Improved biomass stoves in rural area :A boon

ABSTRACT

Aims: the study aimed for quantification of fuel wood consumption in traditional and biomass stove as well as to estimation of the Carbon dioxide (Co2) and Corbon monoxide (Co) while cooking with different fuel wood.

Study design: exploratory and experimental

Place and Duration of Study: The duration of the Study was 2 years and place of the study was Dharwad and Vijayapur districts of Karnataka state India.

Methodology: Keeping this in view a study was conducted in two villages namely Timmapur Village of Dharwad district and Bhaganager village of Vijayapur district Karanarak State India. From each village 60 households were selected randomly thus total sample size comprises 120 rural women.

Results: About 80 per cent of the women were illiterate in Timmapur and 76.70 per cent of the women were illiterate in Bhaganagar. The quantity of ash, charcoal and smoke after food preparation was significantly varied in both the villages. The reduction in percentage of both carbon dioxide and carbon monoxide was found in biomass stove compared to traditional stove. The experimental research revealed that as 58 percent of the fuel wood was saved per year per100 families when compared to traditional stove. Whereas the traditional stove consumes 1200 kg /month/100 families.

Conclusion: Improved biomass stoves should be promoted to encourage the rural women for better use of stove.

Key word: Energy, Biomass, Carbon Emission, Indoor pollution.

1. INTRODUCTION

Half of the global population relies on solid biomass fuels including fuel wood, crop residues, charcoal and dung for cooking. India leads the world in number of people using traditional biomass for cooking. Over two thirds of the national population (772 million) uses biomass as their main cooking fuel, accounting for 30 % of the global total of biomass users (Legros *et al.,* 2009).

This resulted in tree cutting and loss of vegetation. In addition traditional stove creates problems of health such as eye nose throat irritation may cause impaired lung function and increased respiratory infections especially in women and children due to smock. World Bank and kumari *et al.* 2011. Improved biomass stoves are best alternative to overcome the problem.

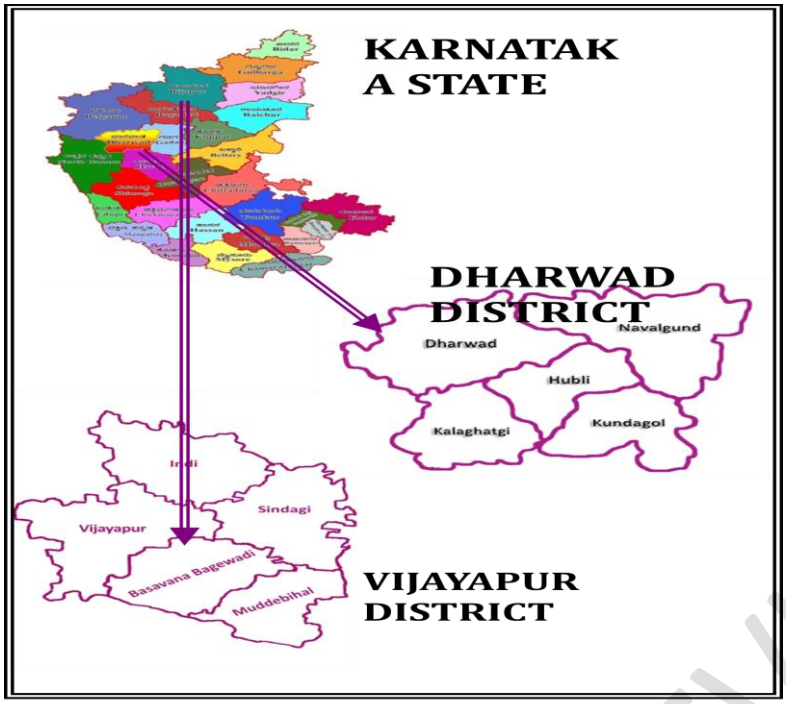

Fig. 1: Map showing study area

Modified version of traditional cooking stove is the improved biomass stove (IBS). Certain features had been modified to make more efficient with respect to fuel wood consumption, make convenient for cooking and much safer from a health point of Improved biomass stove reduces exposure to harmful pollutants by improving combustion efficiency and introducing chimneys in some of the fixed biomass stove and also it reduces cooking time.

