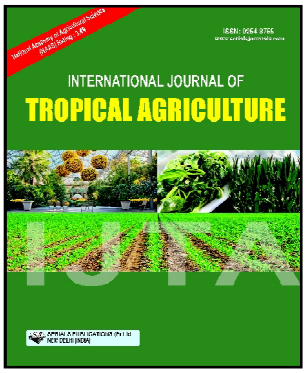

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A Study on Energy Use Pattern and Performance of Biogas Plant in Villages of Hassan District, Karnataka, India

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Abstract: The study was carried out in Hassan district of Karnataka and data were collected by using personal interview scheduled to assess impact of biogas technology on rural households. The study revealed that majority of the respondents using biogas for cooking. Most of the owners opined that biogas helps in eliminating environmental pollution, reduces deforestation, reduction in hazards. Among the respondents, 91.67% of the users use cattle dung for feeding biogas plant. With the use of biogas plants, the user can save 57.33% of energy which is getting by burning 2697 kg of fuelwood per year and average 41.40 kg of LPG fuel per year. By the study, it is also revealed that 71.67% of the respondent replaced chemical fertilizer with biogas slurry for conserving, increasing soil nutrient and yield, perception of the respondent toward the use of biogas plant was revealed that 100% of the respondent was satisfied in one or the other ways.

Keywords: *Biogas, energy, respondents, and fuel*

INTRODUCTION

India is emerging as one of the fastest growing countries in the world with a GDP growth exceeding 7.2 percent year-on-year and this trend is expected to continue (*https://tradingeconomic.com*). Energy is the driver of this growth its availability is of the utmost importance to sustain this level of growth. The official projections show that the energy demand is expected to be more than three to four times the current level in another 30 years (Planning commission report, 2014).

The agricultural waste, firewood from village forests & animal dung are the principal sources of energy for cooking in rural India. Forest covers 67.71 million ha in India, which is 20.60% of its geographical area which has decreased from 22.7% in 1951 (Planning commission report, 2014). Deforestation takes place mainly due demand for wood, as source of fuel, which is not uniform across the country. The state of natural resources has important ramifications for the country's population. For instance, the depletion of forest area places enormous strain on the rural people that would be forced to travel longer distances for firewood collection.

Biogas is a renewable and a hygienic form of energy that is a supplement to traditional and commercial energy sources because of its environmental friendliness permitting for well-organized waste utilization and nutrient recycling (Bhat *et al.,* 2001).

From a national perspective, biogas systems have helped reduce the pressure on forests. This, in turn, has important implications for watershed management and soil erosion. In addition, use of bio-slurry reduces the depletion of soil nutrients by providing organically rich nutrients resulting in increased crop yield and hence reduces the pressure to expand cropland, the principal cause of deforestation in India.

With considering the above facts concerning the importance of renewable energies, present study on "Energy use pattern and performance of biogas plants installed in selected smokeless villages of Hassan district, Karnataka, India" were undertaken.

MATERIAL AND METHODS

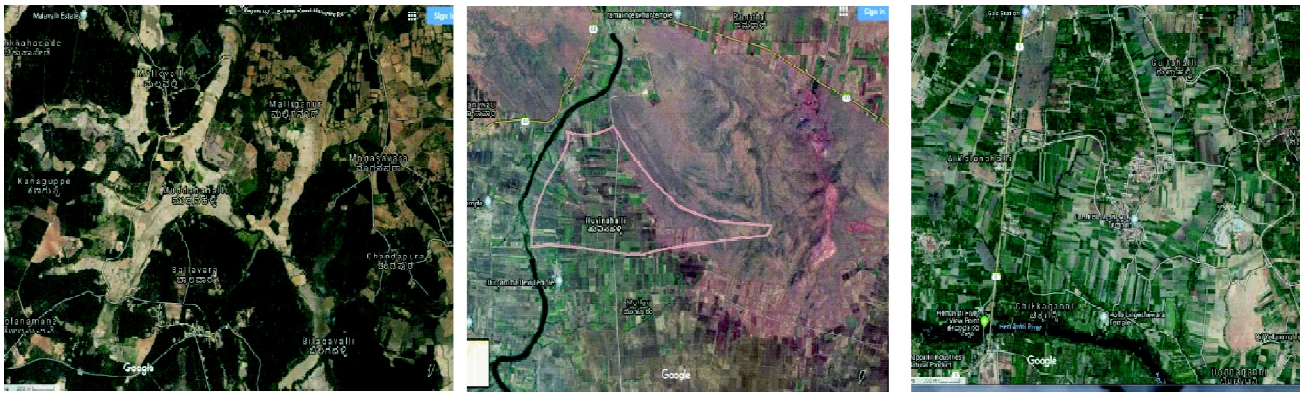
The present investigation was carried out in three villages viz., Muddanahalli, Huvinahalli and Kalenahalli, Hassan district of Karnataka state, India. Three villages were selected from two Taluks (Hassan and Channarayapatna) randomly and considered for a study on the basis of the number of biogas beneficiaries.

