform. The outlet pipe and tank are provided to remove the digested / treated sludge or fermentation residue and the slurry platform is provided to maintain the treated slurry in clean condition. A pipe leading from the top of the dome to the stove will be provided to supply biogas to a 2-ring stove inside the house.



Plan of Deenabandhu Model Biogas Plant

[5] Approved design by the Ministry of New and Renewable Energy. http://www.mnre.gov.in/

Constructed Deenabandhu Biogas Unit

Biogas Stove used for Cooking and Heating Water for bath

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

Please indicate the chosen crediting period and provide the estimation of total emission reductions as well as annual estimates for the chosen crediting period. Information of the emission reductions shall be indicated using the following tabular format.

Years	Estimation of annual emission reductions in tonnes of CO_2e
2012-13 (1st June 2012)	18,872
2013-14	37,744
2014-15	56,616
2015-16	56,616
2016-17	56,616
2017-18	56,616
2018-19	56,616
Total estimated reductions (tonnes of CO_2e)	**3,39,697**
Total number of crediting years	7
Annual average of the estimated reductions over the crediting period (tCO_2e)	**48,528**

After registration of the project and securing CER forward finance funding, the project will be implemented in phases. The project implementation will be over a three years period. Each year, 5,000 units will be built totaling 15,000 units over three years period.

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

There will be no public funding involved in the project activity. The project would be financed completely with carbon revenues.

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

According to Annex 13, EB 54, "Guidelines on assessment of debundling for SSC project activities", the small-scale project activity is not a de-bundled component of a large project activity since there is no registered small-scale CDM project activity or an application to register another small-scale CDM project activity:

- With the same project participants;
- In the same project category or technology; and
- Registered within the previous two years; and
- Whose project boundary is within 1 km of the project boundary of the proposed small-scale activity at the closest point.

SECTION B. Application of a baseline and monitoring methodology

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

Sectoral Scope 01, TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, Version 04, EB 60.

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

This project is applicable as per the definition in the Annex B of the simplified methodologies for selected small-scale CDM project activity categories, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04:

1. The project activity comprises of biogas units that will displace the use non-renewable biomass by introducing new renewable end-user technology, the biogas stoves.
2. As shown in section B.4, the communities are using the non-renewable biomass since 31st December 1989.
3. The capacity of the project activity is below 45 MW_{th} and will remain under the limits of small-scale project activity during every year of the crediting period as shown below.

ACCION FATERNA BIOGAS CDM PROJECT FOR RURAL COMMUNITIES IN ANANTAPUR, ANDHRA PRADESH"			
Activity Data	**Value**	**Unit**	**Reference**
$E = \eta . H_b . V_b$			
Where:			
E = Energy available from a biogas digester			
η= combustion efficiency of burners	**60%**		Reference: Biogas Technology, B.T. Nijajuna, New Age International Publishers, New Delhi, 2002
H_b = heat of combustion per unit volume of biogas	**22.1**	**MJ/m3**	
V_b = Volume of the biogas	**2**	**m3/day**	Deenabandhu Model, of 2 cum, construction
E =	**26.52**	**MJ/day**	Calculated $E = \eta . H_b . V_b$
E =	**7.37**	**kWh/day**	Calculated @ 1 megajoule = 0.277 777 777 78 kilowatt hour
E =	**1.78**	**kW thermal Capacity**	Calculated installed capacity of biogas
E =	**27**	**MW, thermal**	Calculated for 15,000 biogas units
1 megajoule = 0.277 777 777 78 kilowatt hour			
Reference: Biogas Technology, B.T. Nijajuna, New Age International Publishers, New Delhi, 2002			

B.3. Description of the project boundary:

In accordance with Paragraph 4 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, EB 60:

The project boundary is the physical, geographic site of the use of biomass or the renewable energy.

The projects boundary will therefore encompass the sum of the 15,000 physical geographical sites of all individual biogas plants (digester system, pipe leading to the stove and the stove itself) realized by the project activity.

Based on the methodology, the GHG included for the baseline and project scenario (leakage) for the project activity is CO_2.

B.4. Description of baseline and its development:

It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs. In accordance with Paragraph 4 and 5 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04:

It is assumed that in the absence of the project activity, the baseline scenario would be the use of fossil fuels for meeting similar thermal energy needs.

And

Emission reductions would be calculated as:

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

Where:

ER_y	Emission reductions during the year *y* in tCO_2e
B_y	Quantity of woody biomass that is substituted or displaced in tonnes
$f_{NRB,y}$	Fraction of woody biomass used in the absence of the project activity in year *y* that can be established as non renewable biomass using survey methods
$NCV_{biomass}$	Net calorific value of the non-renewable woody biomass that is substituted (IPCC default for wood fuel, 0.015 TJ/tonne)
$EF_{projected\_fossilfuel}$	Emission factor for the substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO_2/TJ

Step 1: B_y is determined:

According to Paragraph 6 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, EB 60, using Option (a):

B_y is determined by taking the following option:

(a) *Calculated as the product of the number of appliances multiplied by the estimate of average annual consumption of woody biomass per appliance (tonnes/year). This can be derived from historical data or estimated using survey methods.*

Adopting Option (a):

The average annual consumption of biomass per appliance (t/yr) was derived from survey methods done scientifically. A sample survey was conducted covering 745 households of the project beneficiaries. The per capita woody biomass consumption is 1.99±0.15 kgs/day at 95/5 confidence/precision level. The methodology adopted to conduct the survey is described in Annex 3. According to the survey, the annual consumption of biomass per appliance i.e. per family is **3.57 t/yr (average family size is 5 members)**.

The By is 3.57 t/yr x 15,000 = 53,550 t/yr

Conservativeness of biomass consumption estimate

There are no published data on the woody biomass consumption in the project area, i.e. at the mandals or Anantapur district. But an exhaustive study was conducted in the neighbouring district of Kolar, Karnataka, with similar agro-ecological situation[6]. Kolar is basically a dry zone with scrub vegetation and annual rainfall is much similar to the most of the regions of Rayalaseema, Andhra Pradesh (Anantapur being part of Rayalaseema region)[7]. Bagepalli taluk of Kolar district skirts the southern border of Rayalaseema desert belt and shares the same language, culture and social structure, as also the stark poverty that afflicts southern Andhra Pradesh, though located in Karnataka state[8]. Thus the comparison is justifiable. Fuel wood consumption in Bagepalli taluk is 3.69 t/yr/HH which is much higher than that considered for emission reduction for the project activity.

The result from this study is compared to the sample survey. The woody biomass and kerosene use for cooking in kolar district is shown in Table 1. Of course this survey was conducted across all socio-economic sections of rural Kolar.

Table 1: Woody biomass and kerosene usage in the neighbouring Kolar district of the project area[6]

Taluks	Woody biomass for cooking (t/family/yr)	Kerosene for cooking (lts/family/yr)	Energy Equivalent (MJ)
Bagepalli	3.69	101.00	7355
Bangarpet	2.42	89.00	5240
Chikballapur	3.32	56.60	5996
Chintamani	2.48	59.80	4803
Gauribidanur	3.69	26.60	6019
Gudibanda	3.58	49.40	6267
Kolar	2.32	90.40	5119
Malur	2.46	69.00	4933
Mulbagal	3.27	52.20	5852
Sidlaghatta	2.30	37.80	4132

[6] T V Ramachandra , S Vamsee Krishna and B V Shruthi. Decision Support System for Regional Domestic Energy Planning. Journal of Scientific & Industrial Research Vol. 64, March 2005, pp 163-174.

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

[8] http://www.bagepallitown.gov.in

Srinivasapur	3.33	34.40	5613
Average	**2.99**	**60.56**	**5,575**

The study shows that the average annual woody biomass use is 2.99 t/family/yr and kerosene use is 60 lts/family/yr. Together it provides an energy equivalent of 5,575 MJ/year.

Table 2: Comparative energy use in the project area and neighbouring district

Parameters	In the project area based on survey	Third party study in the neighbouring district
Total Woody biomass Use/family/year (t)	**3.57**	**2.99**
NCV of wood GJ/ton	15	15
Efficiency of traditional Stove (%)	10%	10%
Energy delivered to the pot MJ	5,355	4481
Kerosene used (litres/yr)	**0.37**	**60.56**
Density of kerosene (kg/l)	0.75	0.75
NCV of kerosene (TJ/Gg)	43.8	43.8
Efficiency of kerosene stove (%)	55%	55%
Energy delivered to the pot (MJ)	7	1094
Total energy used for cooking (MJ)	**5,362**	**5,575**

Comparatively, in the project area, the sample survey shows woody biomass use of 3.57 t/family/yr and negligible kerosene usage (0.37 lts/family/yr), providing energy equivalent of 5,467 MJ/yr (Table 2). The families use less of kerosene and more of biomass for cooking. This is due to the fact that availability of kerosene is limited to just 2 litres in the PDS system and they are not able to procure from the open market at higher prices. The beneficiaries are from the lower economic strata and will not spend on buying kerosene from the open market (at the rate of Rs.34/lt) and rather collect biomass with no costs. This is evidenced by the fact that the per capita income of families is far less than 1$/day (Annex 3).

A survey by the Government of India showed that rural households belonging to the lower MPCE (Monthly Per Capita Expenditure) classes used more firewood than any other fuel type (Figure 2) and among different household occupational types in rural India, the percentage of households using firewood was highest for agricultural labour households[9]. This is in concurrence with the survey conducted in the project area. Thus the woody biomass use of 3.57 t/family/yr can be taken as conservative.

Adopting option (a), the B_y value is shown below

Amount of Biomass using survey method - option a)	
Item	**Value**
Number of Biogas Units	15,000
Average annual biomass consumption per biogas Unit (tonnes/year)	3.57
B_y = Quantity of Biomass that is substituted or displaced (in tonnes)	53,550

[9] 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

The quantity of biomass that will be substituted or displaced is 53,550 t/year.

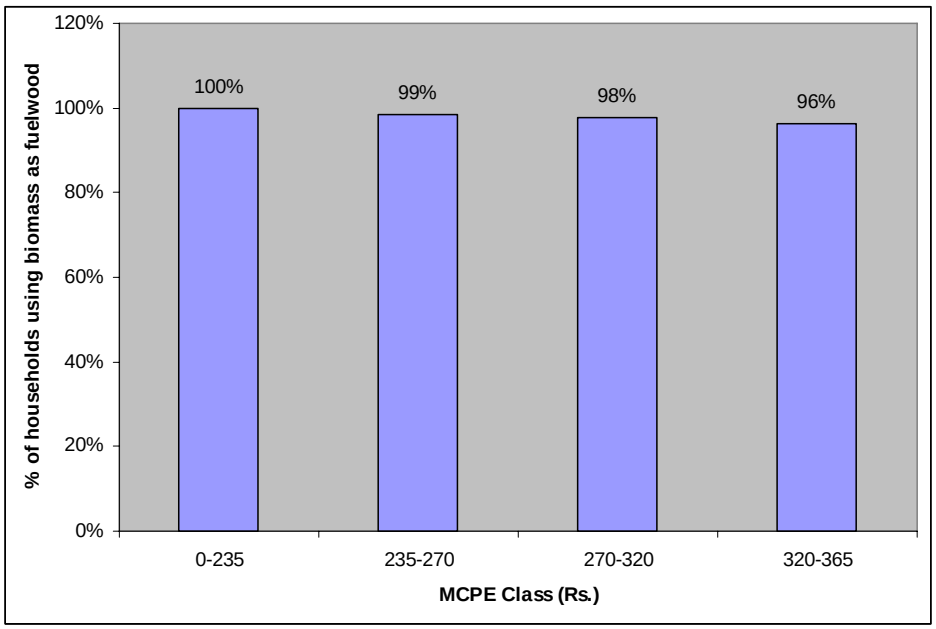


Figure 2: Percent of families using woody biomass in the lower income group in rural areas of Andhra Pradesh, India based on NSSO data, 2007

Step 2: Determining $f_{NRB,y}$:

In accordance with Paragraph 7 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04:

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

According to Paragraph 8 of the methodology, the fraction of woody biomass saved by the project activity is year y that can be established as non-renewable is

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

Based on the above concept, a national study was conducted by the Forest Survey of India, Ministry of Environment and Forests, Government of India to assess the woody biomass demand and availability at the state and national level in India during 1995. Based on the same concept and the national, local, remote sensing data and peer-reviewed research papers, the renewable and non-renewable component of biomass has been established at the Mandal level for the project area as detailed below and shown in Table 4.

Renewable Biomass

The land use pattern for the 15 mandals in which the project will be implemented is as follows:

Table 3 – Mandal wise land utilization pattern for 2009[4] (ha)

Name of the mandal	Forest	Barren & uncultivable land	Agricultural land	Grazing lands	Tree crops & groves	Cultivable waste	Other fallow lands	Current fallows	Net area sown	Geographical area
Anantapur	714	2,524	6,082	12	-	846	1,351	2,814	14,687	29,030
Atmakur	4,140	2,250	2,029	28	3	1,100	934	1,185	19,265	30,934
Bathalapalli	360	2,898	1,142	34	286	445	817	545	16,544	23,071
Beluguppa	1,787	1,274	303	7	25	821	505	2,495	26,872	34,089
Brahmasam-udram	1,342	2,199	3,207	6	45	702	1,616	1,502	18,204	28,823
Dharmavar-am	3,199	3,407	3,720	217	42	1,483	1,745	2,383	21,167	37,363
Garladinne	3,522	2,956	1,102	-	-	1,616	2,125	1,105	18,071	30,497
Kalyandurg	4,681	1,732	2,064	26	-	55	540	5,047	34,878	49,023
Kambadur	1,060	4,005	3,344	341	172	1,216	983	2,452	26,404	39,977
Kanekal	-	1,023	2,817	-	474	1,823	3,327	7,033	23,768	40,265
Kudair	3,814	4,896	1,619	-	824	1,066	1,656	1,527	22,918	38,320
Kundurpi	2,664	2,763	1,085	427	579	363	162	455	21,682	30,180
Raptadu	-	2,602	852	33	722	482	1,172	1,720	19,172	26,755
Rayadurg	5,264	2,264	609	-	455	1,586	969	886	21,632	33,665
Settur	2,532	1,834	1,294	-	222	1,094	-	2,305	21,685	30,966
Total	**35,079**	**38,627**	**31,269**	**1,131**	**3,849**	**14,698**	**17,902**	**33,454**	**3,26,949**	**5,02,957**
%	6.97	7.68	6.22	0.22	0.77	2.92	3.56	6.65	65.01	100.00

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.

The area classified as forests is as follows:

(a) The total area under forests together for 15 Mandals is 35,079 ha (Table 3) accounting for 6.97% of the geographic area. This area will remain as forests.
(b) These forests are classified as Tropical Dry Deciduous. Undertaking sustainable management practices on these land areas to ensure that there is no systematic decrease of carbon stocks, the sustainable rate of extraction from tropical dry deciduous forests are 0.22 t/ha/yr (Ravindranath *et al*. 2001[10]).
(c) Thus the renewable biomass component from the project area is Area (ha) x sustainable harvest (t/ha/yr) = 35,079 x 0.22 = 7,717 t/year.
(d) This estimation is conservative as the legal area classified as forests is considered. The actual area under forest vegetation according to satellite imagery is far lesser. For Anantapur district, the

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

total area officially under forests is 10.29%[4], while according to satellite imagery the actual area under forest vegetation is 2.23% of geographic area[11].

