# Fuelwood Consumption Survey in Rural Areas of District Dera Ismail Khan Khyber Pakhtunkhwa, Pakistan

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## Abstract

The study examined different types of fuels used in rural Pakistan. A total of 108 respondents in 12 villages were randomly selected to collect information on socioeconomic factors and fuel used. The average household size was seven and fuel wood was most common source or domestic energy. Approximately 95% of the households were using fuel woods. Only (5%) was found using efficient commercial fuels (LPG, kerosene oil *etc*). The survey verified that the choice of fuels in rural areas is influenced by the ease in access to fuel wood resources, uncertainty in the supply of LPG and income of the household. The fuel pattern was influenced by the landholding size, number of these factors showed a very weak correlation. The consumption of wood with respect to education level was negatively correlated with fuel types but was positive when related to household size. The household size, types or fuels and their costs were important factors to predict the consumption of fuel wood for a household in rural areas of D.I Khan. In conclusion fuel wood and dung will remain major sources of domestic energy in the future until cheaper fuels are available or poverty is reduced.

*Keywords: Fuel wood, domestic energy, LPG dung.*

## INTRODUCTION

The expansion of timber and fuel wood extraction, processing, and usage for energy generation generates a plethora of economic options as well as a steady means of revenue, which helps to alleviate unemployment problems (Ullah *et al*. 2021).Approximately 2.8

billion people use biomass fuels such as firewood, charcoal, dung, and agricultural residues as their primary source of cooking energy; however, 66 percent of the world population has access to clean cooking fuel in 2019, up 1% annually between 2000 as well as 2019, and is anticipated to achieve 72 percent by 2030(Nagar et al. 2021). Fuel wood is the main source of energy in the developing world, and shortages of fuel wood are a serious problem. As we go from rural to urban regions, we see a rise in the utilization of alternative energy sources to wood(Eba'a Atyi et al. 2016). Pakistan is experiencing a rapid increase in its national energy consumption with increasing population and economic development. The country is poor in forest wealth because 70 to 80% of its land area falls in arid or semi-arid zones with very low precipitation to support tree growth (Gul Jan 2011). In Pakistan, the wood fuels represent 51% of timber utilization, while construction, furniture, and export is account for the remaining 49% of timber use (Ullah *et al*. 2021). The average annual household expenditure on fuel wood in 1991 was estimated as Rs. 31,147, which is still much lower than the expenditure on electricity (Rs.38,599/year) or natural gas (Rs.54, 330/year). Fuel wood expenditures represent 10% of the total household expenses (Secondary Information).

Fuel wood is considered a non-tradable commodity in rural areas. The landowner obtain its supplies from their lands, and other individuals collect it as free from the wastelands and public forest. Because of the dependency on fuel wood in rural areas, the present study was conducted to estimate household energy consumption patterns in district D.I. Khan, a rural area of Pakistan. The study also collected information about the socio-economic conditions of the population. The main concerns are related to over exploitation of tree resources and conversion of woodlands to other non-forestry purposes which potentially have negative impact not only on climate change but also on local food and feed projection. (Van Dam *et al*. 2010). Almost all the countries are major bioenergy consumers as well as producers (Koopmans 2005). The biomass fuels are supplied from trees or other secondary plantation forest. The way of collecting biomass fuel is unsustainable. Furthermore on the one hand biomass fuel preference is directly related to the local available biomass and the socioeconomic condition of the consumers (Kennes *et al*. 1984).

## STUDY AREA

Dera Ismail Khan (D.I. Khan) is the southernmost district of KPK. The total area of the district is 9334 km2. The district was founded in 1439. It lies from 31-15' to 32-32' North latitudes and 70-11' to 71-20 East longitudes. The area is a dry alluvial plain with only hills of the Khisar range commonly known as Ratta Koh (*i.e*, red-mountain). The prominent streams, flowing within the district, are Gomal, Gejastan, and Sawan in the west and Gundh and Paniala in the north.

The climate is dry and hot in summer. The temperature begins to rise in April, and the months of May, June, July, and August are extremely hot. June is the hottest month, with maximum and minimum temperatures of 46 (C and 23 (C, respectively. The vegetation of the district is mostly comprised of bushes with varying density of trees and shrubs. The most common plants are kikan masquite, tamarix, phulai, and ber. The forest department has planted kikar, eucalyptus, and shisham on forest area in addition to linear plantation along the roadsides.