Muddanahalli is a small Village in Hassan Taluk, Hassan District of Karnataka State, India. It comes under Handinakere Panchayath. It belongs to Mysore Division. It is located 5 km towards west from District head quarters Hassan, 7 km from Hassan and 195 km from State capital Bangalore. **Huvinahalli** is a small Village in Hassan Taluk, Hassan District of Karnataka State, India. It comes under Huvinahalli Panchayath. It belongs to Mysore Division. It is located 7 km towards west from District head quarters Hassan, 9 km from Hassan and 195 km from State capital Bangalore. **Kalenahalli** is a small Village in Channarayapatna Taluk, Hassan District of Karnataka State, India. It comes under KalenahalliPanchayath. It belongs to Mysore Division. It is located 45 km towards East from District head quarters Hassan, 9 km from Channarayapatna and 146 km from State capital Bangalore. (*www.onefivenine.com/exploreindia*)

A list of biogas beneficiaries of each selected village was prepared with the help of Hassan Biofuel Park. About 60 biogas owners were personally interviewed with the help of specially prepared schedule. The household survey was conducted to examine the socio-economic characteristics of the household resources use for their energy needs before and after utilization of biogas plant. The questionnaires were administered to households to collect various information about family viz., Family size, education, land holding, livestock position, feeding of the biogas plant and fuelwood consumption, Liquid Petroleum Gas consumption & fertilizer utilization before and after installing biogas plant and Perception of respondents on the utilization of biogas plant also evaluated.

RESULTS AND DISCUSSION

All the plants were built with the help and assistance of the local Zilla Panchayat. The total cost of each 2



Muddanahalli Huvinahalli Kalenahalli

Figure 1: Map of all selected villages

Figure 2: Data collection from biogas users with direct interview

m^3 plant installed in the villages were Rs. 24,000. But, 80% of the construction cost is subsidized by the government and remaining 20% of the cost has to pay by respective family. The basic criteria on which the household was selected to get biogas technology was firstly the financial status of the family if they are capable of paying the 20% of the cost and secondly, they having sufficient livestock to provide feed to the digesters. Constructing a standard 2 m^3 capacity plant require approximately 10 bags of cement, 1100 bricks, 10 feet of PVC pipe and 64 labor hours (3 labors working approximately 8 working hours per day for 3 days).

Family Size

Based on the interaction with the respondents the family size of the total respondents was divided into three groups, small, medium and large family size.

Family size might have helped in assessing the impact of adoption of biogas plant on the socioeconomic status of biogas users regarding improved biogas technology. This may be due to the fact that individual in the family has more social interaction with persons of different categories and different types of organization and thereby possessed more improved construction and production of biogas and they gain more economic benefits to the biogas plant.

Table 1
Distribution of the respondents according to their family size (N=60)

Sl. No.	*Family size*	*Frequency*	*Percentage*
1.	Small size (up to 5 members)	28	46.67
2.	Medium size (6 - 10 members)	25	41.67
3.	Large size (above 10 members)	7	11.67

Source: field survey, 2018

Education

Education was considered as the number of years of formal education acquired by the respondents which may affect the knowledge and development of the farmer community. It is the factor which has the high influence on all the dimensions of an individual's life. The education level of the respondents was categorized and presented in table 2 as follows.

Table 2
Distribution of the respondents according to their education (N=60)

Sl. No.	*Education*	*Frequency*	*Percentage*
1	Low	15	25.00
2	Medium	35	58.33
3	High	10	16.67

Source: field survey, 2018

The result revealed that there was a positive relationship between education and impact of adoption of biogas plant by biogas users. This may be due to the fact that more the education more is the desire to study and know about the biogas and its benefits. Similar observations were made by Jayale (1992) and Jain, J. K. (2014).

