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Resource Recovery from Organic Wastes through Community Biogas Plants

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Abstract: ***India as a developing country is gaining importance in several spheres in the world arena. Energy and environment are the main yard stick to measure the country's sustainable development. In this regard the present study addresses these issues and present workable solutions for energy security and environmental sanitation. Human night soil management is a major sanitation problem in rural India. In India, the practice of open defecation had been a major problem. So, the multifaceted problems facing the rural households such as non-availability of clean energy, indoor pollution and insanitary surrounding due to open defecation can be mitigated through the night soil/garbage based Community Biogas Plant. The study has been framed in order to assess the benefits accrued in qualitative and quantitative terms by installing Community Biogas Plants.***

Keywords: Environmental sanitation, Indoor pollution, Night soil, Carbon Monoxide Meter, Community Biogas Plant

1. Introduction

The ensuing words of our first Prime Minister Jawaharlal Nehru clearly brings forth the right path for rural development.

"We want to urbanise the villages not to take away the people from the villages to the towns that are growing up, but brings urban standard to the villages and help the bright persons of the village in the village itself".

The programme of rural development are intended to bring about changes in the existing level of living of the people in terms of improving their conditions with regard to food, clothing, fuel, education, communication and so on while concerned efforts had been taken in many areas, the problem of fuel energy has been thought of only recently. Fuel energy is one of the basic need and is a means to improve the quality of life to increase productivity and employment (Sangma, 2011) [1]. To improve the quality of life of the nation the energy problem facing the country should be viewed in the context of 75 percent of its population living in villages. An analysis of the energy consumption indicates that fuel wood is the fourth largest source of energy coming next to petroleum product, coal and natural gas. Fuel wood has been the conventional source of energy meeting 87 percent of the domestic fuel needs. The problem of fuel wood is more menacing than is usually realized and unless adequate measures are taken the fuel wood supply will be critical and unmanageable. If this situation continues the future generation is bound to inherit a barren, polluted and dismal world. Besides the traditional household open chulah has an extremely low thermal efficiency, so the heat actually absorbed by the substances are extremely low, compared to the heat given out by the wood consumed during the process. Apart from this the smoke emitted from these stoves contains 17 major pollutants, 14 known cancer causing substances and toxic agents. Hence an alternate efficient source of energy is the need of the hour.

A major portion of the population in India is widely spread among many small and isolated villages with the result that commercial energy sources are hardly be expected to meet their enormous energy needs. Renewable sources have a role to play, not only they are environmentally beneficial but also they require less infrastructure development. In a country like India where capital is relatively scarce and where individual earnings are not high, this is deterrent to most potential users of renewable energy system.

Among a number of options in the renewable sources of energy, solar and biomass gained more importance. But the use of solar cooker the rural areas has certain limitations – such as need to pre-plan the menu and cook according to the sunshine take comparatively more time; impossible to use in the night, shortage of electricity and inadequacy of fuel have posed problems in the rural areas wherever it is available and also the price is exorbitant with the result, dried cattle dung has become the main source of fuel (Pandey, 2003) [2].

In view of the fuel crisis and environmental pollution in recent years, biogas technology has attracted worldwide attention. Biogas technology is an appropriate solution to offer fuel, fertilizer and promotes environmental sanitation. The ultimate application of this technology in the rural areas will have far reaching effect in the rural reconstruction efforts by giving clean energy, healthy environment, smoke free cooking atmosphere and protecting the women from indoor pollution (Ajay, 2009) [3].

In this biomethanated process, the wastes will be managed most satisfactorily in addition valuable energy in the form of biogas could be recovered substantially. At the same time the waste management will be conducive to health and be environment friendly.

This phenomenon prompted the investigator to take up a micro level study titled as "Resource Recovery from Organic Wastes through Community Biogas Plants.

2. Objectives of the study

1. Analyzing the socio-economic impact among women in using Community Biogas Plants
2. Monitoring the indoor air pollution arise from the kitchen of rural households

3. Methods and Materials

The Bannari Amman Rural Foundation is a registered non-profit charitable trust under the aegis of Bannari Amman group of companies. As a part of the Rural Reconstruction Programme they installed two Night soil based Community Biogas Plants with the objective of encouraging enhanced energy supply to rural households as well as to restore clean surroundings in the rural areas.

3.1 Description of Community Biogas Plant

The Community Biogas Plant comprises of a digester made of bricks and cement mortar, gas holder, mixing tank, outlet and compost pits of adequate size to ferment organic waste such as night soil, garbage and left over foods in an efficient manner. Wastes from the sanitary complexes of the villages were directly connected to digester during the construction of the gas plant. Garbage and left over foods generated in the community kitchen and rural households were collected by a person in-charge of the maintenance of the plant and allowed to pass through the mixing tank of the gas plant. Since there is no air in the digester the organic wastes such as night soil, garbage and left over foods ferment and produce biogas. The gas collected in the gas storage dome flows out from the plant through a pipeline up to the point of its use i.e. to the community kitchen located at a distance of 60 meters from the biogas plant.