Thus the present study was primarily aimed at determining full time utilization of improved biomass stoves coupled with assessing the health impact of its usage on users. Specifically, study was set up with a view to achieving the following objectives

Objectives of the study:

- Quantification of fuel wood consumption in traditional and biomass stove as well as
- To estimation of the Carbon dioxide (Co2) and Corbon monoxide (Co) while cooking with different fuel wood.

2. MATERIALS AND METHODS

2.1 Study area

The study was conducted in two villages, namely Timmapur Village in Dharwad district and Bhaganager village in Vijayapur district, Karanataka State India. The villages shown in Fig 1; from each village, 60 households were selected randomly thus total sample size comprises of 120 households who regularly used fuel wood for cooking. Personal interview schedule was used to elicit the required information from the participants of the study

Plate 1. Traditional cook stove

Plate 2. Improved cook stove

Traditional cook stove: Traditional stove is an oldest cooking method it may be built under ground or over ground using three stones Mud-built cylinder with three raised points. It is also called as open fire stove (Plate 1).

Improved cook stove: A modified version of the traditional cooking stove is the Improved Biomass Stove (IBS) or Improved Cook Stove (ICS). Certain features have been modified to make more efficient with respect to fuel wood consumption, make convenient for cooking and much safer from a health point of view (Plate 2).

3. RESULTS AND DISCUSSION

The data in figure 1 indicate that socio-economic status of the rural women in the selected households. In Timmapur village, majority 51.70 percent of the rural women belonged to middle age group (< 30 years) followed by 33.3 % of them belonging to old age group (> 51 year) and 15% of the women belonged to young age group (31 to 50 years). While in Bhaganagar village, majority 56.70% of the women belonged to middle age group (< 30 years) followed by 28.30 % of them belonged to young age group (31 to 50 years) and 15% women belonged to old age group (> 51 years).

In Timmapur village, majority of the women were illiterate 80.00 % followed by11.70% of the women who were educated up to primary level and 8.30% of them had studied up to middle level. About 66 per cent of the respondents studied up to primary school level. A very few percent of them had studied up middle school level. The results are similar to the results of study conducted by Komala *et al*., (2016).

In Timapur village, majority of the women belonged to agricultural labourer (98.30 %) and followed by a few per cent of them belonged to agriculture (1.70 %).

In Bhaganagar village, main occupation of respondents was agriculture 76.70 % followed by agricultural labouers 23.30 %. With respect to the family type majority of the women in Timmapur village, belonged to nuclear family (61.70 %) where as about 38.30 % of them belonged to joint family. While in Bhaganagar, majority of the women belonged to nuclear family 58.33 %followed by joint family.

The data on the family size in Timmapur village, is presented in Table 1. Majority of 56.60 % the women respondents had medium family size (4-6 members) followed by equal per cent (21.70 %) of them had small family size (< 3) and large family size (6 and above). While in Bhaganagar village, majority 46.60 % of the women had medium family size (4-6 members) followed by 36.70 per cent of women had small family size (< 3) and 16.70 per cent of them had large family size (6 and above). The results are in line with Somnath *et al.,* (2014).

With respect to the annual family income, in Timmapur village, that fifty of the women had low annual income (< 60,000) followed by 45 % of the women were in the medium annual income (Rs. 60,000 to 1,20,000), only 5 per cent of the women were in the high income group (> 1,20,000). While in Bhaganagar, majority 66.66 % of the women were in the medium income (Rs. 60,000 to 1, 20,000) followed by 26.70 per cent of the women were in the high income (> 1, 20,000) only 6.66 per cent of the women had low income (< 60,000). It can be observed that, more than fifty percent of the women belonged to landless category followed by 41.70 per cent of the women were small farmers (< 5 acres), and few 6.70 per cent of them belonged medium farmers category (5-10 acres) in Timmapur village. While in Bhaganagar, one third (38.30 %) of the women respondents belonged to medium farmers (5-10 acres) categories, followed by 35 per cent of them belonged to small famers (< 5 acres) and 20 per cent of them belonged to landless categories.

