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## Article

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## Fuel Consumption Practices on Khulna Region: A Comparative Study on Traditional Fuel and Clean Fuel Use

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**Abstract:** The study involves fuel consumption practice on Khulna region of Bangladesh, to identify the determinants working behind the scenario and effects on environment as well as the socio-economic life of the people. To accomplish the motive, six rural villages Maheswarpasha, Telegati, Jabdipur, Mirerdanga, Shiromoni and Jogipol of Khulna district, located outside of city corporation on which fuel mapping is incomplete, have been considered as the study area. 60 family samples have been collected to understand the use of traditional fuel for household cooking, their impact on users and drawbacks, affordability and interest of using clean gases like LPG, LNG fuels. Traditional fuels cause indoor air pollutions which create severe impact on the users and environment. But according to this study 59% of the people use traditional fuel. The household of the rural people should use more alternate fuels than traditional one and better cooking methods like improved cook stoves for a better fuel consumption experience, saving cooking times, escaping health hazards and reducing air pollution.

**Keywords:** *traditional-fuel, alternate-fuels, pollutions, health hazard, improved cook stoves*

### 1. Introduction

Bangladesh is a densely populated country with a large amount of people living under the poverty line. At the national level of the economy, poverty rates are still relatively high which is close to 40%. More than 60 million people still live in poverty, with two thirds of them in the most terrible circumstances [1]. 4% of the population are covered with centralized gas connection and almost 80% people who lived out of metropolitans depend on traditional fuels for their household cooking. Biomass, wood, dried cow dung, agricultural residue are the main types of fuels they use as their cooking fuels. Traditional fuels at rural areas are frequently used because of availability, low costs and long period practices in those areas [2]. The fuel consumption is scattering towards cleaner and user-friendly fuels like LPG which indicates the concern of cooking hours, pollution etc. At 2018 the demand for LPG in Bangladesh was about 750,000 MT, and by 2025 it will increase by 25 percent to be at 250,000 MT. LPG has already grabbed 16% of national fuel consumption for cooking. But the pricing of a 12KG LPG cylinder was almost 1200-1300 BDT which is very higher in terms of expenditure against fuel buying for the lower class and middle-class people as they want to spend as less as possible [3]. Various factors like the socio-economic structure of rural areas, monthly income of the family, family size, food taste variation on fuels, cooking hours, and

age of person involved on cooking are behind the different practices on fuel consumption. Rice et al., reported that Bangladesh ranks eleventh best among the fifty-two developing nations that the World Bank evaluated in 2019 for their regulatory frameworks on clean cooking. In terms of energy efficiency, it scored only 44% while massive use of traditional fuels in undeveloped infrastructure causes huge energy loss [4]. Sagar & Kartha et al., have found that because inefficient fuel burning produces gases like methane and carbon monoxide that have a greater potential for global warming than carbon dioxide, cooking with traditional fuels and biomass can have an impact on the environment. Several socio-economic factors influence the use of traditional fuels that varies geographical area wise and behaviour of consumption [5]. Ahmed et al., has found biomass, wood etc. have major contribution on rural areas fuel necessity because of the availability and costs. At least 50% of the total consumption in these areas depend on wood and dried life [6].

Table 1. Wood cost per kilogram in Bangladesh on 2017

Types of Fuel	Dhaka (Taka per Kg)	Jessore (Taka per Kg)
Dried Wood	7.5/7	5
Wood from rice husk	10	9

The Table-1 shows that the price of traditional fuel is cheap on the rural areas, which influence users to consume it without thinking the health or environmental effect of it.

Kumar et al., reported that the health of those who use traditional stoves and their families is at risk because of the absence of vent pipes and poor home ventilation that allowed smoke to accumulate in the kitchen. Firewood is the most common type of cooking fuel in the world which claims at least 75% of total fuel use worldwide that indicates massive use of traditional fuels [7]. Aziz, et al., reported that due to diminishing domestic gas reserves, the government halted providing new natural gas distribution in 2016–2017. As of 2018, approximately 4 million households were linked to a natural gas pipeline which basically increases the demand of LPG cylinders for household cooking [8]. Ahmed et al., also found as no piped supply distributed on Khulna, Rajshahi, Barishal and Rangpur division, LPG plays a big role as cooking fuel on that region of Bangladesh. But the expenditure is very expensive for lower- and middle-class people as it costs on average 1000BDT and a family of five members need at least two cylinders per month and the government has no control on these markets as the private companies holding almost the whole stake of the market [6]. Miah, et al., have found 95% of households on Bangladesh use biomass and related mix-up fuels for household cooking where 40% of them are collected from nearby forests shows intends towards deforestation and pollution through incomplete combustion by using traditional fuels [9]. A literature gap on fuel consumption information and the potentiality of the market to use alternative fuels on the rural areas. This study is proposing to fill this gap selecting rural villages on Khulna district considering the socio-economic infrastructure of the users and various factors that influence the practice of fuel consumption behaviour. The major objectives of this study to explore the fuel consumption practice for cooking on Khulna region, estimation of average cooking hours and reasons behind

the difference of cooking hours, and to understand the fluctuation of clean fuel uses over traditional fuels with the factors compensate the user behaviours.