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

i. The land area remains cropland and/or grasslands or is reverted to 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, 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 3, are considered under this category:

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

- The total area under (a) to (g) is 4,64,030 ha.
- The total number of trees on these lands is 11.2 trees/ha[12]. This is based on studies conducted by Andhra Pradesh Forest Department, 2008.
- Total Culturable Non-Forest land[13] (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:
    - 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[11]).
    - 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[14]). 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 this land use for the project area is
  Area (ha) x sustainable harvest (t/ha/yr) = 4,64,030 ha x 0.13 t/ha/yr = 60,515 t/year.

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

- The total area under tree crops is 3,849 ha.
- Sustainable extraction rate is 2 t/ha/hr (Ravindranath *et al*, 2001)[10].
- Total sustainable biomass is 3,849 ha x 2 t/ha/yr = 7,698 t/yr.

Thus summarizing the above steps, Table 4 below shows the renewable biomass available as woody biomass.

[11] http://www.fsi.org.in/sfr2009/andhra_pradesh.pdf . Satellite imagery information by FSI is given at district level.

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

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

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

Table 4: Renewable Biomass Calculations for the project area

NRB Calculations			
Item	**Value**	**Unit**	**Source**
RENEWABLE BIOMASS IN THE PROJECT AREA			
Total Geographical Area of 15 Mandals	5,02,957	ha	Hand Book of Statistics 2010, Anantapur District, Chief Planning Officer, Anantapur
I. Renewable biomass from forests			
Forest Land	35,079	ha	Hand Book of Statistics 2010, Anantapur District, Chief Planning Officer, Anantapur
% of forest land classified as tropical dry deciduous	100%		Anantapur Forest department
Sustainable rate of woody biomass extraction from Tropical Dry Deciduous Forests	0.22	t/ha/yr	Ravindranath et al. 2001
Renewable biomass extraction from forests	**7,717**	**t/yr**	**Area x sustainable rate of extraction**
II. Renewable biomass from Culturable non-forest land			
Total Culturable Non-Forest land	4,64,030	ha	Hand Book of Statistics 2010, Anantapur District, Chief Planning Officer, Anantapur
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
Average Standing biomass/tree	0.41	tonnes	Based on Indian State of Forest Report, FSI, 2009
Average Standing biomass/ha	4.59	tonnes	Calculated
Mean Annual Increment	0.13	tonnes/ha	Calculated
Sustainable extraction from trees on CNFA	**60,515**	**tonnes**	**Area x sustainable rate of extraction**
III. Renewable biomass from Plantation			
Total Plantation area including misc tree crops and groves	3,849	ha	Hand Book of Statistics 2010, Anantapur District, Chief Planning Officer, Anantapur
Sustainable extraction rate from plantations	2.00	t/ha/year	Ravindranath et al. 2001
Sustainable extraction from plantations	**7,698**	**tonnes**	**calculated**
Total Sustainable Biomass Available	**75,931**	**tonnes/year**	**calculated**

The woody biomass requirement of the mandal and the renewable and non-renewable biomass used is shown below:

Adult Equivalent using Fuelwood (82.3% of rural population)	4,29,900	Adult Equivalent	Hand Book of Statistics 2010, Anantapur District, Chief Planning Officer, Anantapur
Fuelwood requirement per adult	1.99	tonnes/year	Based on household survey
Total fuelwood requirement	**8,57,430**	**tonnes/year**	**calculated**
Renewable Woody Biomass (DRB)			
Renewable Woody Biomass	**75,931**	**tonnes/year**	**calculated**
Non Renewable Woody Biomass (NRB)			
Non Renewable Woody Biomass	**7,81,500**	**tonnes/year**	**calculated**
Fraction of non-renewable biomass ($f_{NRB,y}$)			
$f_{NRB,y}$	**0.91**		**calculated**

The fraction of non-renewable woody biomass used in the absence of the project activity is 0.91.

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,[15] "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. 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"[16]. 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[17]. 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

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

[16] 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.

[17] 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.

Non Sustainable Wood Use	12.09	12.49	12.90	13.33	13.77
Fraction of Non renewable biomass f_{NRB}	**0.90**	**0.91**	**0.91**	**0.91**	**0.91**

- The f_{NRB} calculated for the Mandals of the project area is in agreement with other studies.
- Further at the district level (project area), the total forest cover of Anantapur district is a mere 2.23% of the total area (Table 5 and Figure 4). The district is the second most drought-affected district of India[18,19]. Over the years the process of desertification has been taking place in large tracts of the district because of degradation of the forests. The landscape is undulating and has large arid, treeless expanses of poor soils due to large-scale lopping of the trees in the patches of green.
- *Decrease in carbon stocks:* According to the National Remote Sensing Agency (2000, 2005 and 2010), based on remote sensing satellite imagery, the percentage of wastelands has increased (from 16.9% to 18.73%) and the degraded forests in Anantapur increased between 1995 and 2005[20,21]. Today the remaining forests provide very little wood for fuel while the continuous usage of them further is damaging the vegetation and soil. According to the remote sensing satellite imagery, the only forests in the district are very scanty and disperse scrub and open forests (Table 5). Desertification is spreading widely in Anantapur, due to deforestation and degradation attributable to extraction for fuelwood and further accelerated by erratic rainfall and heavy soil erosion[22].

Number of districts: 23 (area in km²)

District	Geographical area	Very dense forest	Mod. dense forest	Open forest	Total	% of G.A.	Change*	Scrub
Anantapur	19,130	0	73	353	426	2.23	-2	956

Table 5: Forest Cover of Anantapur district based on Remote Sensing Satellite Imagery. Source: Forest Survey of India, Ministry of Environment and Forests, Govt. of India[23].

[18] http://www.timbaktu.org/conditions.html

[19] http://www.anantapur.gov.in/html/agri-dep-profile.htm

[20] Wasteland Map of India, 2000, 2005 and 2010, National Remote Sensing Agency, Hyderabad. http://dolr.nic.in/wasteland_atlas.htm

[21] Andhra Pradesh Human Development Report, 2007. Govt of Andhra Pradesh

[22] http://www.deccanchronicle.com/anantapur/desertification-threat-looms-over-anantapur-713

[23] http://www.fsi.org.in/sfr2009/andhra_pradesh.pdf

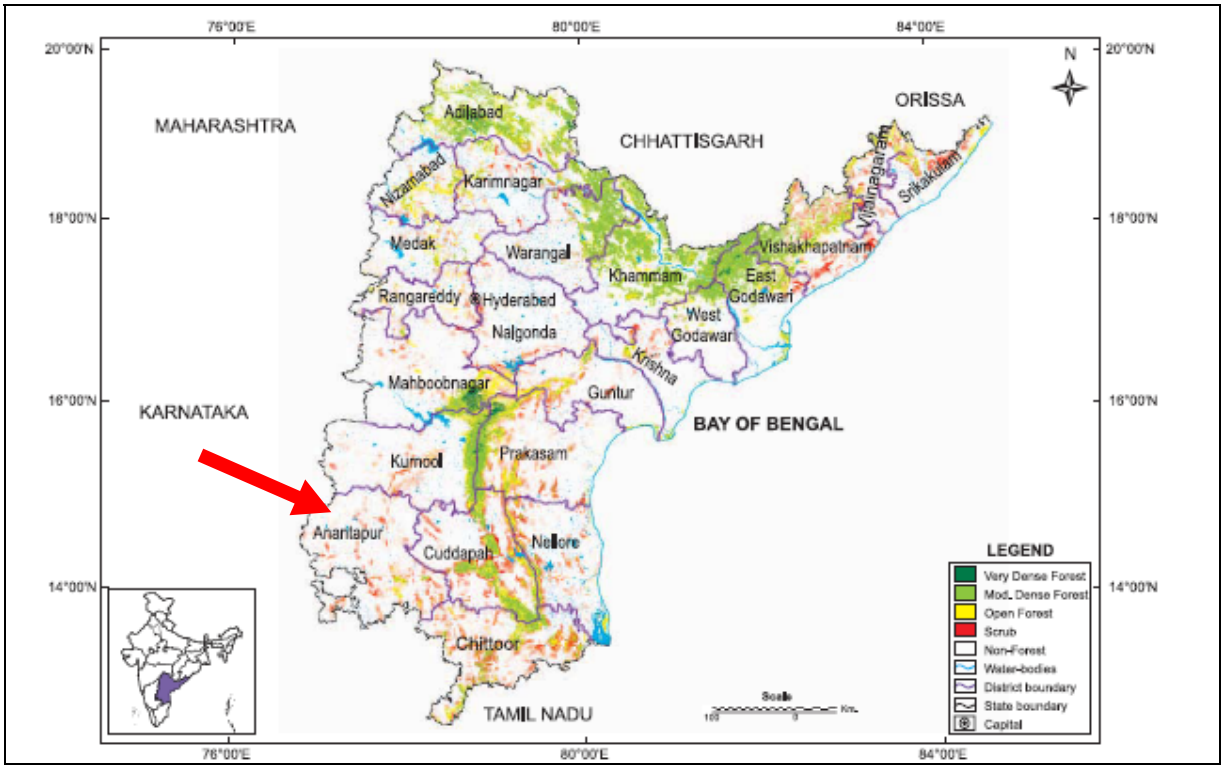


Figure 4: Forest Cover Map based on Remote Sensing of Andhra Pradesh State showing Anantapur district. Source: Forest Survey of India, Government of Environment and Forests, Govt. of India[23].

Increasing trends in fuel wood price indicating scarcity;

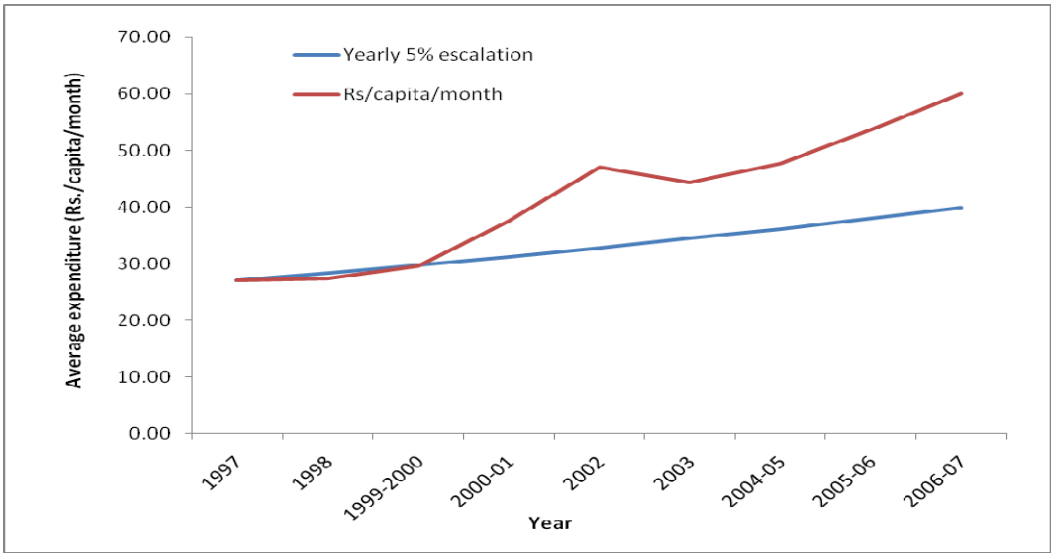


Figure 5: Relative escalation of prices (5% per year corresponds to the average inflation rate in India vis-vis the actual prices towards fuel and light spent by rural population in Andhra Pradesh

Yearly consumer expenditure survey among Indian households is carried out by the National Sample

Survey Organisation (NSSO). Information on energy sources used both for cooking and lighting was collected as part of the survey. The survey conducted during 2004 presented separately the energy used for cooking and lighting in rural areas, which shows that fuelwood consumption accounted for 54% of the total consumption expenditure. As such, it can be seen that there is an increase in price beyond the yearly inflation rate, indicating scarcity (Fig 5).

As mentioned in the methodology, the above two conditions; remote sensing data showing depleting carbon stocks in the project area and increasing trends in fuel wood price indicating scarcity, clearly proves non-renewable woody biomass use in the project area.

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

The district is facing fuelwood crisis since many years as the area has scanty vegetation (Figure 6). The use of non-renewable biomass since 1989 is demonstrated below applying the same steps as shown above for 2010. As can be seen from Table 6, 0.88 of the woody biomass was non-renewable woody biomass. Though large-scale plantations are being promoted in the district by the Forest Department, non-renewable use of woody biomass has increased over the past 20 years. This is due to the fact that the population has increased by 30% over the past 20 years.

Table 6: Use of non-renewable use in 1989 in the 15 Mandals of the project area.

NRB Calculations			
Item	**Value**	**Unit**	**Source**
RENEWABLE BIOMASS IN THE PROJECT AREA			
Total Geographical Area of 15 Mandals	5,07,504	ha	Hand Book of Statistics 1989, Anantapur District, Chief Planning Officer, Anantapur
I. Renewable biomass from Forests			
Forest Land	30,843	ha	Hand Book of Statistics 1989, Anantapur District, Chief Planning Officer, Anantapur
% of forest land classified as tropical dry deciduous	100%		Anantapur Forest department
Sustainable rate of fuelwood extraction from Tropical Dry Deciduous Forests	0.22	t/ha/yr	Ravindranath et al. 2001
Renewable biomass extraction from forests	**6,785**	**t/yr**	**Area x sustainable rate of extraction**
II. Renewable biomass from Non-forest land			
Total Culturable Non-Forest land	4,73,603	ha	Hand Book of Statistics 1989, Anantapur District, Chief Planning Officer, Anantapur
No of trees/ha of Culturable Non Forest Area	11.2	trees/ha	Based on Indian State of Forest Report, FSI, 2009
Mean Annual Increment	2.84%	of standing Biomass	Shailaja and Sudha, 1987
Average Standing biomass/tree	0.41	tonnes	Based on FSI, 2007 report - State of Forest Report 2005
Average Standing biomass/ha	4.49	tonnes	Calculated

Mean Annual Increment	0.13	tonnes/ha	Calculated
Sustainable extraction from trees on CNFA	**61,764**	**tonnes**	**Area x sustainable rate of extraction**
III. Renewable biomass from Plantation			
Total Plantation area including misc tree crops and groves	3,058	ha	Hand Book of Statistics 1989, Anantapur District, Chief Planning Officer, Anantapur
sustainable extraction rate from plantations	2.00	t/ha/year	Ravindranath et al. 2001
Sustainable extraction from plantations	**6,116**	**tonnes**	**calculated**
Total Sustainable Biomass Available	**74,665**	**tonnes/year**	**calculated**
FUELWOOD REQUIREMENT FOR THE 15 MANDALS			
Adult Equivalent using Fuelwood (82.3% of rural population)	3,19,878	Adult Equivalent	Hand Book of Statistics 1989, Anantapur District, Chief Planning Officer, Anantapur
Fuel wood requirement per adult	1.99	tonnes/year	Based on household survey
Total fuel wood requirement	**6,37,994**	**tonnes/year**	**calculated**
Renewable Woody Biomass (DRB)			
Renewable Woody Biomass	**74,665**	**tonnes/year**	**calculated**
Non Renewable Woody Biomass (NRB)			
Non Renewable Woody Biomass	**5,63,329**	**tonnes/year**	**calculated**
Fraction of non-renewable biomass ($f_{NRB,y}$)			
$f_{NRB,y}$	**0.88**		**calculated**