Landholding

Landholding is directly correlated with the size of the business and their production. Land size is an important factor for the family in motivating to acquire new knowledge. Landholding was divided into three categories vis., small, medium and large.

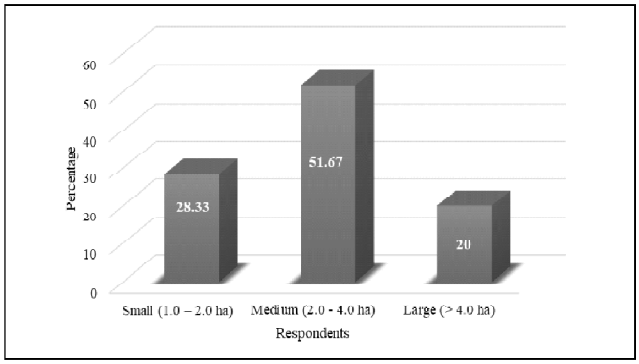


Figure 3: Distribution of respondents according to their land holding (N=60)

Fig. 3 highlights the percentage distribution of land holding of the respondents. It indicates that out of total respondents, 20.0% had the large size of land holding, while 28.33% belongs to the small size of land holding and 51.67% possessed medium landholding.

Livestock positions among respondents

Livestock of biogas households was surveyed based on types of animal they hold viz., buffalo, cow, goat, and hen. Based on the total number of livestock holding by respondent it can be categorized and presented in table 3.

Table 3
Livestock positions among respondents (N=60)

Sl. No.	*Livestock*	*Frequency*	*Percentage*
1.	Low (<3.0)	11.0	18.00
2.	Medium (3.0-5.0)	39.0	65.00
3.	High >5.0	10.0	17.00

Source: field survey, 2018

The number of animals is an important factor in assessing the improved of the biogas plant users regarding improved biogas technology as this helps to increase the profit as well as the production of biogas. Similar observations were made by Jayale (1992) and Jain, J. K., 2014.

Feeding of biogas plants

According to the survey conducted in the selected three villages of Hassan district kind of feeding of biogas plants was found different. The kinds of feeding performed were mentioned in Fig. 4.

It shows material used for feeding biogas plant to produce biogas by all respondents. It shows that among the respondent's majority around 91.67% of

them feed cow dung and 5.00 % of them use poultry dung along with cow dung.

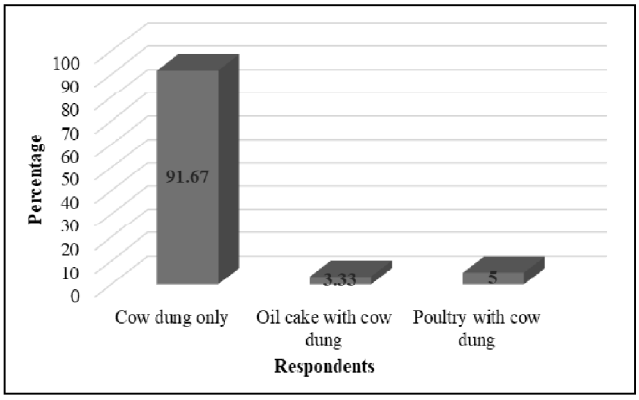


Figure 4. Feeding of biogas plant (N=60)

Source: field survey, 2018

In the study area, biogas households used buffalo and cow dung as the major feeding materials for biogas plants. As regards to feeding, all the surveyed biogas households fed their plants once a day. Shrestha, A. (2010) reported theoretically that feeding amount (34.92 kg of dung and 34.92 liters of water) was adequate to maintain a plant of average size 5.82 m^3.

Fuelwood consumption before and after installing the biogas plant

The study was conducted among the biogas users to know the fuel wood consumption pattern before and after installation of the biogas plant in households.

Fig. 5. highlights the impact of biogas installation on fuel wood consumption for cooking and burning. With the use of biogas nearly 57.33% of energy can be saved against burning of fuel wood at the rate of 2697 kg/year/household, which can save Rs. 4045 kg/year/household. This reduction in fuel wood consumption can help in reducing global greenhouse gas emission.

Liquid Petroleum Gas (LPG) consumption before and after installing the biogas plant

Fuel consumption pattern of biogas users was studied towards consumption of Liquid Petroleum Gas (LPG) before and after installing biogas plant. The results were presented in table 5.