## 2. Methodology

The primary data on which the study conducted has been collected from field survey. Six different villages were taken as the survey area considering the distance and time, affiliation with the local people and the cost on conducting the survey. The study area was taken outside of Khulna city corporation area to achieve variation in the socio-economic structure on the survey. 60 respondents, 10 from each village were taken by simple random sampling techniques and data was taken from all economical class. The person involved on cooking mostly the women of the household were taken as the respondents to achieve the actual data including fuels costs and sourcing, cooking hours, reasons behind choosing fuels, willingness of using better alternate fuels and the financial influence on the fuel consumption.

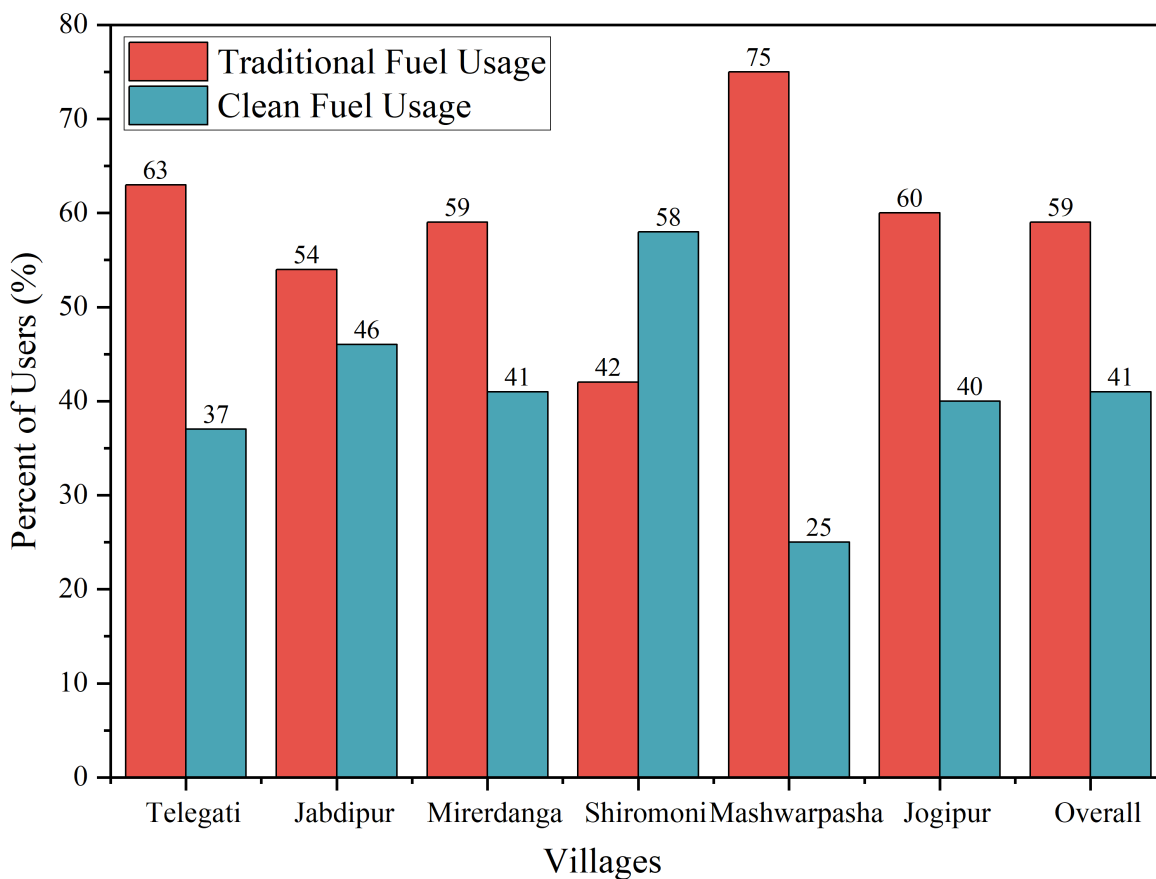
Two different methods were used to analyse the data. In inferential analysis method, amount of fuel consumption monthly, household income, cooking hours etc. were estimated by hypothesis testing. In descriptive analysis by using quantitative data analysis, costs of traditional and clean fuel users, number of users of the fuels individually have measured by verbal description and figures.