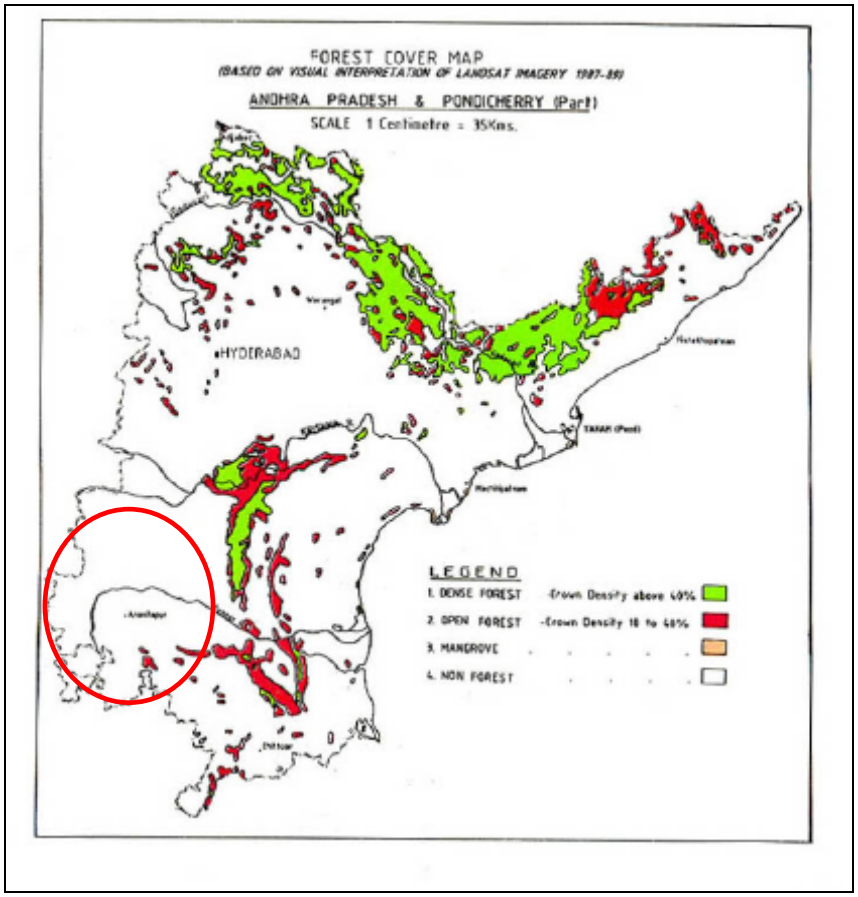


Figure 6: Forest Map of Andhra Pradesh for 1989 showing the project area.

Step 3: Choosing $EF_{projected\_fossilfuel}$

According to Paragraph 5 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04, this should be *emission factor for the substitution of non-renewable woody biomass by similar consumers. Use a value of 81.6 tCO_2/TJ.*

As can be seen from the energy ladder for rural India (Fig 7), the mix of present and future fuels used would consist of a solid fossil fuel at the lowest in the ladder of fuel use choices, followed by liquid and gaseous fuel type in progression.

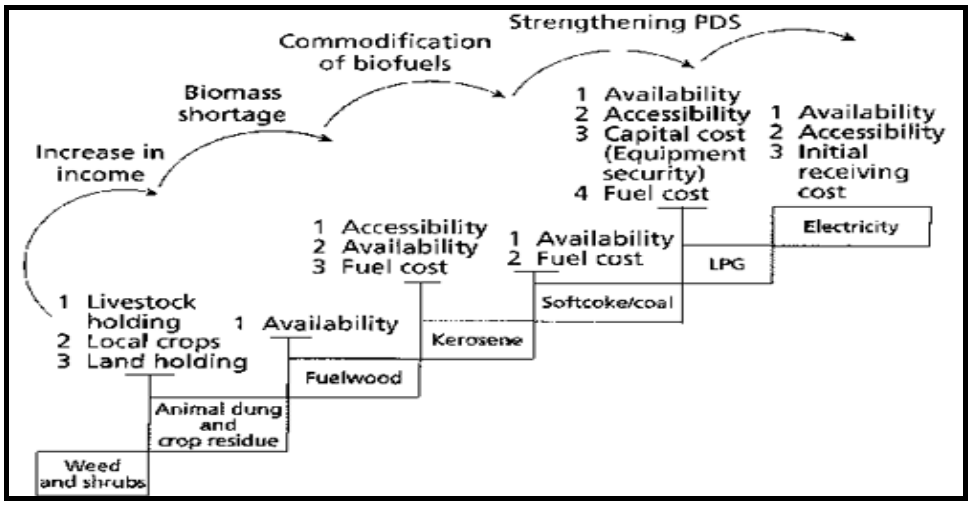


Fig 7: Environmental implications of the energy ladder in rural India. Boiling Point. Issue 42. Household energy and the environment[24]

Thus $EF_{projected\_fossilfuel}$ is 81.6 tCO_2/TJ.

Step 4: Calculating ER_y

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

Emissions from the use of fossil fuels for meeting similar thermal energy needs			
Activity Data	**Value**	**Unit**	**ID Ref**
Quantity of Biomass that is substituted (t/yr)	53,550	tonnes/yr	*By*
Fraction of NRB	0.91	-	$f_{NRB, y}$
NCV Biomass (TJ/t)	0.015	TJ/tonne	$NCV_{biomass}$
Emission factor (tCO_2/TJ)	81.6	tCO_2/TJ	$EF_{projected\_fossilfuel}$
Emission Reductions (tCO_2/yr)	59,596	tCO_2/yr	ER_y
Emission Reductions (tCO_2/yr)/family	**3.97**	**tCO_2/family/yr**	

This equates to emissions reduction of **3.97 tCO_2/ household/yr.**

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

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

[24]http://www.greenstone.org/greenstone3/nzdl?a=d&d=HASH1f8cf18388e35f9d815937.4.pp&c=cdl&sib=1&dt=&ec=&et=&p.a=b&p.s=ClassifierBrowse&p.sa=

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

Use of coal/charcoal: Coal and charcoal are not considered as an alternative as they are not used by the communities for cooking purposes in this region[9]. This is also evident from the survey conducted (Annex 3). Thus, this alternative is not included for barrier analysis.

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

i) Continued use of traditional cook stove for cooking: The use of traditional wood stoves represents the baseline situation in the local area leading to 3.97 tCO_2/family/yr. The traditionally used stoves come in 3 basic categories; a traditional 3-stone stove with no associated costs, and a mud/clay or cement stove which is build with local material with no costs to a costing of about Rs.200. The traditional cook stove is fabricated *in situ* by housewives using locally available clay or mud. The fabrication usually involves a labour investment of 3-4 hrs. A traditional cook stove in rural India is usually installed and maintained at zero cost. For maintenance, the traditional cook stove is plastered regularly with fresh clay and water. The opportunity cost for regular construction and maintenance is considered negligible[25]. The running cost of all the above cook stoves is not considered an investment barrier as biomass is collected free from local wasteland, forest land, and agricultural land[26]. The rural poor do not have much cash to spend on energy and use the fuels they collect to meet their cooking needs[25]. Thus self-collected fuels do not have a monetary cost (Reddy, 2009)[27].

A study in Andhra Pradesh shows that around 85% of the households in Andhra Pradesh are dependent on biomass as fuel for meeting cooking and heating purposes. The families using biomass for cooking accounts for 80.85%, followed by 2.76% of cow dung, 0.48% of biogas, 7.75% of kerosene, 5.95% of LPG, 0.86% of coal/coke and 0.12% electricity (Ramachandran, 2004)[28]. Based on a national survey conducted by NSSO, in rural areas, at the national level, 75% of the households and at the state level in Andhra Pradesh, 80.3% of the households use firewood as the primary source of energy (NSSO, 2007[9]). In households from the lower economic strata of rural areas, nearly 98% of households use firewood for cooking (Fig 8). Thus it can be seen that firewood has been the dominant cooking fuel in rural Andhra Pradesh as shown below. The demographic survey in the project area (507 villages) also shows that biomass is used by nearly 95.12% of the families. Thus it can be seen that firewood has been the dominant cooking fuel in the project area.

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

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

[27] Reddy.B.S., Balachandra. P., Nathan.H.S.K. (2009). Universalization of access to modern energy services in Indian households - Economic and policy analysis. Energy Policy 37 (2009) 4645–4657.

[28] http://www.unescap.org/esd/energy/cap_building/integration/egm/documents/G_Ramachandran_paper.pdf

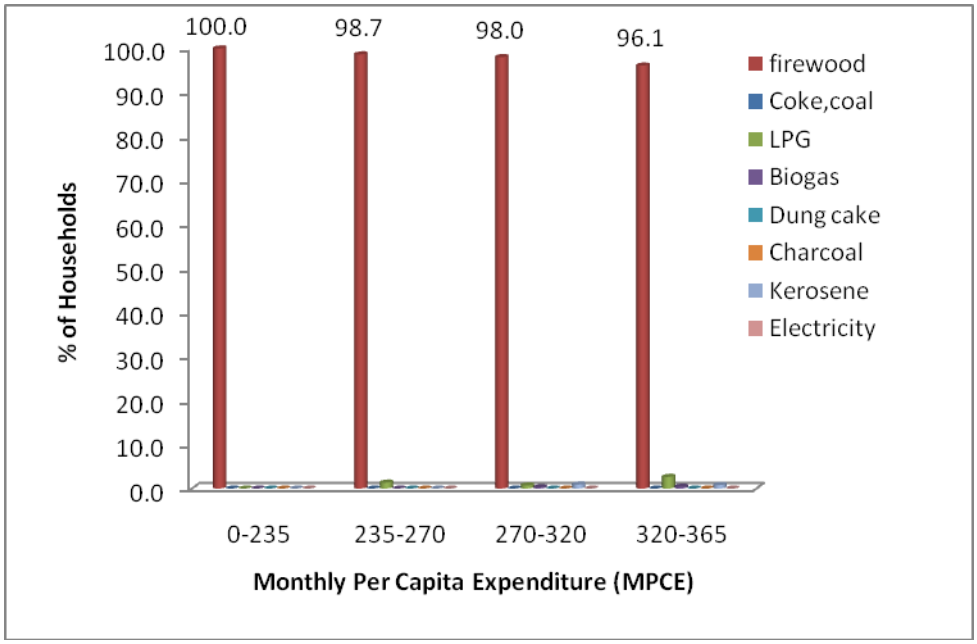


Fig 8: Fuel type used by lower MPCE group in rural areas of Andhra Pradesh (NSSO, 2007)

Thus there is no investment barrier to the continued use of traditional cook stoves and non renewable biomass for cooking.

ii) Use of Kerosene: Kerosene as a cooking fuel is available to families below the poverty line through the public distribution system at subsidized prices. Two litres of kerosene are supplied each month via the public distribution system in Anantapur district at a subsidised rate of Rs.13 per litre to ration card holders[29]. Approximately 24.7 litres of kerosene (Annex 3) are required to completely replace fuel wood and meet the cooking requirements of an average rural household per month. Additional kerosene has to be purchased from the open market at a rate of Rs.34 per litre[30]. Reliance on kerosene as the sole cooking fuel would equate to a monthly cost of nearly Rs. 800 for the average family and is thus not a viable alternative for any of the participating families. Subsidies for kerosene are limited to amounts sufficient only for lighting homes, and are inadequate for meeting the cooking requirements of poorer women. In spite of such subsidies for many decades they have failed to shift fuel consumption patterns away from biomass in rural areas[31].

Further, the baseline survey revealed an average monthly consumption of only 0.37 litres per household primarily for kindling the fuelwood. The remainder of kerosene obtained via the government distribution service is used as fuel in kerosene lamps for lighting and not for cooking. This is also substantiated by the fact that kerosene is not the primary fuel for cooking in rural households at the national or state level[9].

[29] http://anantapur.gov.in/images/inner/district_intiatives/k-oil-05-08-2010.pdf

[30] http://www.hindu.com/2006/04/20/stories/2006042009960200.htm

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

This proves to be high costs compared to using traditional cook stoves and kerosene is not a financially viable option to completely replace the traditional cook stove. Thus the poor continue to rely on biomass, which are procured with no costs.

iii) Use of LPG: The lump sum initial investment required for LPG installation (including security deposit, regulator, LPG hose, cylinder and gas stove) is Rs. 3000[32]. A 14.2-litre cylinder of LPG costs approximately Rs. 395[33] after subsidy and will last an average family less than a month if used to meet all cooking requirements. An LPG connection (deposit for the pressurised cylinder/canister) and stove constitute a large upfront cost (when compared with the equipment required for other fuels), so that the few who can afford the fuel cannot make the initial investment[34]. The poor rural communities participating in this biogas project are unable to afford the upfront costs of the LPG kit since the majority are agricultural and daily-wage workers with an income of less than 1$/day/capita.

Further, there is also lack of infrastructural support (e.g. lack of facilities for refilling LPG cylinders at the doorstep) that further prohibits the widespread adoption of LPG in the rural context. In India, LPG is supplied through distribution outlets of oil marketing companies. Currently, rural areas of the country are located far from such distribution centres, so that users have to pay for the extra costs of cylinder supply. For the project area, the additional cost for transportation of cylinder to the doorstep is approximately Rs.50. Thus the total cost will work out to Rs.450/- per month. Moreover, for small and remote markets, refills often take more than a week. For those users that do not keep a second cylinder, this could mean going without fuel for as long as two weeks. Signing up for two cylinders to avoid running out of cooking fuel would further increase the start-up cost of LPG service. Again, this infrequent delivery of refill cylinders serves as a disincentive against switching entirely to LPG[35]. Due to logistical problems the few rural LPG users that exist often have to wait for long duration to get a cylinder refilled. Due to such circumstances it is impossible for even a wealthy rural household to rely on LPG as its main cooking fuel.

Presently, Government of India is planning a large scale implementation of distributing LPG cylinders in rural households. Locations for setting up of Rajiv Gandhi Gramin LPG Vitrak (RGGLV)[36] are identified broadly based on potential of average monthly sale of 600 LPG cylinders of 14.2 kg and 1800 customers with monthly per capita consumption of about 5 Kg, The assessment of refill sale potential is based on several factors including population, population growth rate, economic prosperity of the location and the distance from the existing nearest distributor. Setting up of RGGLV at the identified location is still a business proposition. Thus it is not a scheme, wherein there is a reach to all the rural households irrespective of their economic conditions. The initial investment barrier would still prevail making it difficult for the rural population to adopt LPG as cooking fuel. Among the distributors' list announced at the national level, Anantapur does not have any distributor appointed under the scheme[37].

[32] http://www.iocl.com/Products/LiquefiedPetroleumGasFAQ.aspx shows the investment cost for LPG connection. Additionally, LPG hose pipe is Rs. 200 and stove cost is Rs. 1000.

[33] http://www.deccanchronicle.com/channels/cities/hyderabad/lpg-price-hiked-rs-50-diesel-costlier-rs-3-480

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

[35] http://siteresources.worldbank.org/INDIAEXTN/Resources/Reports-Publications/Access-Of-Poor/KeroseneLPG.pdf

[36] http://www.iocl.com/Talktous/Brochure_RGGLV1261009.pdf

[37] http://www.ebharatgas.com/ebgas/pages/general/gen_result_rgglv.jsp

The Government of Andhra Pradesh launched a targeted subsidy programme called the Deepam Scheme, to encourage the uptake of LPG among low-income households in July 1999. In this Scheme, the Government pays the LPG connection fee for women who belong to Self-Help Groups (SHGs) and whose households are classified as being below the poverty line (BPL). The Deepam scheme differs from traditional fuel subsidies in two respects: (1) it is targeted; and (2) it is a one-time capital subsidy in that it subsidies LPG connection rather than LPG refill as with price subsidies. Deepam beneficiaries have to cover other upfront costs of taking up LPG purchase of a stove and connecting accessories amounting to about Rs.1,000. A World Bank evaluation study of the scheme showed that the scheme had not made an impact due to lack of adequate LPG distribution net work, lack of refilling of cylinders at doorstep, the higher refill cost depending on the distance to the dealer[38].