The installation of Community Biogas Plant is a novel venture introduced into these households with a major aim of providing smoke free energy to remove indoor air pollution, removing the drudgery associated with the collection, purchase and storage of firewood and use them in the inefficient traditional chulah and maintaining the interior and exterior environment clean. At this juncture it becomes imperative to take up an evaluatory study to know the resultant change among the rural households. The steps adopted for this evaluation are as follows;

1. Selecting the villages
Komarapalayam and Kolinjanur (AD Colony) villages of Sathyamangalam Taluk in Erode district has been chosen for this phase of the study.

2. Selecting the respondents and methods of evaluation
The qualitative and quantitative methods of evaluation have been used to gather the data.

3.2 Indoor Air Pollution

Indoor Air Pollution in rural areas in developing countries where biomass is the principal fuel source has now been recognized as a serious and widespread health problem. It is estimated that about half of the world's households cook daily with biomass fuels. Most of this cooking is done using unvented stoves, with women, infants and young children experiencing the highest exposures of indoor air pollution (Pandey, 2003; Singh and Prasad, 2010)[4].

The quick analysis in the 312 household surveyed indicated nearly 80 per cent of homemakers are still using the traditional chulah which emits lot of smoke. In order to bring awareness to the homemakers regarding the ill effects of the smoke emission an experimental study was carried out. Out of the 250 households, only 40 households were selected based on purposiverandom sampling to measure the concentration of CO using Carbon Monoxide Meter. The study was conducted in the early morning 7a.m since most of the rural women have to complete the cooking before they go for their work and in the late evening 7p.m. The pollutant emitted from the smoke emission of chulah was estimated in terms of the amount of carbon monoxide present, using Carbon Monoxide Meter. It was used to detect the presence of carbon monoxide (CO) from traditional chulah and to measure the concentrations between 1-1000 parts per million (ppm). The meter indicates the presence of CO by a reading on the LCD and a beeper tone.

4. Preparing the Research Tool

The 'Interview Method' was used for gathering information owing to its convenience, comprehensiveness and possibility of obtaining genuine information.

4.1 Conducting the study

In order to draw genuine and authentic information from the women, a good rapport was initially established through informal visits. The study was conducted in three phases. In the first phases all the 312 households were interviewed during their leisure hours without detrimental to their normal chores to understand socio economic profile, fuel management practices the reasons for adopting or non-adopting biogas as fuel. At the time of interview the investigator had an opportunity to see the mode of cooking, the condition of kitchen, the type of chulah, kind of fuel used and smoke emitted from their fireplace.

4.2 Consolidating and analyzing the data

The data thus collected was consolidated and analysed to study the impact of Community Biogas Plant among women beneficiaries.

5. Results and Discussion

5.1 Profile of the Rural Households in Selected Villages

Evaluating Socio-Economic impacts is concerned with understanding the visible parameters of quality of life of the people. The presentation in this module describes what socio-economic impacts and why they are important, based on an intervention in two remote villages of Tamil Nadu and considers how these impacts have changed their lifestyle.

5.2 Fuel management practices in households

Energy consumed for cooking in developing countries is a major component of the total energy consumption. Firewood continues to remain a major source of energy for cooking. Table 1 illustrates the fuel usage pattern of the households.

Table 1: Fuel Usage Pattern

Fuel usage	*Households*	
	N:312	*Percentage*
Firewood, barks and twigs	109	35
Firewood	93	30
Firewood and kerosene	33	10
Firewood and Biogas	62	20
LPG	15	5

Majority of the homemakers collected the firewood from the nearby hilly areas. They collected barks and twigs of jasmine plants, chilly plants, coconut husks and other dried twigs. Few women expressed their inability to walk long distances to collect firewood and hence they purchased firewood in markets. Out of the 312 families surveyed only 15 households are using LPG for their cooking requirements. None of the agricultural labour families or the daily wage earning families is using LPG due to their low economic status. The introduction of Community Biogas Plant to supply biogas is a boon to these households, so 62 households made use of this opportunity and perform their daily cooking using biogas.

5.3 Problems Faced with the use of Fuel

Women faces several drudgery in spending lot of precious resources such as time, money and energy in adopting age old practices of using firewood in an open chulah. Table 2 outlines the problems associated with the use of fuel.

Table 2: Problems Associated with the use of Fuel

Problems	*Households*	
	N	*%*
Firewood (N:249)		
Difficult to collect	240	96
Occupies space	235	94
Insect menace	234	93
Difficult to store	228	91
Not available at reasonable cost	226	90
Causes eye strain and breathing problems	219	87
Possibility to burn fingers	204	81
Prone to fire accidents	177	71
Requires more time to clean the utensils	167	67
Blackens the kitchen wall	124	49
Kerosene (N:75)		
Time constraint	72	96
Standing in the hot sun to purchase	69	92
Costly	53	71

* Multiple responses

The homemakers narrated several problems in using firewood. More than 80 per cent of them mentioned walking long distances to collect firewood, dangers of poisonous snakes and insects in the forest area, spending a lot of time, insufficient storage space, fuel not available at reasonable cost, taking more time to clean the utensils, smoky kitchen and eye strain as their major problems.

