# Improved biomass stoves in rural areas in Karnataka, India


## ABSTRACT

**Aims:** the study aimed to quantify fuel wood consumption in traditional and biomass stoves as well as to estimate the Carbon dioxide (Co2) and carbon 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 the 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 villages. A reduction in the percentage of both carbon dioxide and carbon monoxide was found in biomass stoves compared to traditional stoves. The experimental research revealed that 58 per cent of the fuel wood was saved per year per 100 families when compared to traditional stoves. Whereas the traditional stove consumes 1200 kg /month/100 families.

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



**Keywords:** 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 and 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 the best alternative to overcome the problem.

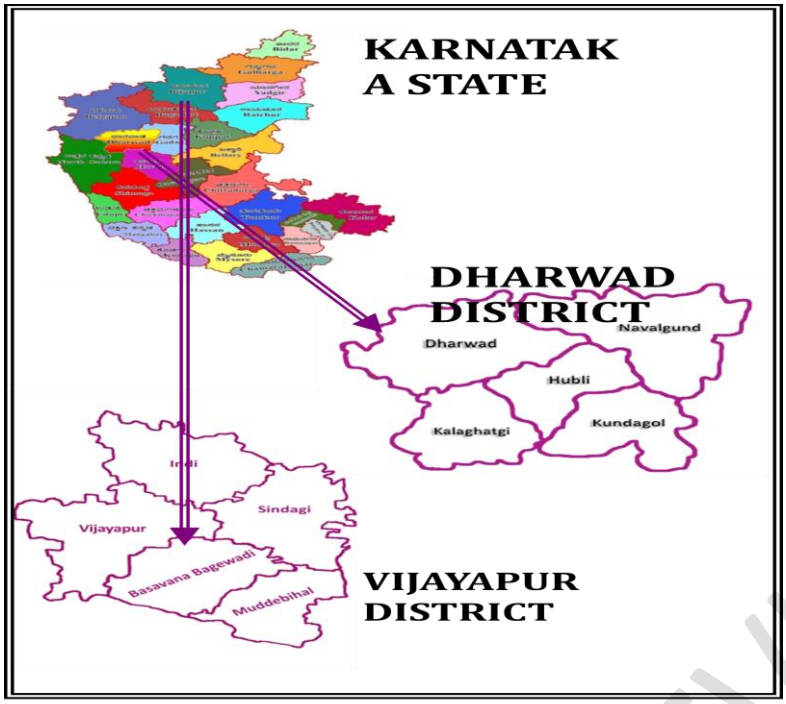


Fig. 1: Map showing study area

A modified version of a traditional cooking stove is the improved biomass stove (IBS). Certain features have been modified to make it more efficient with respect to fuel wood consumption, convenient for cooking and much safer from a health point of Improved biomass stoves reduce 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, the 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 stoves as well as
- To estimate the Carbon dioxide (Co2) and carbon 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, Karnataka State India. The villages shown in Fig 1; from each village, 60 households were selected randomly thus total sample size comprises 120 households that regularly used fuel wood for cooking. The personal interview schedule was used to elicit the required information from the participants of the study

Plate 1. Traditional cookstove Plate 2. Improved cook stove

**Traditional cook stove:** The traditional stove is the oldest cooking method it may be built underground or over ground using three stones Mud-built cylinder with three raised points. It is also called an 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 it more efficient with respect to fuel wood consumption, making it convenient for cooking and much safer from a health point of view (Plate 2).

## 3. RESULTS AND DISCUSSION

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

In Bhaganagar village, the majority 56.70% of the women belonged to the middle age group (< 30 years) followed by 28.30 % of them belonging to the young age group (31 to 50 years) and 15% of women belonged to old age group (> 51 years).

In Timmapur village, the majority of the women were illiterate 80.00 % followed by 11.70% of the women who were educated up to the primary level and 8.30% of them had studied up to the middle level. About 66 per cent of the respondents studied up to the primary school level. Very few per cent of them had studied up to middle school level. The results are similar to the results of a study conducted by Komala *et al*., (2016).

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

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

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

With respect to the annual family income, in Timmapur village, fifty of the women had a low annual income (< 60,000) followed by 45 % of the women with a 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, the 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 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 per cent of the women belonged to the landless category followed by 41.70 per cent of the women who were small farmers (< 5 acres), and 6.70 per cent of them belonged medium farmers category (5-10 acres) in Timmapur village. 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 belonging to small farmers (< 5 acres) and 20 per cent of them belonging to landless categories.