Thus in rural areas, the penetration of LPG, especially in the lower MPCE class is negligible, due to high initial investment and recurring costs. Thus investment barrier prevents the adoption of LPG.

iv) Implementation of the project in the absence of CDM revenue: An individual 2 meter cubed biogas unit costs approximately Rs. 16,200[39]. This is a sum that far exceeds what the target population of this project can afford. They are not able to save or get personal loans to meet this cost. Even though all the project participants are aware of the potential of biogas technology, they continue to put up with the adverse health effects caused through the use of traditional wood stoves in unventilated kitchens. This can be evidenced by the low rate of biogas units installed and running so far in the project area.

A National Programme for Biogas Development (NPBD) is implemented by the Government of India that offers subsidy for installing biogas units. The NPBD of the Ministry of New Renewable Energy (MNRE) was started in 1981-82 for promotion of family type biogas plants, the current potential of which is estimated at 12 million, to provide clean alternate fuel to the rural masses and enriched organic manure for agriculture. The implicit objective of the programme is to reduce the use of fuel wood[40]. It is a central sector scheme covered under 20-point programme. According to Non-conventional Energy Development Corporation of Andhra Pradesh Limited (NEDCAP), the state nodal agency responsible for the implementation of the NPBD programme, 2.5 lakh family biogas plants have been installed within the state of Andhra Pradesh to date, while the overall potential is 10.9 lakh units[41].

In Anantapur district, in the past 28 years ever since the scheme started, 18,585 biogas units have been built on an average of 664 biogas units/year[42] whereas based on the livestock population the potential in the district is approximately 5 lakhs[43].

To date, even with subsidies, this programme has resulted in very less penetration of biogas at the national, state, district or project area level. Even with subsidies it is beyond the reach of the rural poor communities. The subsidy from the Government ranges between Rs.2,100-Rs.2,700 depending on

[38] http://www.unescap.org/esd/energy/cap_building/integration/egm/documents/G_Ramachandran_paper.pdf

[39] Dr. K. C. Khandelwal. 2008. Country Report on Financing of Domestic Biogas Plants in India. International Workshop on Financing of Domestic Biogas Plants Bangkok, Thailand. Asia Biogas Programme, SNV Netherlands Development Organisation

[40] Ministry of New and Renewable Energy. http://www.mnre.gov.in/

[41] http://www.nedcap.gov.in/Biogas_and_Bioenergy.aspx?ID=35

[42] NEDCAP, Anantapur District, 2010

[43] @ the rate of 2 adult cattle/biogas and 4 calf/biogas

beneficiaries economic status[44]. Even with subsidies, it is beyond the reach of the poor rural communities as they will still have to spend Rs.13,000 -14,000 as capital cost for construction of a biogas unit. An evaluation study undertaken by the Government of India found that majority of biogas users benefiting from the scheme are well-to-do farmers holding a sizeable amount of agricultural land[45]. Thus based on NSSO study, in Andhra Pradesh, 0.02% of rural households and at the lower MCPE households, approximately 0.2% of rural households use biogas[9].

Further the government programme for providing biogas plants for the poor has been reduced at the State level, and thus the capital shortfall prevents the continued expansion of the biogas programme in India. The common practice for poor households is to depend on free sources of firewood. The evaluation concludes that the impact of the NPBD programme is not significant even though the programme has remained operational for about two decades.

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

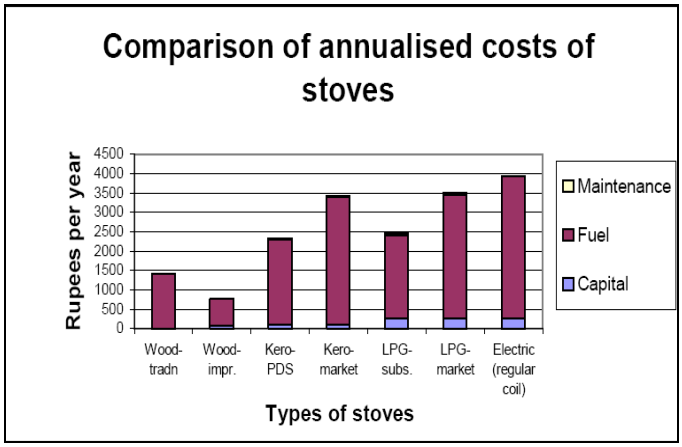


Figure 9: Comparison of annualized costs of stoves for cooking[34]

Thus the continued combustion of non-renewable biomass fuel for cooking and water heating is the cheapest option (Figure 9), leading to higher GHG emissions. Thus even now all the households use traditional fuel wood stoves for cooking and water heating in the mandals. Poorer households in rural areas in India still have very little access to formal finance. A Rural Finance Access Survey, conducted jointly by the World Bank and the National Council of Applied Economic Research, India, indicates that rural banks serve primarily the needs of the richer rural borrowers: some 66% of large farmers have a deposit account; 44% have access to credit. Meanwhile, the rural poor face severe difficulties in accessing savings and credit from the formal sector: 70% of marginal/landless farmers do not have a bank account and 87% have no access to credit from a formal source. Thus, access to formal credit for farmers to implement energy saving devices is an issue[25]. As such, the communities prefer to use the traditional cook stove instead of building a biogas plant which involves highest initial capital cost of all energy options for

[44] Ministry of Non Conventional Energy, National biogas and manure management programme, http://www.mnre.gov.in/adm-approvals/prog-ftbp.htm

[45] http://planningcommission.gov.in/reports/peoreport/peoevalu/peo_npbd.pdf

cooking. Similar activities in the region have been only implemented with subsidies under the National Programme for Biogas Development. Even with subsidies, the cost to build a biogas unit will be very high in the project area for the rural poor.

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

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

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

Biogas plants have to be constructed very carefully. This takes skill, diligence, careful working with acute attention to detail and the careful design of each plant as shown in section A.4.2 so that it is suited to the local conditions at each plot of land where it is to be constructed[46]. At present there is a shortage of adequately trained biogas masons capable of constructing and maintaining high quality functioning biogas units.

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

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

One of the barrier to successful implementation of a biogas project is good maintenance; attending to structural and operational problems of the biogas units for continuous operation of the biogas units. The success or failure of any biogas plant mainly depends upon the quality of construction works. To successfully construct a biogas plant, the mason should not only respect the dimensions as indicated on the drawing (section A.4.2) but also follow the correct construction method. It takes organizational and management skills and coordination to organize construction and continued use of the biogas units[47]. Not

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

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

only do the plants have to be built to suit local soil conditions, but service and maintenance crews have to be trained and stationed in all the villages to ensure smooth running of the plants. Emissions from the combustion of non-renewable biomass fuel can only be avoided through professional attention to this rural renewable energy technology and manage it efficiently with sufficient resource – financial, technical, operational and managerial. Ineffective repair and maintenance strategy, poor service backup to handle the technical hiccups in field during operation are the main institutional barriers to this technology[48]. The Government evaluation studies shows that 55% of the biogas plans built are non-functional due to structural and operational problems, failure of dissemination strategy, lack of users training and follow-up services[45]. These services are required for continuous operation of the biogas units.

Thus, proper extension and support services will be provided by AF Ecology Centre at the village level as described in section B.7.2. At each village, the biogas units will be monitored for its usage. If any biogas unit falls to despair, it will be repaired immediately to make it functional. Thus, in this way, plants will not be allowed to fall into disrepair, when their functioning will depend upon adequate maintenance skills, which should be available in every village. The emphasis will be to promote the participation of local people in the whole process of education, planning and monitoring, so that the renewable technology is viable and sustainable to the communities it is designed to serve. Coordinated management information systems will be developed as part of biogas development, in order to identify problems and undertake remedial measures. A portion of the CER revenues received as forward funding for the project will be set aside to undertake repair and maintenance of biogas units.

Construction of a Deenabandhu 2 cum model costs Rs. 16,200[49]. Thus as per EB 59, Para 36, applying simple cost analysis for the project activity, the cost of implementation of the project activity for 15,000 households in a span of 3 years is Rs. 243 million.

Year	Cost of stoves	Total (Rs)
Year 1	Rs. 16,200/biogas/family @ 5000 constructed per year	81,000,000
Year 2	Rs. 16,200/biogas/family @ 5000 constructed per year	81,000,000
Year 3	Rs. 16,200/biogas/family @ 5000 constructed per year	81,000,000
Total Cost		243,000,000

This does not take into account price escalation of building materials such as cement, bricks, sand, labour, steel, pipes, stoves, etc. and associated maintenance costs. This also does not take into account the costs involved with CDM registration process (i.e. pre-project costs, documentation, monitoring costs, validations and verifications etc.). The project activity does not produce any economic benefit other than CDM revenues, which would be Rs. 204,314,400 (@10 Euros/CER) for the crediting period.

AF Ecology Centre as an NGO would not be able to finance; the training of its field staff, the end users of the biogas units, the proposed biogas mason apprenticeship scheme and the training of a biogas maintenance team, with out CDM revenue. It would also not be able to attract the managerial resources and undertake the required organizational building required.

Conclusion

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

[49] http://www.mnre.gov.in/adm-approvals/prog-ftbp.htm

The project will be implemented among the End User Group formed at the village level in 507 villages across 15 Mandals. Taking into account the national and sectoral policies and circumstances, the emissions reductions will not occur in the absence of the proposed small-scale project activity. The proposed project has to overcome various barriers as mentioned above and displace economically viable options which lead to higher emissions. Barriers make it unlikely that biogas plants will be built and in the absence of CDM revenue, these barriers would automatically lead to an implementation of a technology with higher emissions. In the absence of this CDM project, the above barriers would prevent the construction and maintenance of the proposed biogas units. Thus the traditional stone/mud stove which is financially a more viable alternative to the project activity and is less technologically advanced has lower risks to performance uncertainty leading to higher emissions. On the other hand, the project activity has low market share and is technologically more advanced, requiring skilled labour to build them. The aim is that CDM revenue will enable biogas technology for cooking to overcome the described barriers and promote biogas plants in the project area. The CDM project will overcome this barrier by providing upfront CER revenue for construction of the biogas units and continuous support for monitoring and maintenance of the units.

The described project activity is clearly additional because it will be financed completely through the revenues from forward financing of CER sales, and cannot be realized without the revenues from carbon credits. Thus it is clear that, in the absence of CDM project, which will provide the upfront investment for the establishment of 15,000 biogas plants for the rural poor, this project will not happen.

B.6. Emission reductions:

B.6.1. Explanation of methodological choices:

Sectoral Scope 01, TYPE I - RENEWABLE ENERGY PROJECTS, I.E. Thermal energy for the user, Version 04, EB 60. According to the methodology, the baseline emission reductions and leakage emissions will be calculated step-wise as described in section B.4.

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

Data / Parameter:	**Rating Biogas**
Data unit:	kW/digester
Description:	Capacity of a digester
Source of data used:	Calculated as shown in Section B.2
Value applied:	1.78
Justification of the choice of data or description of measurement methods and procedures actually applied :	Calculated as shown in Section B.2
Any comment:	Qualifies as a small-scale project. This parameter is fixed for the entire crediting period

Data / Parameter:	**B_y**
Data unit:	Tonnes /family/year
Description:	Quantity of woody biomass that is substituted or displaced in tonnes
Source of data used:	Survey

Value applied:	3.57 tonnes/year/family
Justification of the choice of data or description of measurement methods and procedures actually applied :	Based on sample survey. This is further supported by a study done by Ramachandra, 2005. Details of the survey is given in Annex – 3
Any comment:	This parameter is fixed for the entire crediting period

Data / Parameter:	$f_{NRB,y}$
Data unit:	-
Description:	Fraction of woody biomass used in the absence of the project activity in year y that can be established as non-renewable biomass
Source of data used:	Assessment of Non Renewable Biomass
Value applied:	91% for 2010 and 88% for 1989
Justification of the choice of data or description of measurement methods and procedures actually applied :	- utilized government data and method followed by the Forest Survey of India, Ministry of Environment and Forests, Government of India.
Any comment:	This parameter is fixed for the entire crediting period

Data / Parameter:	$NCV_{biomass}$
Data unit:	TJ/tonne
Description:	Net Calorific Value of Biomass
Source of data used:	I.E Methodology, Version 4.
Value applied:	0.015
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	This parameter is fixed for the entire crediting period

Data / Parameter:	$EF_{projected\_fossilfuel}$
Data unit:	tCO_2/TJ
Description:	Emission factor for substitution of non-renewable woody biomass by similar consumers.
Source of data used:	IPCC I.E Methodology, Version 4.
Value applied:	81.6
Justification of the choice of data or description of measurement methods and procedures actually applied :	-
Any comment:	This parameter is fixed for the entire crediting period

Data / Parameter:	**Diversion of non-renewable biomass saved under the project activity by non-project households**
Data unit:	tonnes / year
Description:	Diversion of non-renewable biomass saved under the project activity by non-project households
Source of data to be used:	Based on the methodology B_y will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages.
Value of data	**2700 t/yr**
Description of measurement methods and procedures to be applied:	According to I.E, Version 4, B_y can be multiplied by a net to gross adjustment factor of 0.95 to account for leakages, in which case surveys are not required. **3.57 – 3.39 = 0.18 t/Household/yr x 15,000 = 2700 t/yr**
QA/QC procedures to be applied:	This parameter is fixed for the entire crediting period. Surveys will not be conducted to determine leakage
Any comment:	Based on the methodology B_y will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages.

B.6.3 Ex-ante calculation of emission reductions:

Emission Reductions:

Emission Reductions (tCO_2) = Baseline Emissions – Project Activity Emission – Leakage

According to the methodology, there are no project emissions. According to the methodology, Para 4, the specific equations for calculations of Baseline emissions and Project emissions is not provided, but only for Emissions Reductions as follows:

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

Baseline Emissions

The parameters and values for baseline emissions are explained in Section B.4.

Emissions from the use of fossil fuels for meeting similar thermal energy needs		
Activity Data	**Value**	**ID Ref**
Quantity of Biomass that is substituted (t/yr)	53,550	B_y
Fraction of NRB	0.91	$f_{NRB, y}$
NCV Biomass (TJ/t)	0.015	$NCV_{biomass}$
Emission factor (tCO_2/TJ)	81.6	$EF_{projected\_fossilfuel}$
Emission Reductions (tCO_2/yr)	59,596	$\boldsymbol{ER_y}$
Emission Reductions (tCO_2/yr)/family	**3.97**	

Leakage

According to Para 10 and 11 of the methodology:

Leakage related to the non-renewable woody biomass saved by the project activity shall be assessed based on ex post surveys of users and the areas from which this woody biomass is sourced (using 90/30 precision for a selection of samples). The following potential source of leakage shall be considered:

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

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

There will not be any transfer of equipment being currently utilized transferred from outside the project boundary to the project boundary. All the biogas units will be constructed at site. Thus leakage from equipment transfer need not be monitored.

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

Thus B_y is considered as 3.39 taking into account leakage factor. Thus survey will not be conducted to account for leakage.