## METHODOLOGY

Large-scale can be inappropriate when the study time bound as well as inadequate resources. In such case mini-surveys are advised to cover limited number of people or communities. a mini-survey approach was adopted to collect data for present study A questionnaire was designed as a survey instrument to collect data. It was divide Qd into two parts. The first part deal with the background information of the respondent the second part dealt with fuel consumption in summer and winter months, fuel types used for cooking room healing, water healing and lightening, cost of fuels, the questionnaire was pre tested before use. D.I Khan administrative entity was selected as the survey universe for undertaking sample survey to study fuel wood consumption pattern in rural households. The district was composed of five major administrative units, namely Dera Ismail, Tank and Kulachi, Paroa, Darabn Out of these randomly chosen area was D.I. Khan. The area was composed of 2017 village. Outs of these 12 village were selected randomly keeping following criteria in view to make the study more meaningful in relation to natural forest resources:

1. The location of village to be chosen should be in close proximity to natural forest resource and dependent on it to obtain fuel wood.
2. The villages were involved in consumption and marketing of fuel wood obtained from forest.
3. They have no other alternative sources or substitutes to fuel wood.

### Data Collection

The study used a mixture of random and purposive sampling techniques. Care was taken to select households in similar zones or with similar characteristics. In the sampled villages, eight to ten households were randomly selected. The inter-connected houses were avoided, but efforts were made to select house fairly distributed in the village. The senior member of the sampled household was interviewed. The randomly selected sample households in village are as follow:

**Table.** 1 Sample Size by Village

| S. No | Sample Village | No. of Households |
|---|---|---|
| **1** | Paroa | 10 |
| **2** | Chira Polad | 10 |
| **3** | Baber | 10 |
| **4** | Derwesha | 10 |
| **5** | Gari Hayat | 10 |
| **6** | Pota | 10 |
| **7** | Sohlan | 8 |
| **8** | Shorkot | 8 |
| **9** | Ratta Kulachi | 8 |
| **10** | Pahar Pur | 8 |
| **11** | Rang Pur | 8 |
| **12** | Mubarak S | 8 |
| **Total** | | 108 |

## RESULTS AND DISCUSSIONS

### Basic Statistics of Sample Area

The age composition of surveyed respondents is shown in table 1. The mean values indicate that knots or the selected sample were in a position to respond to question in a better way as their level of understanding must be high due to experience in personal life. The minimum age of respondent was 21 years and 85 years was the maximum. However, respondents of the village Shore were the eldest and their age ranged between 43-85 years.

**Table 1**. Mean Age of Respondent in Surveyed Village

| Village | Number | Minimum | Maximum | Mean |
|---|---|---|---|---|
| 1. Paroa | 10 | 32 | 60 | 42 |
| 2. Chira | 10 | 27 | 63 | 42 |
| 3. Baber | 10 | 36 | 57 | 49 |
| 4. Darwesha | 10 | 26 | 65 | 46 |
| 5. G. Hayat | 10 | 29 | 49 | 38 |
| 6. Pota | 10 | 26 | 53 | 39 |
| 7. Sohlan | 8 | 21 | 60 | 41 |
| 8. Shorkot | 8 | 43 | 85 | 57 |
| 9. R. Kulachi | 8 | 33 | 70 | 48 |
| 10. Paharpur | 8 | 31 | 65 | 46 |
| 11. Rang pur | 8 | 28 | 65 | 49 |
| 12. Mubarak | 8 | 28 | 65 | 49 |

### Household Size

The household size of the sampled population varied from village to village. The minimum size was zero and was 27 person per household in the study area. The mean minimum people per household were recorded in villages Paharpur and Chira Polad whereas maximum number of 27 people living jointly were found in village Shorekot (Table 3).

**Table 2.** Mean Household Size of Sample Villages

| Village | Number | Minimum | Maximum | Mean |
|---|---|---|---|---|
| 1. Paroa | 10 | 4 | 11 | 7 |
| 2. Chira | 10 | 0 | 12 | 8 |
| 3. Baber | 10 | 6 | 16 | 12 |
| 4. Darwesha | 10 | 5 | 22 | 12 |
| 5. G. Hayat | 10 | 5 | 22 | 10 |
| 6. Pota | 10 | 4 | 15 | 9 |
| 7. Sohlan | 8 | 5 | 19 | 11 |
| 8. Shorkot | 8 | 9 | 27 | 13 |
| 9. R. Kulachi | 8 | 6 | 11 | 8 |
| 10. Paharpur | 8 | 4 | 11 | 7 |
| 11. Rang pur | 8 | 4 | 20 | 9 |
| 12. Mubarak | 8 | 4 | 20 | 9 |