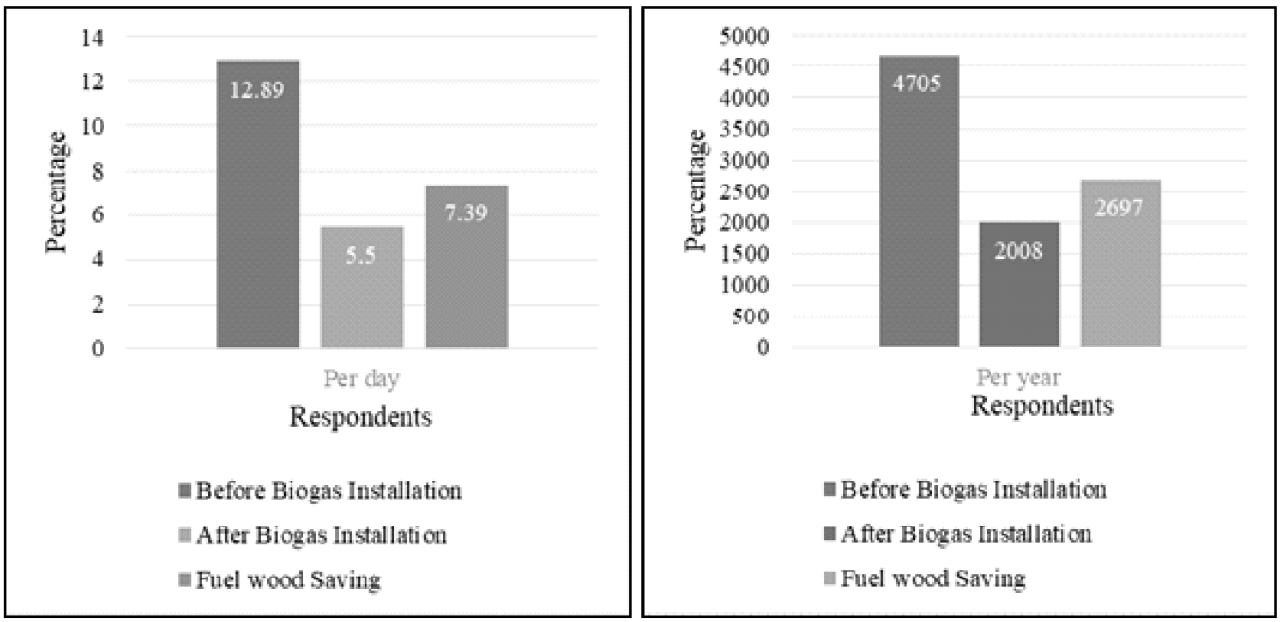


Figure 5: Fuel wood consumption before and after installing biogas plant (N=60)

Source: field survey, 2018

Figure 5, represents Liquid Petroleum Gas (LPG) consumption among the respondents before and after installing biogas plant. It clearly shows that by using biogas as main or alternate fuel in the household it can save 3.42 kg of fuel per month which can save of Rs. 181.51. The impact of the difference in fuel consumption by using biogas can save up to 205 kg of fuel per year, which has a cost of Rs. 2178.15. Sharma and Nema (2013) estimated that $2m^3$ biogas plants are installed in a family of 4 persons can save up to 2,880 kg wood/year or 6 LPG Cylinders.

Table 5
Liquid Petroleum Gas (LPG) consumption among respondents (N=60)

Sl.No.	*Liquid Petroleum Gas consumption for cooking*	*The quantity of LPG consumed per month among respondents (kg)*	*Average LPG consumed (kg/ month/ household)*
1.	Before biogas plant installation	334.5	5.58
2.	After biogas plant installation	129.5	2.16
3.	Total fuel saved per month	**205**	**3.42**
Saving per month in INR.			**181.51**
Saving per year in INR.			**2178.15**