According to the methodology, Version 4, after considering leakage, the emission reduction calculations are as follows:

Activity Data	Value
B_y	3.57
B_y adjusted for leakage (B_y x 0.95)	**3.39**
f_{NRBy}	0.91
Quantity of Biomass that is substituted (t/yr) after considering leakage (factor of 0.95)	50,873
$NCV_{biomass}$ (TJ/tonne)	0.015
$EF_{projected\_fossilfuel}$ (tCO_2/TJ)	81.6
CER generated for the project activity (15,000 HHs)	**56,616**
CERs generated/HH	**3.77**

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

Year	Estimation of project activity Emissions (tCO_2e)	Estimation of Baseline Emissions (tCO_2e)	Estimation of leakage (tCO_2e)	Estimation of overall emission reductions (tCO_2e)
2012-13 (1st June 2012)	0	19,865	993	18,872
2013-14	0	39,731	1,987	37,744
2014-15	0	59,596	2,980	56,616

2015-16	0	59,596	2,980	56,616
2016-17	0	59,596	2,980	56,616
2017-18	0	59,596	2,980	56,616
2018-19	0	59,596	2,980	56,616
Total (tonnes of CO_{2e})	0	3,57,576	17,880	3,39,697

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

B.7.1 Data and parameters monitored:

Data / Parameter:	**Biogas Units constructed**
Data unit:	Number
Description:	Number of biogas units constructed
Source of data to be used:	Monitoring of construction of biogas units and its start date of operation will be from the on-line monitoring solution of AF Ecology Centre
Value of data	5,000 units/year for 3 years totalling to 15,000
Description of measurement methods and procedures to be applied:	- The biogas units built for the households will be entered into the on-line monitoring database. - The beneficiary will sign an End User agreement with AF Ecology Centre with all details of the family to identify the user irrefutably. - The timeline of construction of the units will be monitored and database maintained
QA/QC procedures to be applied:	100% of the units will be monitored from the procurement of material till construction and commissioning of the biogas units
Any comment:	

Data / Parameter:	**Number of biogas plants operating**
Data unit:	Number
Description:	Number of plants operating in year (t)
Source of data to be used:	Log books maintained and entered in the digitized monitoring database for Daily monitoring of the biogas units operating
Value of data	5,000 in Yr 1; 10,000 in Yr 2, and 15,000 every following year.
Description of measurement methods and procedures to be applied:	In every village, the Village Level Volunteers (VLV) will monitor the biogas units that are operating for every single day.
QA/QC procedures to be applied:	Log books and digitized database will be checked regularly by project staff and CDM coordinator.
Any comment:	-

Data / Parameter:	**Confirmation that non-renewable biomass has been substituted**
Data unit:	
Description:	Confirmation that non-renewable biomass has been substituted
Source of data to be used:	Sample survey
Value of data	91% of 3.57 t/family/year i.e. 3.31 t/family/year is substituted
Description of	Sample survey

measurement methods and procedures to be applied:	
QA/QC procedures to be applied:	Annual stratified sampling will be conducted.
Any comment:	-

Data / Parameter:	**Non-usage of biogas plants**
Data unit:	Days
Description:	Usage of non-renewable biomass in case of non-performance of biogas units
Source of data to be used:	The days not used from the daily monitoring report for each of the unit done at the village level and data maintained on the digitized monitoring database.
Value of data	Dependent on the number of days the biogas units are under repair
Description of measurement methods and procedures to be applied:	As and when the biogas units are not functional, the beneficiaries will report to the village level volunteer, who in turn will report to the Biogas Field Worker of the project for the repair of the unit. A log book will be maintained for the reason of non-function and days under repair.
QA/QC procedures to be applied:	CERs will be reduced for the non-functional days of the units.
Any comment:	

B.7.2 Description of the monitoring plan:

1. Implementation Plan

The project activity will be implemented only after its gets registered as a CDM project activity. CERs generated will be sold, in advance, to a Carbon Investor under an ERPA drawn up for the purpose. Revenues will be used in a completely open and transparent manner to construct the 15,000 biogas units. Orders to various local entrepreneurs for construction of biogas units i.e. bricks, cement, sand, stoves, pipes, noozle will be placed after procuring the advance CER revenues as the project will be funded only from CER revenues.

As elaborated below, before commencement of the Biogas CDM Project, village-wise Participation Agreements will be signed between AF Ecology Centre and potential End Users, describing the roles and responsibilities.

A CDM Team will be appointed to facilitate construction and maintenance of the biogas units as described below.

Every year, 5,000 biogas units will be built.

A Standard Operation Procedure Manual will be prepared for implementation and monitoring of the project activity, which will be followed by the CDM Team.

2. Project Management and Monitoring

This Biogas CDM project will be implemented and monitored by AF Ecology Centre, wherein over 3 years AF Ecology Centre will construct 15,000 domestic biogas units of $2m^3$ capacity, for as many farmer families in about 507 villages spread over 15 Mandalams of Anantapur district, A.P., India.

AF Ecology Centre will facilitate the End User families to set up village level institutions to take care of minor repair, maintenance and the social controls/peer support needed to cope with various exigencies that will crop up. These will be participatory mutual support systems in each and every village. The sudden loss of animals, destruction of fodder, family illness and other exigencies that lead to a non-functioning of biogas units will be considerably reduced due to the operation of these grassroots structures and systems.

2.1. Biogas Project Management Unit within AF Ecology Centre

A dedicated team will be set up within AF Ecology Centre for management and monitoring of the Biogas CDM Project. This Project Management & Monitoring Unit will consist of the following staff:

- **Biogas CDM Project Manager:** A biogas CDM project manager will be appointed for overall in-charge of the project activity. The CDM project manager will be responsible for overall project implementation in the first 3-4 years and meeting the requirements of monitoring protocol thereafter. He will be directly appointed by AF Ecology Centre Board of Trustees and will report to the Director, AF Ecology Centre. His main function will be as follows:
    - To deal with CDM issues (DOE, DNA, CDM Consultants),
    - Coordinate Biogas CDM Staff and village functionaries,
    - Ensure quality from material supply, through construction, to commissioning of units
    - Set up a repair and maintenance system to attend to issues that cannot be locally addressed through the village level systems
- **IT Professional:** A IT profession will be appointed who will directly report to the Director, AF Ecology Centre. He will be responsible for the following:
    - Maintain the digitized monitoring solution and monitoring sheets for CDM Verification
    - Ensure that authentic data is entered into the solution and make spot checks to verify
    - Deal with the IT Company, TRISTLE that prepared the solution.
    - Peruse the analytical reports in the digitized monitoring solution and recognise patterns to predict problem areas and under-performance
- **Accountant:** An account will be appointed for the project activity, who will be responsible for ensuring a strict and diligent spending of CER Revenues and the recording thereof in a computerised accounting package. He will report to Finance Manager, AF Ecology Centre, and be an integral part of the general finance team of the Centre. He will administer the following tasks:
    - Arrange for the bulk purchase of cement and hardware and transfer them to the Mandalam storehouses
    - Arrange timely payments for material suppliers and masons
    - Inspect quality of material (bricks and sand) before making payments
    - Negotiate for the timely supply of high quality cement and hardware
    - Prepare statutory reports for end of year audit

- **Mandalam Storekeepers:** For each of the Mandal, one Mandal Storekeeper, thus 15 Mandal storekeepers will be appointed responsible for the safekeeping of hardware, cement and other material required for construction of biogas units. He will report to the accountant. His responsibility will be to:
    - Maintain a strict inventory of cement and various hardware (asbestos pipes, nozzles, gate valves, gas pipes and stoves)
    - Issue supplies to Biogas Field Workers on the signed orders of the Project Manager.
- **Biogas Field Workers:** Ten biogas field workers will be appointed for overseeing the construction of biogas units. Each field worker will be in-charge of construction of approximately 500 units during the 3-4 year construction phase. They will report to the Project Manager and their tasks will be to:
    - Inspect the number of cattle, distance from kitchen in each household, mark and arrange for excavation of pits
    - Identify local suppliers of material (bricks and sand) for each village, get the price and quality approved by the Project Manager, and arrange for transportation to the villages
    - Transport cement and hardware from the Mandalam storehouses
    - Assign Masons to particular villages and oversee the quality of their work and ensure that End User family labour is actively used
    - Record the progress of processes in specially designed formats and enter the data into the digitized monitoring solution on a fixed day every week

Local Masons will be trained at ongoing Biogas CDM Projects in the neighbourhood. They will be assigned to each Biogas Field Worker. They will be paid a piece rate for each unit they build and their personal and contact details will be stored in the digitized monitoring solution to fix responsibility.

Similarly, the personal and contact details of each Material Supplier will also be recorded, along with their bank account numbers. Payments will be made only by crossed cheque.

Post construction of the biogas units for the initial three years, the biogas field workers will continue to be responsible to:

- Form and support village level institutions; assist in selection of Volunteers, train and support them
- Record the monthly totals from the Daily Monitoring Books maintained by Volunteers and, once a month, enter the data into the digitized monitoring solution
- Contract Masons and attend to major repairs that cannot be handled by the village level institutions

2.2. Management system at village level:

- **End User Groups:** About 30 End User families will be organized into a group called End User Group. These will function on the lines of Self Help Groups (SHGs) specifically for local management of construction and post construction, ensuring proper functioning of all biogas units in their respective villages. These End User Groups are a support system to each End User. E.g. If a cow or buffalo suddenly dies and the family faces a dung shortage, the Group will make arrangement with neighbours to ensure that the unit functions uninterrupted.

They will select a Volunteer to maintain the Daily Monitoring Books where usage hours and reasons for non-usage are recorded every single day. They will create an environment of transparency, trust, and feelings of belonging and solidarity. The scope of these Groups go beyond the Biogas, into fostering and managing cooperation in agriculture, timely credit, better bargaining with Government agencies, traders, etc.

- **Volunteers:** Every participating village will have a Volunteer to monitor usage of about 30 biogas units. She will be a young, schooled woman, selected by the End User Group of her village.

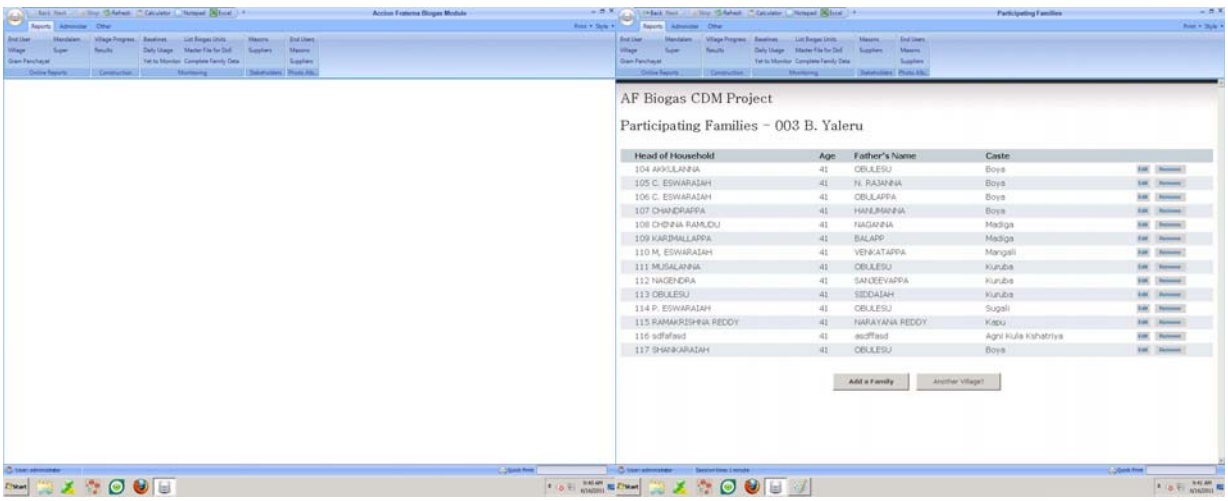
  She will be responsible for post construction monitoring of usage and be the first to identify dysfunctional units. The Volunteer will either prompt the End User Group to set right a problem or bring it to the notice of the Biogas Field Worker.

  Volunteers will be paid by their respective End User Groups from the maintenance fund given to them.

2.3 Digitized Monitoring system

A customised Biogas CDM Monitoring Solution developed and tested by Tristle Technologies Pvt. Ltd., will be used to maintain demographic data, construction processes, and the regular monitoring.

Tristle Technologies Pvt. Ltd. has developed a web based solution which is permission driven, intuitive and easy to use by Project Staff and Volunteers. All activity processes, including financial transactions, will be digitally monitored using an Intranet solution. Open and transparent online reports can be used by all the Project Staff and secondary stakeholders to know the Progress and Results. Reports can be generated at all levels – Project, Mandal, Gram Panchayat, Village and Participating Family. The database will be updated on an everyday basis, as and when Project Staff return from their respective villages.



Progress Reports: Real-time Progress Reports can be available to everyone in an open and transparent manner for the following:

- Implementation Progress (overall project to village reports) on
  - Construction progress, time line & efficiency

  - Gender disaggregated analysis & dwelling details of participating families
  - Daily usage resume, Audit & Maintenance & CER generation to date
  - Total expenditure & average cost per unit
- Participating Families
  - Demographic details
  - Mason, Commissioned Date & Usage Days
  - Construction Details with Date, Process, & Who Monitored
- Construction Overview
  - Village-wise Progress
  - Output, Outcome & Results
- Monitoring of operating units
- Masons & Suppliers
  - Masons
  - Suppliers
  - Photo Albums of Masons and Suppliers
- Reports that meet CER Verification requirements
  - Monitoring operating units
  - Full List of all the Commissioned Units
  - Non-usage days

Processes: The solution will be used to:

- Record the Mandalams, Gram Panchayats and Villages where the CDM project is implemented
- Enter demographic details on participating Families
- Select Villages & Families
- Assign Staff and Volunteer responsibilities during the actual construction and monitoring phases, respectively

2.4 Monitoring the Construction Phase

Construction of 15,000 Biogas Units will be carried out in a phased manner over 3 years. The various processes involved in the implementation of the technology are as follows:

- Selection of Participating Families
- Defining Masons & Material Suppliers
- Monitoring Construction Progress
  - Marking
  - Excavation
  - Supplying crushed Stone Jelly, Sand, Bricks and Cement
  - Supplying Hardware
  - Concreting, Brick Work & Plastering
  - Filling Gobar
  - Supplying & Fixing Pipes and Stove
  - Fixing the Safety Grill
- Commissioning the Biogas Units

- Generating End User Agreements
- Monitoring operating units
- Logging Breakdowns & Repairs – Non usage days

Project Staff will ensure quality of installed Biogas Units. They will check the quality and ensure that the required quantities of material are used during construction. All payments will be made by cheque and Suppliers irrefutably identified with personal data and digital photographs fed into the computerized databank.

Each Biogas Unit will be marked with a unique Identification Number and date of construction. Along with the Village Code and Family Code, these will irrefutably identify each of the 15,000 Biogas Units.

After commissioning and satisfactory functioning of the Biogas Unit for a minimum of 2 weeks, an End User Agreement will be signed with the Participating Family. Full account of emission reduction will be considered from Day 1 of commissioning.

2.5 Monitoring after Commissioning of biogas units

A Daily Monitoring Book with a separate sheet for each of the Biogas User will be maintained in each of the 507 villages. This data will be fed into the individual Biogas User's on-line database, once a month, for days not used and reasons.