## Fuel Consumption Patterns

The data indicate that use of fuel Wood and dung is a common practice in the area to meet household energy requirements for cooking and heating. Half of the village population was consuming fuel wood below the overall average consumption Level or 290 kg as determined by the survey. However, the average Coal wood consumption level per household village shore was the highest (488 kg) and wood waste was the lowest (20 kg). The habitant of this village was also using maximum quantity Of LPG (6.3 kg) as compared to rest in the study area. The consumption of dung and kerosene was found close to the average figures of the survey for these commodities (Table 4).

**Table 3.** Mean Monthly Fuel Consumption of Sample Household

| Village | Fuelwood (Kg) | Wood Waste (Kg) | Dung (Kg) | Kerosene (Litters) | LPG (Kg) |
|---|---|---|---|---|---|
| **1. Paroa** | 220 | 92 | 105 | 1.5 | 2.3 |
| **2. Chira** | 210 | 220 | 132 | 1.4 | 0.5 |
| **3. Baber** | 312 | 200 | 137 | 1.6 | 2.7 |
| **4. Darwesha** | 156 | 520 | 104 | 1.4 | 1.0 |
| **5. G. Hayat** | 236 | 220 | 154 | 1.0 | 4.4 |
| **6. Pota** | 192 | 66 | 132 | 1.0 | 3.2 |
| **7. Sohlan** | 427 | 0 | 99 | 1.9 | 5.6 |
| **8. Shorkot** | 488 | 20 | 120 | 1.0 | 6.3 |
| **9. R. Kulachi** | 383 | 23 | 74 | 1.4 | 3.6 |
| **10. Paharpur** | 297 | 0 | 69 | 0.5 | 5.0 |
| **11. Rang pur** | 386 | 0 | 101 | 1.0 | 1.9 |
| **12. Mubarak** | 275 | 0 | 97 | 1.0 | 2.1 |
| **All** | **290** | **60** | **112** | **1.2** | **3.1** |

## Household Size

According to 1998 Census Report, the average household size for the District has increased To 7.5 persons in 1998 from 6.2 persons in 1981. Contrary to other parts of the country, the average annual growth rate has also increased from 3.23 percent in 1981 to 3.26 percent in 1998.

**Table 4.** The Household Size of Study Area.

| S. No | Size | No. of Household | % Age |
|---|---|---|---|
| **1** | 1-4 | 17 | 15.7 |
| **2** | 5-8 | 44 | 40.7 |
| **3** | Above 8 | 47 | 43.5 |
| | **Total** | **108** | **100** |

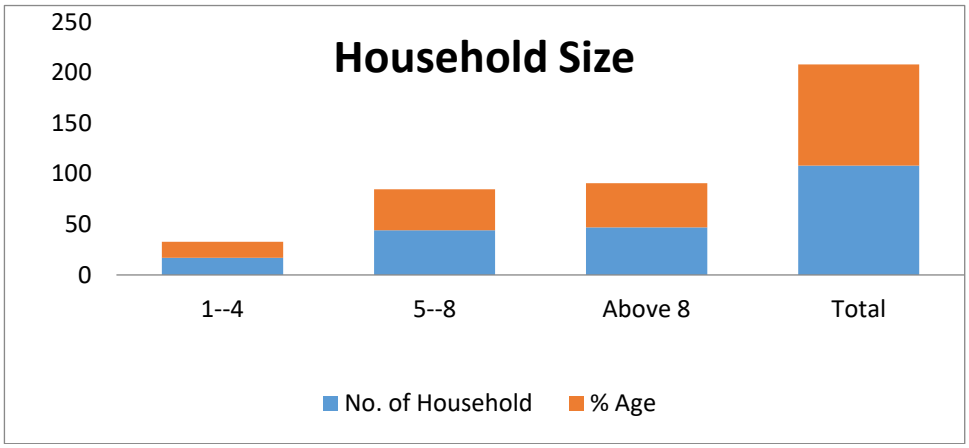


*Figure 1Household Size with reference to Percentage*

It is clear from the table 4 that out of 108 surveyed households, only 15.7% had family size between 1-4 members, 40.7% were having 5-8 members and larger part (43.5%) had above 8 members. The average household size in the study area was observed as 9.6 persons, which is about two persons higher than the total district size. It may be due to low education rate and stronger religious believes spread against family planning.