Source: field survey, 2018

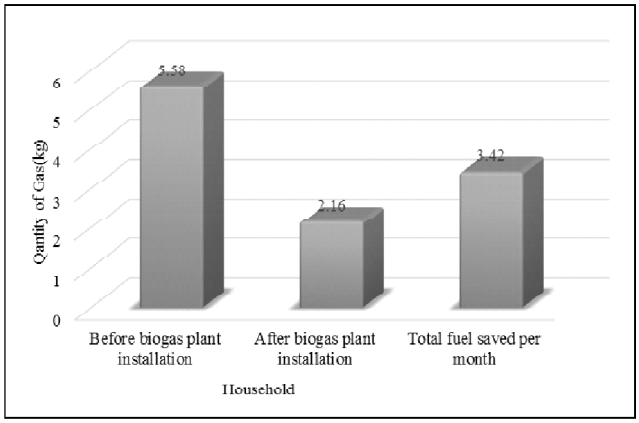


Figure 6: Liquid Petroleum Gas (LPG) consumption among respondents (N=60)

Fertilizer utilization before and after installation of the biogas plant

Three kinds of fertilizers were commonly used by farmers are chemical fertilizer, compost & farmyard manure and biogas slurry. In this study, we found that impact of biogas plants on the utilization of fertilizers by replacing the chemical fertilizers to biogas slurry from the corresponding respondents. The same has been presented in Table 6.

In the Table 6 represents the usage of fertilizers before and after installation biogas plant. Among the respondents, all of them used chemical fertilizer and compost for enriching the soil. But by understanding the problem of using chemical fertilizer and utilization of biogas slurry by practically and motivation of Biofuel park of Hassan district, 43 (71.67%) respondent of the 60 respondent replaced chemical fertilizer with using biogas slurry. Sharma and Nema (2013) did the survey that included 22 families which were using biogas for cooking purposes and slurry as fertilizer. 96% of them are using digested biogas slurry as fertilizer and all of them stated that it is very helpful in improving soil structure and yield. 90% of the farmers were able to reduce their use of chemical fertilizer.

Perception of respondents on the utilization of biogas plant

The data collected on working of the biogas plant and utilization of biogas plant the questionaries' were prepared to know the satisfaction level of using biogas plant among the respondents and categorized as follows.

Table 6
Fertilizer utilization before and after installation of biogas plant (N=60)

Sl. No.	*Fertilizer*	*Before using biogas*		*After using biogas*	
		No. of respondents	*Percentage*	*No. of respondents*	*Percentage*
1.	Chemical Fertilizer	53	88.33	8	13.33
2.	Compost & FYM	60	100	29	48.33
3.	Biogas slurry	0	0	43	71.67

Source: field survey, 2018

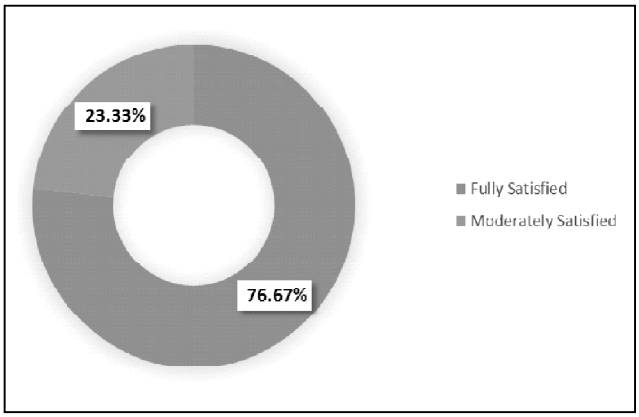


Figure 7: Perception of respondents on the utilization of biogas plant

Source: field survey, 2018

Figure 7 indicates that, among the respondents, 46 households were fully satisfied and 14 households were moderately satisfied with the installation & utilization towards biogas plant. Among the respondents the all respondents were satisfied in one or other ways for adoption of biofuel plant.

CONCLUSION

Biogas technology is considered to be simple and comes handy to the rural households. It can be concluded that there has been a significant impact of biogas technology on rural housewives on saving of fuelwood, LPG & fertilizer that helps in maintaining ecological balance. The study revealed that based on the economic condition of the user and livestock position & keeping utilization factors in the mind they constructed different size of biogas plant with the suggestion of expertize. It clearly shows that the saving cost towards the utilization of fuelwood and LPG for cooking & burning and saving towards the use of slurry as fertilizer against chemical fertilizer to their farmland for improving soil conditions. The result observed perception level of the beneficiaries for using biogas plant for work. It was concluded that, the technology is cheaper and much simpler than those for other biofuels, it is ideal for small-scale application and household wastes and bio-wastes can be disposed of usefully and in a healthy manner, it reduces Co_2 emissions of biogas in contrast to fossil fuels and produces enriched organic manure, which can supplement or even replace chemical fertilizers.

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