## 3. Result and Discussion

The data collected from six rural villages Maheswarpasha, Telegati, Jabdipur, Mirerdanga, Shiromoni and Jogipol of Khulna district, Bangladesh has been used to analyze and create a general model of fuel usage practices in rural Bangladesh. The cook who participated in the study had the purpose of cooking only for households. Almost all of the participant were women of different ages. No commercial fuel users were included. The study includes the comparison of fuel users on the basis of socio-economic factors and geological position. The study compares the cooking time fluctuation on the basis of fuel usage types.

### 3.1 Fuel usage difference on basis of geological position

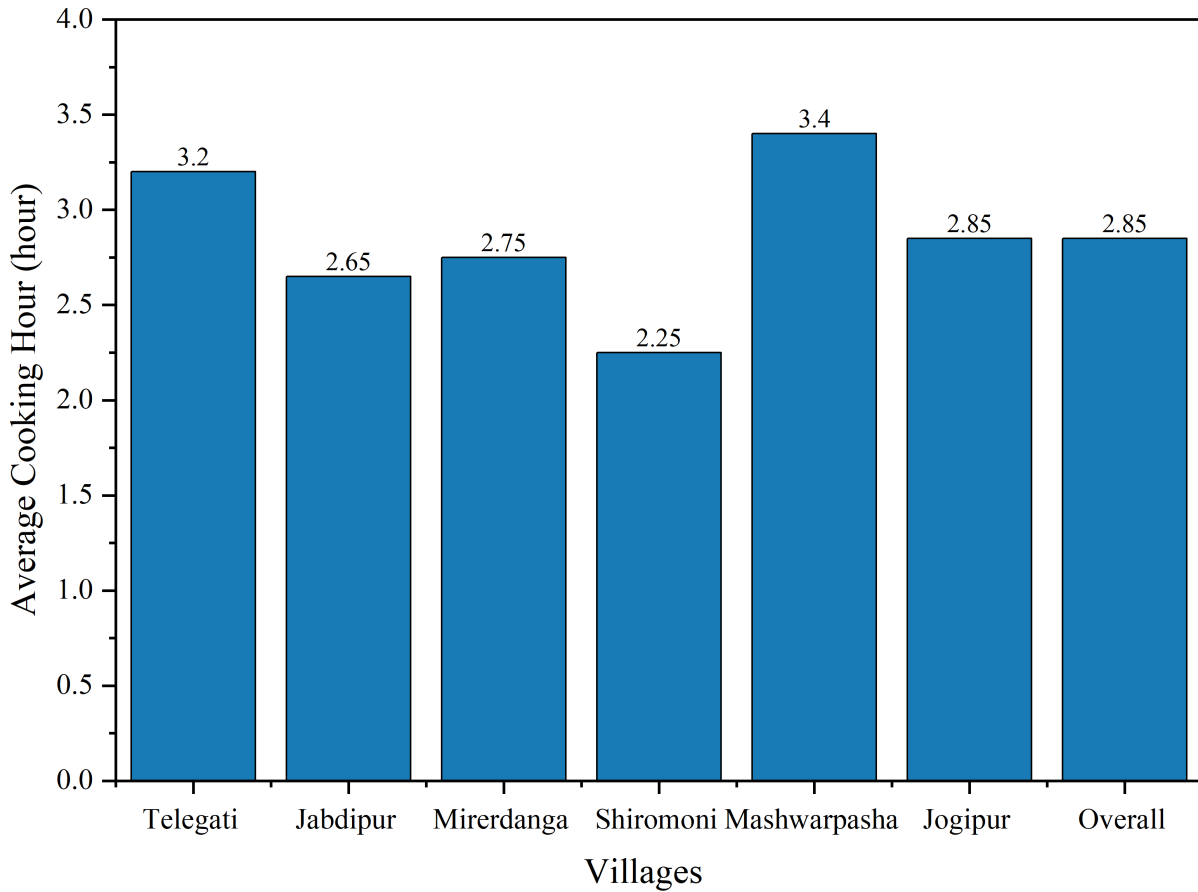
Figure 1 shows that the fuel usage practice fluctuates from village to village. In Telegati 63% of the participants in the survey use traditional fuel and only 37% of the participants use clean fuel. In Jabdidpur, Mirerdanga, Jogipur the result is almost similar to that of Telegati where, respectively, 54%, 59%, and 60% of the participants use Traditional Fuel. These are almost the same as that of the overall fuel usage. In Mashwarpasha it is seen that the traditional fuel use has been raised up to 75%, which is the zenith of traditional fuel usage. It is a 26% jump in usage of traditional fuel usage compared to that of overall. In Shiromoni we see an exception to the trend where more participants of the study used clean fuel than that of the traditional fuel. Here, 58% use clean fuel, which is a 17% rise compared to that of the overall. The traditional fuel user is only 42%. So, it is clear that people's fuel choices differ with the variation of geological position.