Additional parameters will be monitored by a separate Audit Team, after commissioning of Biogas Units:

- Logging Audit Visits
- Logging Repairs
- Automatic calculation of Days Not Used

If any Biogas Unit is faulty or not functional, the problem report will be automatically passed on to the Area Team for action. There will be a continuous database maintained of all the Biogas Units not operational on a day-to-day basis. The computerized solution will provide all the details at the Participating Family level for the number of non-operational days, and the reasons of non-operation. This monitoring will give the operational Biogas Units and serve to triangulate the data.

This monitoring solution will positively impact Staff and Volunteers to enhance Performance and produce good Results.

- The features, organisation and ordering accurately mirror the implementation plan and serve as unambiguous job descriptions for secondary stakeholders. Project processes are sequentially ordered into jobs and tasks. Project staff will know exactly where they stand in terms of progress and results. They will be comfortable in the knowledge that objective standards like number of commissioned Units, recording of breakdowns, conducting timely repairs, etc. will be used to measure their performance.
- The totally open and transparent reports track progress from marking to commissioning. These, along with budget realisations, will keep a wider audience constantly informed on progress and financial health. They will also give up-to-date information on the volume of CERs generated and thereby serve as an indicator on financial viability and feasibility.
- Verification data needed by the DoE will be generated as Excel files.

All data will be archived and stored throughout the crediting period and an additional 2 years.

3. Participation Agreements

Farmer families have been educated on project dynamics, CDM mechanism and the carbon market. This has ensured an informed participation right from the planning state of the CDM Project. They will further be educated on their responsibilities during the construction and post-construction phases.

Before commencement of the Biogas CDM Project, village-wise Participation Agreements will be signed between AF Ecology Centre and potential End Users. This will clearly state the roles and responsibilities of each party, fully disclose the finances and commit AF Ecology Centre to the carbon revenue sharing arrangement.

4. End User Agreements

About 15 days after commissioning each Biogas Unit (i.e. after the satisfactory functioning of the unit), a legally binding End User Agreement will be signed between the Project Proponent (AF Ecology Centre) and every single End User. These will formally spell out the roles, entitlements and responsibilities of both parties.

Once the farmers ready for participating in the project, an End User Agreement on stamp paper will be signed by each participating farmer with AF Ecology Centre.

5. Maintenance, Servicing & dealing with Emergencies

Each End User Group will be given a sum of money, from the forward sale of CERs mentioned earlier, for maintenance and servicing. This fund will be managed by the Group itself in a self governing and transparent manner.

Volunteers will have about 30 units to visit on a daily basis and record Daily Monitoring data. They will therefore be the point persons who will immediately identify problems. Minor repairs will be conducted either by the End User family or the Volunteer herself, since she will be trained and given a kit with tools and spare parts.

If the repair involves the expenditure of monies for the purchase of material, the matter will be discussed in the End User Group and resources obtained. If the problem is beyond their scope, the Biogas Field Worker will be informed and the problem attended to within 3-4 working days.

Other emergencies like the sudden loss of cattle and fodder, etc. will be dealt with by the End User Groups as described earlier.

A serious and well thought through bottom-up plans is chalked out to ensure a 95% + functionality of the 15,000 biogas units that will be built under this CDM Project.

Trainings will be conducted before project implementation at various stages. The types of trainings to be imparted :

- Orientation to end users on the effects of climate change, CDM processes and bio-gas.
- Training beneficiary farmers on quality aspects to be ensured while constructing the units.
- Training beneficiary farmers, particularly women on use and maintenance of bio-gas units.

- Training the masons on construction parameters and quality of construction, including assessment of the quality of materials like bricks, cement etc.
- Training the Volunteers and End User Groups (EUGs) on maintaining Monitoring Records of usage of bio-gas stoves by the families.
- Training the beneficiary families and Volunteers on the "Repair and Maintenance" of Bio-gas units.
- Any other training as per the arising future needs.

6. Monitoring Parameter for Emission Reduction

In accordance with Paragraphs 12 to 16 of the chosen methodology, Type I.E. Switch from Non-Renewable Biomass for Thermal Applications by the User, version 04:

Monitoring shall consist of checking of all appliances or a representative sample thereof, at least once every two years (biennial) to ensure that they are still operating or are replaced by an equivalent in service appliance.

- The single relevant project aspect deemed necessary to monitor and report reliable emission reductions is the continued use of the biogas plant. As mentioned above, the number of systems built and operating annually will be recorded through evidence of continuous daily monitoring at the village level by the village level volunteer as mentioned above.

  This is not just for monitoring of emission reduction, but to ensure that none of the biogas units have fallen to despair and are providing energy for continuous use by the communities.

In order to assess the leakages specified under paragraph 10, monitoring shall include data on the amount of woody biomass saved under the project activity that is used by non-project households/users (who previously used renewable energy sources). Other data on non-renewable woody biomass use required for leakage assessment shall also be collected.

- As stated in para 10(a) of the methodology, By will be multiplied by a net to gross adjustment factor of 0.95 to account for leakages.

- Thus case survey will not be conducted to assess leakage.

Monitoring should confirm the displacement or substitution of the non-renewable woody biomass at each location. In the case of appliances switching to renewable biomass the quantity of renewable biomass used shall be monitored.

- Provided all plants are in continuous use throughout the project period, and emergency preparedness arrangements are recorded as having been used, it is expected that the ex-ante emission reductions will be achieved and there is complete displacement of non-renewable woody biomass by biogas.

- The project activity does not include production of renewable biomass as the substrate is dung. Thus leakage in the production of renewable biomass need not be monitored.

Para 15 of methodology on monitoring is not applicable as option (b) in Para 6 is not chosen.

Para 16 of methodology on monitoring is not applicable, as it is not water treatment technologies that is implemented.

Frequency of Monitoring

- 100% of plants will be monitored for non-usage of biogas units on daily basis and accordingly calculate emission reduction in the monitoring report for only usage days for verification.

All monitored data required for verification and issuance will be kept for two years after the end of the crediting period or the last issuance of CERs for the project activity, whichever occur later both on paper and electronically.

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

Date of Completion: 20th November 2010

Responsible entity: **Fair Climate Network**[50]
19/1, Alexandria Street, Richmond Town
Bangalore – 560025, Karnataka, India.

The Technical Team of Fair Climate Network assists grass root NGOs to do pro-poor CDM projects. The NGOs need to have an intimate contact with the communities they work with, and have open, transparent and upfront Carbon Revenue Sharing Agreements with these families and communities. FCN is not a project participant.

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:

01/01/2012 – Likely Start Date for Construction of Bio-digesters

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

25y-0m[51]

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:

[50] http://www.fairclimate.com/tech/team/
[51] http://www.inseda.org/Additional%20material/Environmental%20and%20social%20Impact%20-%20biogas.pdf

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01/06/2012 or or date of complete submission to the UNFCCC, whichever is latter.

C.2.1.2. Length of the first crediting period:

7y-0m

C.2.2. Fixed crediting period:

C.2.2.1. Starting date:

NA

C.2.2.2. Length:

NA

SECTION D. Environmental impacts

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

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

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

Not applicable

SECTION E. Stakeholders' comments

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

The local stakeholders' meeting was conducted based on Gold Standard guidelines. The stakeholder's meeting was conducted at Lalitha Kala Parishad, Anantapur District, Andhra Pradesh on the 15th September 2010 between 10.00–13.00 hours.

Notification was sent through letters, emails and personally to various categories of stakeholders to attend the stakeholders meeting. A non-technical summary was also enclosed along with an agenda for the meeting. The meeting was conducted in the local language - Telugu. The AF Ecology Centre field staff also spread word of the meeting to all village members they encountered in the weeks preceding the meeting. An open invitation to the meeting was published in the local newspaper "Eenadu & Deccan Chronicle" dated 10.09.2010 and 11.09.2010.

The agenda of the meeting included discussion on the purpose of the consultation, description of the project activity, providing clarifications on the project activity, discussion of the sustainable development checklists for the project and methods by which to monitor them.

The meeting was attended by nearly 660 people. The various stakeholders for the meeting were as follows:

Local Communities: The local communities attending the meeting were from the Village Level Federations which are group of 8-10 farmers. Each group was represented by the Convenor and Co-convenor. The meeting was also attended by media and members from Rural Development Trust.

Local Policy Makers, Representative of Local authority and Official Representatives: The local policy makers, representatives of local authority and official representatives from the Andhra Pradesh Government attended the meeting. Representatives from the Department of Renewable Energy (NEDCAP), Forest Department and Revenue Departments along with Mandal, Zilla and Gram Panchayats members attended the stakeholder's meeting.

Local NGOs: The invitees of local NGOs include those working in Anantapur district, the neighbouring Chickballapur district and NGOs from the Fair Climate Network (FCN). The FCN is a network of grassroot NGOs working on CDM issues, many of whom have taken up CDM projects for the rural communities. There was representation from the NGOs for the meeting

GS NGOs: There are 8 GS NGOs in India. All of them were sent invitations for the meeting. Also international Gold Standard NGOs' supporters were invited to comment on the project activity. FCN, a GS NGO supporter attended the meeting.

Official Representative of DNA: The official representative of the DNA for India, Ministry of Environment and Forests (MoEF) were intimated of the meeting and invited. An invitation to Ministry of New and Renewable Energy was also sent.

For those who were not able to attend the meeting, written comments were invited from them through email and letters. In total, 5 emails were received from NGOs and 33 written comments were received from local authorities and government officials.

E.2. Summary of the comments received:

The local communities were very happy about the introduction of the project. During the meeting, many questions about the technology were clarified. The local policy makers, representative of local authority and official representatives were very happy of this initiative. The district level NEDCAP officer offered his encouragement for the project. He praised the initiative of the organisation in making the merits of clean cooking technologies available to all segments of society. The local NGO's said it was an excellent initiative to help the most vulnerable sector-the rural women and wished AF Ecology Centre all the best in implementing the program.

The overall comments received on the project activity are as follows:

1. The project activity will reduce dependency on firewood and check the destruction of trees.
2. The activity will reduce health hazards and prevent environment pollution.
3. Women will have enough time to concentrate on children's education and health.
4. Biogas project will be more useful to poor women who cannot afford LPG cooking gas. It is nature friendly.
5. Project will enhance the socio-economic development of the people.
6. Encourages gender equality by sharing biogas preparation responsibilities
7. Time saving and reduced expenditure on firewood for cooking purposes
8. Using of biogas slurry will increase crop yields. More rainfall and more recharge of ground water due increase of vegetation.
9. The project activity will not only provide clean energy for cooking, but will also provide employment.

An analysis of the evaluation forms shows the following responses from the stakeholder's meeting. There were no negative comments.

Questions	**Responses**
What is your opinion on this meeting?	Construction of bio-gas solves all the problems of women in cooking. Especially during rainy season it will be very difficult for them to cook with the wet fire wood or to collect and store the firewood in the rain. Now it will become easy for both women & men to cook on bio-gas stove
	Today's meeting is an ideal one. Protection of tree wealth is everybody's responsibility. It is a good opportunity to save the trees by establishing bio-gas unit for each family and reduce atmospheric pollution.
	Good for Anantapur district and is useful to the rural families in many ways. Improves education of children and women health
	This program is good, because it is saying about how to protect our environment by safeguarding the existing trees. I learned that the dung used for producing gas is not going to be a waste product, but the extract can be again used to the fields and vermi compost units.
	Good program because its main aim is to reduce the pollution. Tree cutting leads to low rainfall and in turn leads to less yields and more loss. This was explained very well by the dignitaries.
What did you like in the project?	Use of bio-gas reduces lung diseases, eye infections, sight problems etc; Improves health, environment and living standards. Time will be saved and is boon to rural households.
	Appreciate Mr. Malla Reddy (Director) for taking up such a great program. It is good fortune to Anantapur, Rural Women & Climate.
	Installation of 15,000 bio-gas plants which in turn are connected to the increased access for sustainable agriculture. Helpful for poverty reduction.

	No need for me to make any investment in the establishment of the unit. No smoke will be exhausted, trees can be protected, health will be improved. More over cutting trees is against to Indian culture. Increased timely rains leads to high yields. Droughts will be controlled
What do you dislike in the project?	Only people with two cattle can construct a bio-gas plant. Poor people who do not have cattle also wish to have a bio-gas unit. This project will not help families without cattle.
	Presence of women in the meeting was very low.
	No Comments.

No adverse comments were received for the project activity.

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

The questions from the stakeholders were clarifications regarding project implementation, construction of biogas units, and service and maintenance. All the clarifications requested by the communities were provided during the stakeholder's meeting.
Further trainings will be conducted especially for orientation to end users on the effects of climate change, CDM processes (end user agreements, roles and responsibilities) and on biogas technology. Training particularly for women will be conducted on use, repair and maintenance of biogas units and maintaining monitoring records of usage of bio-gas stoves by the families.

There were no negative comments requiring mitigation measures.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROJECT ACTIVITY

Organization:	**ACCION FRATERNA ECOLOGY CENTRE**
Street/P.O.Box:	Upparapalli Road
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Represented by:	
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Salutation:	Dr.
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Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No ODA will be diverted for this project.

Annex 3

BASELINE INFORMATION

Baseline Survey – Use of woody biomass for cooking and heating water for bath by the households in 15 Mandals of Anantapur district, Andhra Pradesh

A baseline survey was conducted by AF Ecology Centre to estimate the use of woody biomass for cooking and water heating for bath. The purpose of sampling was to obtain unbiased and reliable estimates of the mean value of woody biomass used in the calculations of GHG emission reductions that is not over estimated. The sample survey for the project activity is based on "General Guidelines for sampling and surveys for small-scale CDM project activities - Version 01, EB 50".

1. Project Description

Anantapur is the second most drought prone and biomass scarce district of India. At the district level (project area), the total forest cover of Anantapur district is a mere 2.23% of the total area (Table 5 and Figure 4). For the 15 Mandals, the legal area under forests accounts for 6.97% of the geographic area.

The project is installation of 15, 000 biogas plants (digesters) of 2 m^3 capacity each for single households in 15 Mandals of Anantapur District, Karnataka, India. Each household will install a 2 m^3 biogas plant and feed cattle dung and other organic waste into the anaerobic digester for the production of biogas for cooking purpose and water for bath. The aim of the project is to replace the commonly used inefficient wood fired mud stoves technology, with clean, sustainable and efficient biogas and in this way replace Non-Renewable Biomass with biogas for cooking and hot water heating. The project would be implemented upon registration of the project as a CDM project activity, as the project will be financed completely from carbon revenues.

2. Objectives

Two surveys were conducted in the project area.

- Collect information of the Target families/Beneficiaries in the project area and establish the prevailing practices of the local communities with regard to energy use for everyday cooking and water heating purposes.
- A baseline survey was carried out to;
    - Understand the pattern of energy use for cooking and heating water for bath.
    - Study the quantity of woody biomass use for cooking and hot water bath.

3. Method

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

- Selection of families from the 15 Mandals in which AF Ecology Centre is working.
- The amount of woody biomass used for cooking and hot water bath by a family. This was based on actual measurements taken for a week in each household.
- The value obtained from the study was compared to other scientific studies conducted for similar ecological region.

4. Sample Frame

The NGO, AF Ecology Centre is working in Anantapur District for the past 30 years on rural development issues, and especially with the famers in the region. The sample frame for the baseline survey was developed for the region they have been working with the farmers.

- Firstly the target families or target beneficiaries of 15,000 families in 348 Gram Panchayats and 507 villages were selected. In all, data of 16,142 households were collected.
- From this list, sample survey was conducted to study the quantity of woody biomass used for cooking and heating water for bath at the family level. The sample unit, which is the minimum unit or the clearly defined unit for constructing the sample frame is the traditional wood stove used in each household for cooking and hot water bath.