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

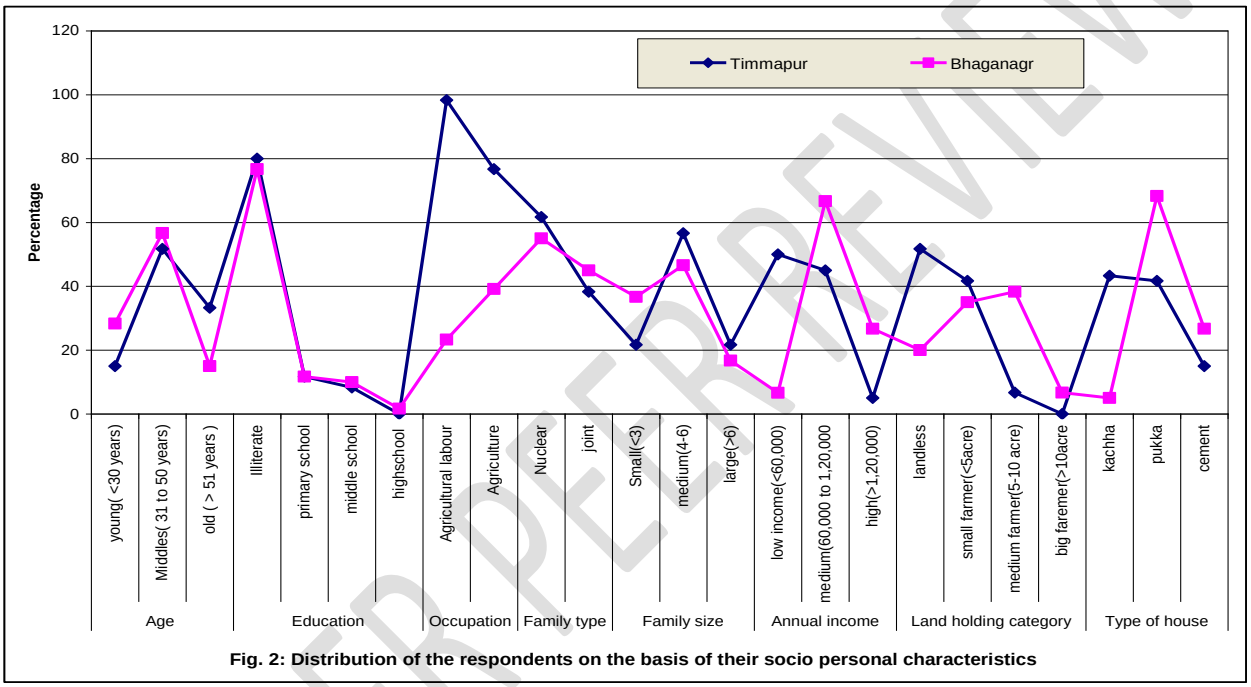


**Fig. 2: Distribution of the respondents on the basis of their socio personal characteristics**

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 prepare 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<br>Medium<br>More | 2.83 | 1.23 | 25.08** | 2.75 | 1.33 | 22.07** |

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

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

Table 2 shows the saving quantification of fuel wood used in the biomass stove. The experimental research revealed that about 58 per cent of the fuel wood was saved per year per 100 families when compared to traditional stoves. About 10-15 kg of wood is utilized per year while cooking with biomass stoves from 100 families with the karijali fuel wood of about 720 kg/ month/100 families. Whereas the traditional stove consumes 1200 kg /month/100 families. By using biomass stoves on an average of 384 trees/ year/100 families could be saved the results with the 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 be higher than the safe level while carbon monoxide (CO) was lower than the safe level (Safe level CO2= 250-350 ppm CO= 9ppm).

A percentage reduction in carbon dioxide and carbon monoxide was found in biomass stoves as compared to traditional stoves. 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 rural women to better use stoves. Rural women should be educated regarding usage and the importance of improved biomass stoves on their quality of life. The government should enact a policy on subsidiaries towards the improved biomass stove. Action-oriented research should be taken up to create awareness of the usage of improved biomass stoves and safeguard the environment.

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