*Figure 1. Comparison between Traditional and Clean fuel usage in different villages (Source: Authors' Estimation Based on Field Survey, 2019)*

### 3.2 Average cooking time in different villages

Figure 2 projects the average cooking hour in different villages. Here the overall cooking time of the village is 2.85 hours, which is quite large in modern times. Here, the average cooking hour of Telegati is 3.2 and Mashwarpasha is 3.4, which are 0.35 and 0.55 hours greater than that compared to the overall respectively. Jogipur has cooking hours similar to that of overall, where, in Jabdipur, Mirerdanga, Shiromoni the average cooking hour has decreased by 0.20, 0.10 and 0.60 hours than that of the overall.



*Figure 2. Average cooking time in different villages. (Source: Authors' Estimation Based on Field Survey, 2019)*

Comparing Fig. 1 and Fig. 2 we can see that Telegati and Mashwarpasha have the largest cooking hours, where they have the largest traditional fuel usage also. Shiromoni had the least cooking hours and the largest clean fuel usage. Analysing the comparison between Fig. 1 and Fig. 2, a relationship can be established between the fuel choice and average cooking hour. The traditional fuel usage increases the cooking hour, the clean fuel usage decreases the average cooking hour.

#### **4. Conclusions and Future Recommendation**

This study focuses on the fuel usage by households in six villages of rural Bangladesh. The main focus was on mainly the two types of fuel: traditional fuel and clean. The study was conducted in the month of November, 2019, which is the winter season in Bangladesh, so the result may vary with that of the other seasons, since the resources and availability of the traditional fuel change with the change of weather. It was found that the fuel type does not vary much except in the village Shiromoni. Cooking time also does not vary much except Shiromoni and Mahshwarpasha. It was also found that the fuel type varies with the socioeconomic factors like monthly income.

Traditional fuel consumption causes more indoor air pollution, where using clean gases like LPG, LNG fuels causes less indoor air pollution. But according to this study 59% of the people use traditional fuel. Indoor air pollution directly affects human health. As the result of this study, we can suggest decreasing clean fuel prices to influence people to use clean fuel, since monthly

income is related to clean fuel consumption, Das et al., also suggest Bondhu Chula [10], which is a locally invented, improved stove, which is also being suggested by the local agricultural department and by the agricultural ministry can also be an alternative to clean fuel. It is costs very low to install one, and also requires very low maintenance. So, Bondhu Chula is a good initiative to decrease indoor air pollution since, majority of people use traditional fuel. On the basis of this study, doing more research on fuel consumption practices in different regions, in different seasons, on the basis of family size, types of fuel availability, family education etc. is suggested to be done for generating an overall model of fuel consumption practice in rural Bangladesh.

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## 6. Appendix A

“Energy Survey Questionnaires (Household)- November 2019

1. What is your name?
2. What is the size of your family?
3. How many earning members are there in the family?
4. What is the main source of income of your family?
5. What is the source of electricity at the house grid/solar/other?
6. What type of fuel do you use generally wood/loose biomass/kerosene/LPG?
7. What is your average consumption of fuels per month/week?
8. What is your preferred fuel? Please mention the reasons for preference.
9. How frequently do you purchase fuels? Please mention your typical purchase volume.
10. How much do you have to pay monthly to pay for purchasing fuels?
11. Is the fuel affordable?
12. What is the fuel used for cooking?
13. For what other purposes is the fuel used for in household lighting/vehicle/pumps & irrigations/others?
14. Are you satisfied with the fuel's quality that you are currently using?
15. How much time spent per day for cooking?
16. For what other purposes is the fuel used for in the household?
17. Are you willing to pay for reducing cooking time using better fuel/stove?
18. If there were any alternative fuel in the market, would you use it?
19. What is your expectation from an alternative fuel cheap/safe/after sales service/wide supply/easy to use environment friendly/commission on purchase/other?
20. Relative contribution in total earning by both male and/or female?
21. Have you borrowed money or taken out a loan?
22. For what purpose have you taken money/loan?
23. Do you participate in or are you a member of any social, political, or religious organizations?
24. How many children do you have?
25. Among the children who helps out in the household more?
26. What level of education would you like to see for your girl and/or boy?
27. If you could ensure more free time for them, what would you like to see them do?”