This study was based on the FAO report: "**A guide for woodfuel surveys", EC**-FAO Partnership Programme (2000-2002). Sustainable Forest Management Programme, Forest Products Division, Forestry Department, FAO and **"Biomass Studies; Field Methods for Monitoring Biomass"** (1997) by Shailaja Ravindranath and Sudha (1997). Oxford & IBH Publishing Co.Pvt. Ltd. New Delhi.

5. Target Population/Beneficiaries

The target population for the project and the field data collection for the project are the beneficiary households from rural areas, who are using traditional cookstove and kerosene stoves for cooking and water heating for bath. They are using woody biomass collected from forests, wastelands and other common property resources which is to a large extent non-renewable. The target population are 15,000 households from 15 Mandals who will be the beneficiaries of the AF Ecology Centre biogas Project. A survey was conducted by AF Ecology Centre in 15 Mandals, 348 Gram Panchayats and 507 villages to identify the target population. In all 16,142 households were visited and the family details collected. A household level questionnaire was designed, field tested and utilized to collect the relevant information at the household level. Each and every family of the 16,142 families was visited to collect relevant information of the Target Families. The data was entered into an online monitoring solution designed by TRISTLE Technologies Pvt. Ltd. A summary of the Mandals, number of Gram Panchayats, Villages and the number of families are shown in Appendix 1.

From the sample survey, rural families using traditional cookstoves, have cattle and have space to build biogas have been selected as beneficiaries. As seen from the survey, they are below poverty line with a per capita income of less than 1$/day/person.

Appendix 1: Number of Mandals, Gram Panchayats , Villages and Families of the project activity

Sl No.	Mandal	Gram Panchayat	Villages	Families
1	Anantapur	20	30	634
2	Atmakur	25	27	497
3	Bathalapalli	13	40	1,496
4	Beluguppa	28	30	1,187
5	Brahmasamudram	20	41	1,192
6	Dharmavaram	41	56	1,453
7	Garladinne	17	28	689
8	Kalyandurg	32	46	1,913
9	Kambadur	13	40	1,775
10	Kanekal	16	24	1,002
11	Kudair	25	28	562

12	Kundurpi	31	38	1,168
13	Raptadu	25	25	849
14	Rayadurg	18	25	865
15	Settur	24	29	860
Total		**348**	**507**	**16,142**

3.1 Target Beneficiary Cooking Pattern

In the project area, nearly 95% of the households are using traditional cookstove for cooking and heating water for bath. These include basic three stone stoves and mud stoves without chimney. Kerosene is used by these families to kindle the fire and a few families also have kerosene stoves alongside to quickly prepare snacks and tea. About 4.6% families use LPG and very few use electric stoves.

The Target families are those families using traditional cook stove. Thus the target group are from the 15,253 families using basic three stove stoves and mud stoves.

Stove and Fuel Used	Number of Families	% of Households
Traditional Cookstove + Kerosene for lighting the stove	15,253	95.12%
Only LPG Stove	741	4.62%
Only Kerosene Stove	37	0.23%
Only Electric Stove	4	0.02%
Total	**16,035**	**100.00%**

6. Sample Method[52]

The baseline survey was performed in 2010 on a sample of 745 families in 52 villages across 9 Mandals of Anantapur District (Appendix 2). **Random sampling** was adopted for the study in all the 9 Mandals of Anantapur district of Andhra Pradesh. The beneficiaries were drawn at random from the sample from which each case having an equal probability of selection. For each chosen sample that participated, they were involved in conducting the required survey along with the field staff of AF Ecology Centre. The details of sampling parameters are given in section VIII.

Appendix 2: List of Mandals and Villages chosen for the sample survey

Mandal	Village	Total
Atmakur	B. Yaleru	3
	Kurlapalli	8
	Madigubba	11
	Madigubba Thanda	11
	P. Kothapalli	25
	Papampalli	10
	Topudurthi	25
Beluguppa	Gangavaram	20
	Gundlapalli	20

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

	Konapuram	11
	Seerpi	9
Dharmavaram	Bilvampalli	16
	Chigicherla	16
	Dharmapuri	16
	Kambadur	8
	Malagundlapalli	16
	Muchurami	16
	Regatipalli	15
	Thummela	16
	Vasanthapuram	16
Kalyandurg	Battuvanipalli	15
	Boyalapalli	20
	Chapiri	20
	Devadulakonda	4
	Duradakunta	4
	Garudapuram	10
	Gowramma	6
	Kadarampalli	19
	Kothur	8
	Mallipalli	17
	Ontimiddi	10
Kuderu	Antharaganga	22
	Aravakuru	4
	Ipperu	2
	Kadadarakunta	5
	Muddalapuram	26
Kundurpi	Bestarapalli	25
	Guruvepalli	23
	Mayadarlapalli	21
	Sreemajjanapalli	22
	Yerragunta	22
Rapthadu	Ayyavaripalli	16
	Bommeparthy	16
	G.Kothapalli	16
	Hampapuram	16
Settur	Cherlopalli	20
	Idukallu	21
	Kanukuru	4
	Khairevu	22
	Mallesapuram	5
	Subhadramma	1
	Tippannapalli	15
Grand Total		**745**

7. Sample Size

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

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

Where:

n_o = size of sample
$t^2_{\propto,v}$ = critical value of student's t test with significance level $\propto$ and v degree of freedom
e = acceptable error
cv = coefficient of variation
v = degree of freedom = n-1

- The desired precision for the baseline fuelwood estimation is ±10%
- The confidence level is at 90% which has a critical t value of 1.645.
- The coefficient of variation is assumed at 1.

Thus $n_o = \frac{(1^2 x 1.645^2)}{(10\%)^2} = 271$

Thus the sample size required to estimate the woody biomass usage within a target 90/10 confidence/precision level is 271. To be conservative and more precise, 745 **samples or 5% of the target population** have been chosen. This also compensates for any sampling error due to sampling approach.

8. Survey Design

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

- All the households are below the poverty line with an income of less than 1$/day/person.
- Survey of 745 households across the 9 mandals in 52 villages situated inside the project boundary was conducted i.e. 5% of the households.
- The type of cooking device used in the sample household was recorded.
- The person who cooks for the household was requested to set aside an approximate quantity of cooking fuel required for a week prior to cooking in the morning.
- The house was visited in the morning before the start of cooking activity.
- The type and weight of the fuel set aside was recorded.
- The fuel from weighed bundle was used for cooking every day.
- After 7 days in the evening after cooking, the remaining fuel was weighted and value recorded.
- The average fuel wood use/day was estimated.
- The timeline use of fuel wood over the 20 years period was also conducted based on PRA.
- The data from the survey was compiled using Microsoft Excel and analysed.

9. Survey Findings

a) Stove and Fuel Type:

Further sample survey of the 745 families show that

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

b) Source of fuel wood collection:

- 67.37% of the households surveyed responded that they collect fuel wood from forest areas and wastelands. About 4.48% of the households only depended on the forests.
- Nearly 19% of households collected some firewood from trees growing on the bunds of agricultural land and wastelands. This also included areas of former agricultural land that had remained fallow for several years.
- 7.84% reported sourced their fuelwood from wastelands, forests and agricultural lands.

c) Time taken to collect firewood:

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

d) Cost of fire wood:

- Respondents were asked to recall what they remembered one headload of firewood to cost in 1988 and what the same costs today. The answers show that the cost of firewood today is 30 times the cost was in 1988. The cost of one headload of firewood now is about Rs.90, while it was Rs.3 years back.
- This price rise is far greater than what can be attributed to inflation alone and supports the idea that the price has risen due to the increasing scarcity of available firewood to local communities.

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

- Alongside fuel wood, only 8% of the respondents reported to use kerosene for the purpose of cooking / water heating.
- Kerosene was used as a supplementary cooking fuel and was generally used for the quick preparation of items such as tea.

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

The results from the survey indicate that on average the woody biomass usage is 1.99±0.15 kg/capita/day at 95% confidence level. At a household level, 3.57 tonnes per HH per year is being used.

g) Time spent cooking/heating water per day:

- Respondents reported spending an average of 3.16 hours cooking / heating water per day.
- This is alarming because such prolonged time periods spent using traditional wood stoves in what are typically unventilated kitchens often results in negative health impacts such as eye inflammation, lung infection and skin diseases.

h) Energy Equivalent:

The energy equivalent of baseline fuel wood usage for kerosene and LPG as shown below, corresponds to 24.7 litres of kerosene and 17.2 kg LPG for a month.

Data	Fuel wood	Source of Information	LPG	Source of Information	Kerosene	Source of Information
Kgs/month	297.5	Baseline Survey	17.2		24.7	Litres/month
Calorific Value (TJ/tonne)	0.015	I.E, Version 4	0.0473	IPCC, 2006	0.0438	IPCC, 2006
				Density of Kerosene	0.75	
Efficiency	10%	I.E, Version 4	55%	World Bank Report[53]	55%	India Mart[54]
Energy Content to Pot (MJ)	**446**	**Calculated**	**447**	**Calculated**	**446**	**Calculated**

[53] http://siteresources.worldbank.org/INDIAEXTN/Resources/Reports-Publications/Access-Of-Poor/KeroseneLPG.pdf

[54] http://catalogs.indiamart.com/products/kerosene-pressure-stoves.html

Annex 4

MONITORING INFORMATION

The monitoring details are detailed in the monitoring section.

Appendix –I:Number of Mandals, Gram Panchayats , Villages and Families of the project activity

Sl No.	Mandal	Gram Panchayat	Villages	Families
1	Anantapur	20	30	634
2	Atmakur	25	27	497
3	Bathalapalli	13	40	1,496
4	Beluguppa	28	30	1,187
5	Brahmasamudram	20	41	1,192
6	Dharmavaram	41	56	1,453
7	Garladinne	17	28	689
8	Kalyandurg	32	46	1,913
9	Kambadur	13	40	1,775
10	Kanekal	16	24	1,002
11	Kudair	25	28	562
12	Kundurpi	31	38	1,168
13	Raptadu	25	25	849
14	Rayadurg	18	25	865
15	Settur	24	29	860
Total		**348**	**507**	**16,142**

Appendix II: Details of Target Beneficiaries for the project activity

Mandal	Gram Panchayat	Village	Beneficiaries
Anantapur	Akkampalli	Akkampalli	11
		NR Colony	4
	Akuthotapalli	Akuthotapalli	13
	Alamur	Alamur	27
		Munibanda Palli	29
	Anantapur Rural	Pilligundla Colony	2
	Chinnampalli	Chinnampalli	7
		Sajjalakaluva	6
	Chiyyedu	Chiyyedu	73
	Etukulapalli	Etukulapalli	33
	Kakkalapalli	Kakkalapalli	5
		Kakkalapalli Colony	5
	Kamarupalli	Gollapalli	12
		Kamarupalli	9
	Kandukuru	Jangalapalli	14
		Kandukuru	72
		Krishnamreddi Palli	36
	Kodimi	Kodimi	14
	Kurugunta	Kurugunta	13
	Mannila	Mannila	58
	Narasanayanakunta	Narasanayanakunta	19
	Narayanapuram	Nagireddipalli	3
		Narayanapuram	20
		Stalin Nagar	1
	Pulakunta	Pulakunta	69
	Rachanapalli	Syndicate Nagar	1

	Somuladoddi	Pamurai	11
		Somuladoddi	16
	Thaticherla	Thaticherla Colony	22
	Upparapalli	Upparapalli	29
Atmakur	Atmakur	Atmakur	54
	B. Yaleru	B. Yaleru	14
	D.K. Thanda	D.K. Thanda	10
	Goridindla	Goridindla	22
	Kurlapalli	Kurlapalli	13
	Madigubba	Madigubba	31
	Madigubba Thanda	Madigubba Thanda	16
	Muttala	Muttala	5
		Papampalli	10
	P. Kothapalli	P. Kothapalli	26
	P. Siddarampuram	P. Siddarampuram	18
	P. Yaleru	P. Yaleru	18
	Pampanur	Pampanur	8
	Pampanur thanda	Pampanur Thanda	8
	Papampalli	Papampalli	6
	Rangampeta	Rangampeta	43
	S. Thanda	S. Thanda	1
	Sanapa	Sanapa	2
	Singampalli	Singampalli	6
		Singampalli Thanda	23
	Thalupur	Thalupur	10
	Thopudurthi	Thopudurthi	82
	V.D. Thanda	V.D. Thanda	20
	V.E. Thanda	V.E. Thanda	9
	Vaddipalli	Vaddipalli	14
	Vepacherla	Vepacherla	18
	Y. Kothapalli	Y. Kothapalli	10
Bathalapalli	Apracheruvu	Apracheruvu	23
		Chennarami Patnam	31
		Gummalagunta	49
	Bathalapalli	Bathalapalli	74
		Ghantapuram	58
		Potlamarri	80
		Velpumadugu	26
	D. Cherlopalli	Pathyapuram Thanda - A	17
		Patyapuram	65
	Dampetla	Dampetla	54
		Kattakindapalli	47
		Ramanujampalli	4
		Suryachandrapuram	10
		Upparlapalli	51
	Dampetla Cherlopalli	D. Cherlopalli	71
	Garisanapalli	Garisanapalli	40
		Jalalpuram	13

		Nethivarampalli	42
	Malyavantham	Anantha Sagaram	42
		Cheemalanage Palli	17
		M. Cherlopalli	46
		Malyavantham	25
		Venkatagaripalli	40
	Musturu	Musturu	66
		Raghavampalli	45
	Nalla Boyanapalli	Katamakunta	51
		Mudddanna Palli	36
		Nalla Boyana Palli	43
	Obulapuram	Chinnekunta Palli	15
		Kodekondla	62
		Obulapuram	25
		Ramapuram	19
	Sangala	Jwlapuram	34
		Sangala	49
		Varadapuram	2
		Viswanathapuram	20
	Sanjeevapuram	Lingareddi Palli	20
		Sanjeevapuram	5
		Yerrayapalli	16
	Thambapuram	Thambapuram	63
Beluguppa	Ankampalli	Ankampalli	36
	Avulenna	Avulenna	63
	Beluguppa	Beluguppa	39
		Beluguppa Thanda	18
	Brahmanapalil	Brahmanapalli	59
	Brahmanapalli Thanda	Brahmanapalli Thanda	30
	Budavarthi	Budavarthi	15
	Duddekunta	Duddekunta	64
	Erragudi	Erragudi	35
	Erragudi Kottal	Erragudi Kottala	15
	Gangavaram	Gangavaram	97
	Gundlapalli	Gundlapalli	59
	Hanimireddi Palli	Hanimireddi Palli	38
	Jeedipalli	Jeedipalli	9
	Kaluvapalli	Kaluvapalli	80
	Konampalli	Konampalli	66
	Konapuram	Konapuram	31
	Krishnapuram	Krishnapuram	25
	Nakkalapalli	Nakkalapalli	24
	Narasapuram	Narasapuram	34
	Ramasagaram	Ramasagaram	51
	Ravenepalli	Ravenepalli	36
	Seerpi	Seerpi	11
		Venkatadripalli	32
	Sree Rangapuram	Sree Rangapuram	45