5.4 Resource recovery in terms of fuel and money

Resource recovery of firewood after installation of CBP is presented in Figure 1.

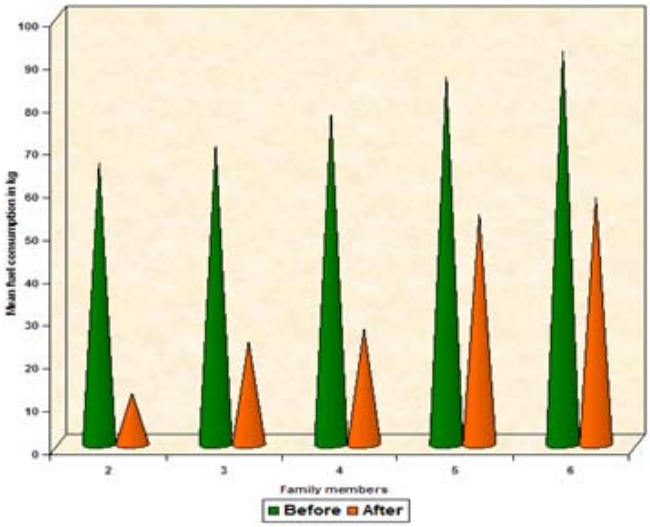

Figure 1: Resource Recovery of Fuel Energy

The consumption of fuel varied with the number of members in the family. On an average they saved firewood ranging from 32 kg to 54kg per month. Similarly a sum of `111-378 per month could be recovered through the use of biogas. This fact denotes that if all the homemakers effectively use the gas plant, a considerable amount of fuel and money could be recovered.

5.5 Indoor Air Pollution and its impact on Health

Several organisations from all over country have taken efforts to improve cooking environment by preventing indoor air pollution through introduction of affordable technologies such as improved chulah, biogas stoves and solar gadgets. But all these efforts are not given expected results. The rural women are not aware of the danger caused by indoor air pollution, so they continue to use traditional chulah. The Carbon Monoxide (CO) emitted from the traditional chulah were measured using Carbon Monoxide Meter at three stages namely beginning of the cooking as initial reading, middle of the cooking as peak reading and end of the cooking as final reading.

Table 3 and Figure 2 illustrate the average concentration of Carbon Monoxide from traditional chulah inside and outside the kitchen among 20 families.

Table 3: Average Concentration of Carbonmonoxide

Particulars	*Average concentration of Carbonmonoxide* (ppm)*			*Average concentration of CO (ppm)*
	Initial Reading	*Peak Reading*	*Final Reading*	
Traditional chulah (Inside kitchen)	120.9	89.85	126.05	112.27
Traditional chulah (Outside kitchen)	94.25	90.05	104.7	96.33

* Average for 20 families

It is clear from the table that average concentration of Carbon Monoxide from traditional chulah (100 ppm-OSHA exposure limit-U.S Department of Labour, Occupational Safety and Health Administration (OSHA) Regulation 1917.24: The CO content in any enclosed space shall be maintained at not more than 50 ppm) when compared with OSHA exposure limit is found to be higher and exceeds the tolerance limit. This shows that firewood used in the

traditional chulah emits carbon monoxide which may affect the health of the homemaker mainly and others inside the house during cooking after a prolonged exposure of smoke.

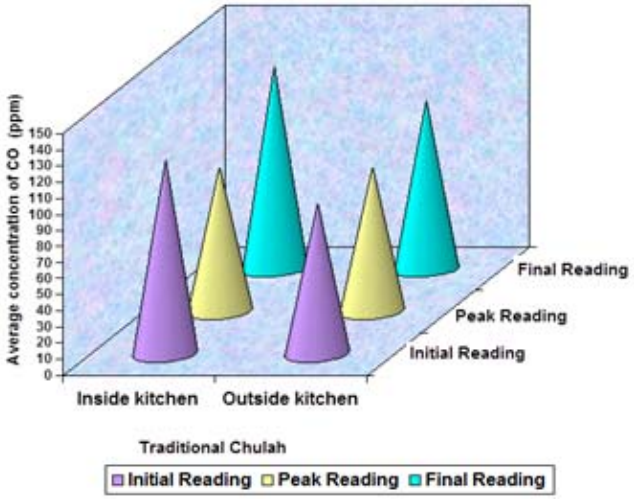

Figure 2: Average Concentration of Carbonmonoxide

6. Conclusion

We, in India are bestowed with vast natural resources as well as rich biological heritage. The day when fossil fuels get exhausted one needs to turn onto the perennial sources of energy - the radiating sun, the blowing wind, the surging tide and other sources of biomass, especially the misplaced resource 'Waste' is not far off. Continuous, conscientise and co-operative efforts on a large scale by Governments, Universities and Voluntary agencies will pave way towards achieving self-sufficiency in energy.

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Author Profile

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