The data in the Table 1 indicates that comparison of time, quantity of fuel wood required to prepared food per day and quantity of smoke perceived, in both the villages were found to be took less time on improved biomass stove as compared with traditional stove and significant difference was found between the quantity of fuel wood and time taken between improved biomass stove and traditional stove.

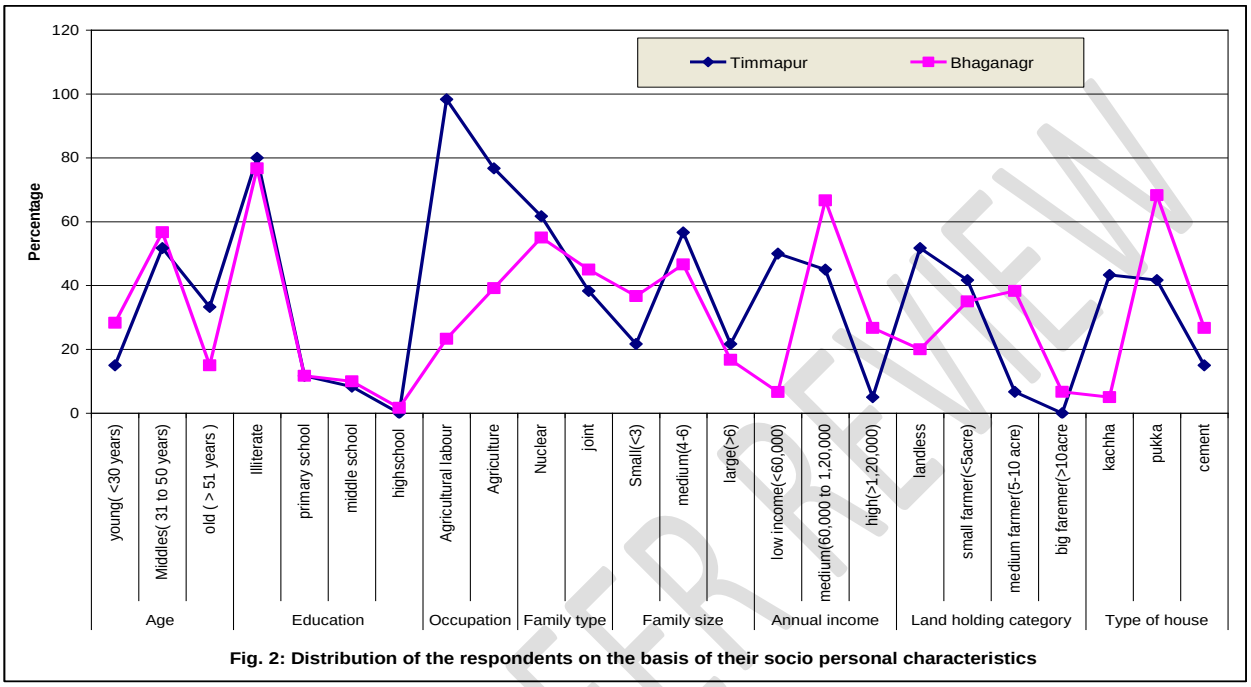

Fig. 2: Distribution of the respondents on the basis of their socio personal characteristics

Fig. 2 distribution of the respondents on the basis of their socio personal characteristics

Table 1. Comparison of time, quantity of fuel wood required to prepared food per day and quantity of smoke perceived

N=120

Particulars	**Timmapur (n_1=60)**			**Bhaganagar (n_2=60)**		
Time (Hours)	**Traditional stove**	**Improved stove**	**t-value**	**Traditional stove**	**Improved stove**	**t-value**
< 2	2.43	1.9	7.71*	2.41	1.73	11.28**
2-4						
> 4						
Fuel wood (kg)						
< 5	2.48	1.96	7.45*	2.43	1.93	7.96*
5-10						
> 10						
Smoke level						
Less	2.83	1.23	25.08**	2.75	1.33	22.07**
Medium						
More						

Note: * Significance at the 0.01 level ** Highly significance at the 0.01 level

With respect to quantity of fuel wood used in traditional and improved stove there was 't' test shows that significant difference between traditional and improved biomass stove and also there was significance difference of perceived smoke between traditional and improved biomass stove.