	Thagguparthi	Thagguparthi	30
	Venkatadripalli	Venkatadripalli	28
	Virupapalli	Virupapalli	38
	Yalagalavanka	Yalagalavanka	31
	Yalagalavanka Thanda	Yalagalavanka Thanda	48
Brahmasamudram	Bhira Samudram	Ajjaiah Doddi	39
	Bhyravani Thippa	Bhyravani Thippa	37
		Polepalli	51
	Bommaganipalli	Bommaganipalli	39
		Vanka Thanda	44
	Brahmasamudram	Bhyrasamudram	34
		Brahmasamudram	81
		Kapatalinganapalli	16
		Nanjapuram	35
		Thimmaiah Doddi	11
		Yerrappa Doddi	23
	Eradikera	Eradikera	37
	Gunduganipalli	Gundaganipalli	24
	Kannepalli	Budemepalli	11
		Gudipalli	62
		Kannepalli	24
		Muddalapuram	29
	Kodipalli	Pobbarlapalli	14
		Santhi Nagar	16
	Muppalakunta	Muppalakunta	29
	Nagireddipalli	Nagireddipalli	44
	Palavenkatapuram	Mamadur	52
		Palavenkatapuram	76
		Yerra Kondapuram	22
	Pillalapalli	Gonchireddipalli	27
		Pillalapalli	24
	Polepalli	Kapatalinganapalli	19
	Rayaladoddi	Kothaindla	16
		T. Rudrampalli	8
		Yanekallu	11
	Rayalappa Doddi	Rayalappa Doddi	27
	S. Kondapuram	Konapuram	36
		S. Kondapuram	13
		Sagepalli	16
	Teetakal	Teetakal	28
	Tetakallu	Kurlagunda	25
	Vepulaparthi	Chalivepalli	15
		Govindaiah Doddi	24
		Vepulaparthi	24
	West Kodipalli	Gollaladoddi	12
		West Kodipalli	17
Dharmavaram	Akuthotapalli	Akuthotapalli	19
	Badanapalli	Badanapalli	25

Bilvampalli	Bilvampalli	46
Buddareddipalli	Buddareddipalli	11
CC Kotha Kota	CC Kotha Kota	9
Chigicherla	Chigicherla	67
Chinnur Bathalapalli	Chinnur Bathalapalli	9
Chinthalapalli	Chinthalapalli	39
Dharmapuri	Dharmapuri	55
Dharmavaram	Chinnuru	24
	Goods Shet Kottala	8
	Guttakindapalli	44
	Sivaram Nagar	7
	Yerragunta	5
Dharshinamala	Dharshinamala	22
	NGP Thurpu Thanda	9
Elukuntla	Elukuntla	28
Garudampalli	Garudampalli	30
Gollapalli	Gollapalli	12
Gotluru	Gotluru	14
Indiramma Colony	Indiramma Colony	6
Kamireddypalli	Kamireddypalli	38
Kanumpalli	Kanumpalli	4
Kattakindapalli	Kattakindapalli	30
Kunutur	Kuntur	41
Malagundlapalli	Malagundlapalli	32
Malakapuram	Malakapuram	21
Mallenipalli	Mallenipalli	22
Mallkaluva	Mallakaluva	37
	Tumparthi	30
Muchu Rami	Muchu Rami	71
Nadimigaddapalli	Nadimigaddapalli	31
Naguluru	Naguluru	8
Nelakota	Nelakota	16
	Nelakota Thanda	9
Obulanayanipalli	Obulanayanipalli	26
Pothukunta	Pothukunta	6
	Satyasai Nagar	3
Pothulingepallil	Kathe Kottala	28
	Motumarla	13
	Pothulingepalli	17
Rampuram	Rampuram	26
Ravulacheruvu	Ambativari Kottal	14
	NRK Kottal	15
	Ravulacheruvu	59
	Yerragunta Palli	58
	Yerraguntapalli Thanda	1
Ravulacheruvu Thanda	Ravulacheruvu Thanda	5
Regatipalli	Regatipalli	63
	Seetharampalli	44

	Subbaraopeta	Subbaraopeta	9
	Thippe palli	Thippe Palli	12
	Tummala	Tummala	72
	Uppunesenapalli	Uppunesenapalli	35
	Vasanthapuram	Vasanthapuram	49
	Venkata Thimmapuram	Venkata Thimmapuram	19
Garladinne	Budedu	Budedu	34
		Sanjeevapuram	28
	Garladinne	Garladinne	59
		Talagachi Palli	13
	Illuru	Illuru	32
	Jammuladinne	Jambuladinne	12
	Kalluru	Kalluru	9
	Kamalapuram	Kamalapuram	30
	Kesavapuram	Kesavapuram	16
	Kondapuram	KK Thanda	15
		Kottalapalli	27
	Koppalakonda	Koppalakonda	36
	Kotanka	Kotanka	70
	Krishnapuram	Krishnapuram	21
	Marthadu	Marthadu	37
	Muntimadugu	Ankampeta	9
		M. Kothapalli	15
		M. Kothur	34
		Muntimadugu	33
	Penakacherla	P. Kothapalli	11
		Penakacherla	18
		Penakacherla Dam	10
	Sirivaram	Guddalapalli	9
		Sirivaram	9
	Thimmam Peta	Papinenipalyam	11
		Thimmam Peta	19
	Yerragunta	Mukundapuram	34
		Yerragunta	38
Kalyandurg	Battuvanipalli	Battuvanipalli	23
		Varli	27
	Borampalli	Borampalli	53
	Boyalapalli	Boyalapalli	45
	Chapiri	Chapiri	65
	Dasampalli	Dasampalli	27
	Devadulakonda	Devadulakonda	23
	Doddagatta	Dodagatta	66
		Gubanapalli	1
	Duradakunta	Duradakunta	29
	E.Kodipalli	E. Kodipalli	23
		Thimmaganipalli	37
	Gajulapalli	Gajulapalli	35
	Garudapuram	Garudapuram	35

		Kurubarahalli	37
		Uppa Vanka	22
		Yerrampalli	31
	Golla	Pathacheruvu	30
		Seeboi	36
	Gubanapalli	Gubanapalli	37
	Hulikallau	Hulikallu	52
		Vitlampalli	30
	Kadarakunta	Kadarakunta	36
	Kadarampalli	Kadarampalli	33
	Kalyandurg	Kalyandurg	150
	Kamakkapalli	Kamakkapalli	48
	Kotturu	Kotturu	50
		Papampalli	34
	Kurakulathota	Kurakulathota	14
	Mallikarjunapalli	Mallikarjunapalli	14
	Mallipalli	Mallipalli	44
	Mangalakunta	Mangalakunta	38
	Manirevu	Manirevu	189
		Obulapuram	39
	Morepalli	Morepalli	24
	Moutikapuram	Moutikapuram	26
	Muddinayanapalli	M. Venkatampalli	31
		Muddinayanipalli	35
		P.T.R.Palli	48
		PTR Palli 'D' Thanda	6
	Mudigalllu	Mudigallu	31
	Narayanapuram	Narayanapuram	20
	NK. Thanda	N.K. Thanda	18
	Ontimiddi	Ontimiddi	86
	Thimmasamudram	Pinjirikottala	20
		Thimmasamudram	115
Kambadur	Chanampalli	Achampalli	35
	Chennampalli	Chennampalli	54
	Gollapalli	Cherlopalli	35
		Gollapalli	30
		Iparsapalli	86
	Kambadur	Andepalli	65
		Jallipalli	27
		Kambadur	168
		Kotaguddam	16
		Kothapalli	18
		Kurlapalli	27
		M. Manda	28
		Vontareddipalli	36
	Karthanaparthi	D.C.Palli	15
		Gullyam	44
		Karthana Parthi	147

		Kothur	42
	Kurakulapalli	Iyampalli	13
		Kurakulapalli	12
	Marrimakulapalli	Guddella	27
		Marrimakulapalli	41
	Mulakaledu	Kadiridevara Palli	37
	Mulakanur	Mulakanur	73
	Nuthimadugu	C.V.Thanda	24
		Nuthimadugu	51
		Thippepalli	27
	Palluru	Devendrapuram	14
		Kottamiddela	12
		Palluru	64
		Venkatampalli	51
		Yerramallepalli	39
	R. Ananthapuram	Melakunta	39
		R. Anantapurm	32
		Rallapalli	39
	Ramapuram	Ramapuram	71
		Y.C.Palli	52
	Thimmapuram	Jakkireddipalli	60
		Obiganipalli	23
		Thimmapuram	75
		Yerrabanda	26
Kanekal	43 Udegolam	43 Udegolam	31
	Benakal	Benikal	21
		S.R.Nagar Camp	11
	Bidurakuntham	Bidurakuntham	36
	Brahmasamudram	Brahmasamudram	108
	Garadachedu	Meenahall	51
	Gopalapuram	Gopalapuram	67
	Hanumapuram	Hanumapuram	31
	Hulikera	Nallampalli	37
		Pullampalli	44
	Jakkala Vadiki	Jakkala Vadiki	59
	Kalekurthi	Kalekurthi	65
	Kanekal	Alur	20
		Gangulapuram	31
		Kanekallu Cross	7
		Kothapalli	80
		Marempalli	37
	Pulacherla	Pulacherla	87
	Rachumarri	Adiganipalli	27
		Rachumarri	46
	Sollapuram	Sollapuram	24
	Thumbiganur	Nagepalli	16
		Thumbiganur	35
	Yarragunta	Yarragunta	31

Kudair	Antharaganga	Antharaganga	16
	Aravakuru	Aravakur	31
	Brahmanapalli	Brahmanapalli	13
	Cholasamudram	Cholasamudram	17
	Gotukuru	Gotukuru	20
	Ipperu	Ipperu	32
	Jallipalli	Jallipalli	22
	Jayapuram	Jayapuram	4
	Kadadarakunta	Kadadarakunta	26
	Kalagalla	Kalagalla	20
	Kammuru	Kammuru	47
	Karutlapalli	Karutlapalli	10
	Korrakodu	Hamsapalli Korrakodu PABR Dam	16 5 4
	Kudair	Kudair	33
	Marutla - 1	Marutla - 1	3
	Marutla - 2	Marutla-2	27
	MM Halli	MM Halli	6
	MM Halli ST Colony	MM Halli ST Colony	3
	Muddalapuram	Muddalapuram	64
	Nagireddipalli	Nagireddipalli	2
	P. Narayanapuram	P. Narayanapuram	28
	Ramachandrapuram	Ramachandrapuram	31
	Thimmapuram	Thimmapuram	9
	Udiripikonda	Sivarampeta Udiripikonda	15 44
	Udiripikonda thanda	Udiripikonda Thanda	14
Kundurpi	Allapuram	Allapuram	28
	Appajipalyam	Appajipalyam	5
	Appilepalli	Appilepalli Mandalapalli	44 1
	Bandameedapalli	Bandameedapalli	18
	Basapuram	Basapuram	27
	Bestarapalli	Bestharapalli	62
	Bodapalli	Bodapalli	20
	Bommajipalli	Bommajipalli	10
	Ellachinta	Ellachinta	15
	Enumuladoddi	Enumuladoddi Guruvepalli	85 45
	Gurivepalli	Guruvepalli	5
	Jambugumpula	Jambugumpula Kenchampalli Kolimi palyam	33 25 79
	Janampalli	Janampalli	30
	Kadarampalli	Kadarampalli	35
	Kaligolimi	Kaligolimi	23
	Kariganapalli	Kariganapalli	19

	Kolimipalyam	Kolimi palyam	19
	Krishnapuram	Krishnapuram	41
	Kundurpi	Kundurpi	20
	Mahanthapuram	Mahanthapuram	66
	Malayanur	Malayanur	26
		Srimanjanapalli	31
		Vaddipalyam	32
	Mandalapalli	Mandalapalli	17
	Mayadarlapalli	Mayadarlapalli	49
	Nagepalli	Nagepalli	7
	Nizavalli	N.Venkatampalli	14
		Nizavalli	15
	Rudrampalli	Rudrampalli	51
	Seegalapalli	Seegalapalli	23
	Tenagallu	Tenagallu	66
	Thammaiah Doddi	Thammaiah Doddi	4
	Thumukunta	Thumukunta	44
	Yerragunta	Yerragunta	34
Raptadu	Ayyavaripalli	Ayyavaripalli	38
	Bandameedapalli	Bandameedapalli	26
	Boginepalli	Boginepalli	65
	Bommeparthi	Bommeparthi	44
	Bukkacherla	Bukkacherla	33
	Chaptla	Chaptla	24
	G. Kothapalli	G. Kothapalli	59
	Gandlaparthi	Gandlaparthi	30
	Gangalakunta	Gangalakunta	33
	Gollapalli	Gollapalli	36
	Gondi Reddy Palli	Gondireddi Palli	19
	Hampapuram	Hampapuram	35
	Krishnapuram	Krishnapuram	32
	Linganapalli	Linganapalli	31
	M. Cherlopalli	M. Cherlopalli	35
	Maruru	Maruru	40
	Palabavi	Palabavi	27
	Palacherla	Palacherla	67
	Parasanna Palli	Parasannaya Palli	20
	Pesarakunta	Pesarakunta	17
	Pullalarevu	Pullalarevu	32
	Ramanepalli	Ramanepalli	28
	Rapthadu	Rapthadu	6
	Varimadugu	Varimadugu	35
	Yerragunta	Yerragunta	37
Rayadurg	74 Udegolam	Ayyathapalli	19
	Avula Dhatla	Avula Dhatla	60
	Baginayakanahalli	Baginayakanahalli	21
		Bommakapalli	23
		Rayam Palli	23

	C.Gollaladoddi	C.Gollaladoddi	30
	Chandam	Chandam	13
	D.Kondapuram	D.Kondapuram	38
	Gramadatla	Gramadatla	18
	Jujurampalli	M.Jujurampalli	25
	Kenchampalli	Kadarampalli	82
		Kaseepuram	100
		Kenchampalli	62
		Nagireddi Palli	51
	Konthanapalli	Konthanapalli	6
	Mallapuram	Mallapuram	32
		Mallapuram Thanda	24
		Pallepalli	18
	Mechiri	Mechiri	32
	Rathibavi vanka	Rathibavi vanka	33
	Rekulakunta	Rekulakunta	10
	T.veerapuram	T.veerapuram	50
	Udegolam	Udegolam	43
	Vadra honnur	Vadra honnur	22
	Yeparala	Yeparala	30
Settur	Adavi Gollapalli	Adavi Gollapalli	19
	Ananpalli	Ananpalli	24
	Ayyagarlapalli	Ayyagarlapalli	39
	Bochupalli	Bochupalli	29
	Cherlopalli	Cherlopalli	32
	Chinnampalli	Chinnampalli	64
	Chintarlapalli	Chintarlapalli	30
	Gantaiah Doddi	Gantaiah Doddi	13
	Gollaladoddi	Gollaladoddi	2
	Idenkal	Idenkal	61
	Kadiripalli	Kadiripalli	30
	Kambalapalli	Kambalapalli	19
	Kanukur	Chowluru	23
		Kanukur	39
		Mucherlopalli	28
	Khairevu	Khairevu	32
	Lakshmampalli	Lakshmampalli	36
	Lingadheerlapalli	Lingadheerlapalli	33
	Mallepalli	Mallepalli	10
	Mulakaledu	Mulakaledu	12
		P.Balapampalli	16
		Rangaiah Palem	1
	Perugupalyam	Perugupalyam	12
	Rangaiah Palem	Rangaiah Palem	15
	Settur	Settur	101
	Thippanapalli	Thippanapalli	24
	Yatakallu	Mangampalli	29
		Yatakallu	56

	Yerraborepalli	Yerraborepalli	31
Grand Total			16142

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