Table 2 shows that the saving quantification of fuel wood used in the biomass stove. The experimental research revealed that about 58 percent of the fuel wood was saved per year per100 families when compared to traditional stove. About10-15 kg of wood is utilized per year while cooking with biomass stove from 100 families with the karijali fuel wood about 720 kg/ month/100 families. Whereas the traditional stove consumes 1200 kg /month/100 families. By using biomass stove on an average 384 trees/ year/100 families could be saved the results are in with result of Marc *et al* 2020.

Table.2 Comparative Fuel wood Consumption **N=10**

Traditional stove	**Biomass stove**
10x30=300 Kg/Week/100Families	6x30=180 Kg/Week/ 100Families
300Kg/ Week/ 100Families	180Kg / Week / 100Families
1200 Kg /Month/ 100 Families	720 Kg / Month / 100 Families
14400 Kg / Year/ 100 Families	8640 Kg/ Year/ 100 Families
14400-8640=5760 Kg Saving	
Therefore each tree = 10-15 Kg wood /Year	
5760/15=384 Trees /Year/100 Families	
5760/100=57.6%/Year/100 Families	

3.1 Experimental results

Table 3: Estimation of carbon dioxide and carbon monoxide

Parameters	Traditional			Biomass stove			Percentage reduction
	Max	Min	Average	Max	Min	Average	
CO_2	754	519	637	510	401	468	26%
CO	21	01	7.50	12	01	5.50	26%

Fuel wood used= cotton stick and Nilagiri, Duration =30 min

Table 3 Shows that the production of carbon dioxide (CO2) was found to higher than the safe level while carbon monoxide (CO) was lower than the safe level (Safe level CO2= 250-350 ppm CO= 9ppm).

The percentage reduction in carbon dioxide and carbon monoxide was found in biomass stove as compared to traditional stove. It could be due to the reduction in smoke and fuel wood consumption in the biomass stove.

4. CONCLUSION

Improved biomass stoves should be promoted to encourage the rural women for better use of stove. Rural women should be educated regarding usage and importance of improved biomass stoves on their quality of life. The government should enact the policy on subsidiary towards the improved biomass stove. Action oriented research should be taken up to create awareness on usage of improved biomass stove and safeguard the environment.

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5. REFERENCES

Kumari, H., Joon, V., Chandar , A., Kaushik, S. C., 2011, Carbon monoxide and nitrogen dioxide emissions from traditional and improved biomass cook stove used in India. IPCBEE. 10:233-236.

Komala H. P. and Devi P. A., 2016, Biomass: A key source of energy in rural households of Chamarajnagar district. Journal of Advance Applied Science and Research , 7(1):85-89.

Legros, G., Havet, I and Bruse, S., 2009, the energy access situation in developing countries: A review focusing on the least developing countries and sub Saharan Africa, New yark and world health organization, pp.1-142.

Marce A. J., Subrendu K. Sushmita S., Mansi V., P., 2020, Adoption and impacts of improved biomass cookstoves in rural Rajasthan. Journal of Energy for Sustainable Development. 5 (7):149-159.

Shinde S., Waghmode V., Dike A and Narole S., Improvement of Traditional Biomass Cook-Stove for its Performance and Pollution Reduction A Review. International Research Journal of Engineering and Technology. 4(11): 93-95

Somnath, H., Jessica, L., Ipsita, D., Ashok, S., 2014, Adoption and use of improved stoves and biogas plants in rural India: A study of sustainable business models, Energy policy, pp.1-13.

The World Bank, www.world bank.org.