## Fuel types consumed

In study area, the majority (48.1%) consumed fuel wood and dung. However, 19.3% were consuming LPG in addition to fuel wood and dung. Only 19.9% were using fuel wood in combination with commercial fuels such as kerosene and LPG. It is evident that people are shifting towards LPG, Kerosene oil gradually. A very small portion of the households was using only fuel wood or dung for meeting domestic energy needs. This clearly shows that people do have tendency of using commercial along with traditional fuels (table 6).

**Table 5.** Fuel Consumed by the Sample Households

| S. No | Fuels Consumed | No of Respondents | %Age |
|---|---|---|---|
| **1** | Fuel Wood + Dung | 52 | 48.1 |
| **2** | Fuel Wood + Dung + LPG | 21 | 19.3 |
| **3** | Fuel Wood + Kerosene | 15 | 13.2 |
| **4** | Fuel Wood + LPG | 7 | 6.7 |
| **5** | Fuel Wood | 2 | 1.8 |
| **6** | Dung | 1 | 0.9 |
| | **Total** | **108** | **100** |

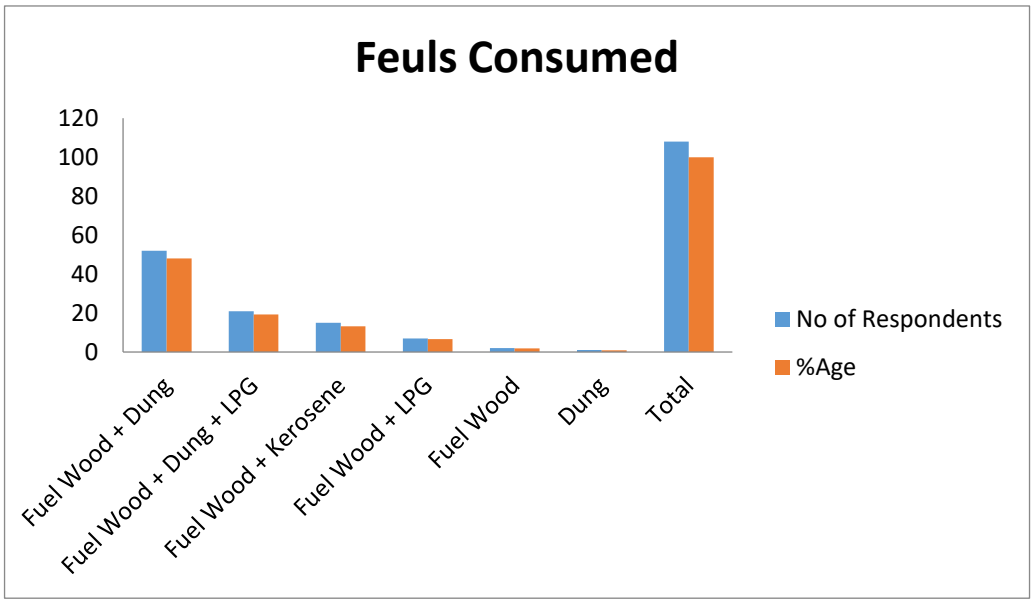


*Figure 2 Fuel Consumption*

## Monthly Consumption of LPG

The data analysis unfolded that only 22.2% of the households' cannot afford the use of LPG as fuel for domestic purposes. However, majority (61 .1%) was in position to afford its use between 1-5.5Kg during a month. The use of LPG was mostly restricted to cooking of meals in cases of emergency. Only 18% of the households used LPG regularly and were consuming more than 5.5 Kg per month (Table 7).

**Table 6.** LPG Consumption by Quantity Groups

| S. No | LPG Group (Kg) | No. of Households | %Age |
|---|---|---|---|
| **1** | 0 | 24 | 22.2 |
| **2** | 1-5.5 | 66 | 61.1 |
| **3** | More than 5.5 | 18 | 16.7 |
| | **Total** | **108** | **100** |

## Monthly Consumption of Dung

The data indicate that only a very small portion (4.6%) of the sampled population were not using dung as fuel because they had the resources to afford use of LPG and electricity to meet domestic fuel needs. However, majority of the population (95.4%) was dependent on dung as a fuel. The study clearly indicates that dung is a common fuel in the area. The main reason is its ease in availability and preparation, low price, slow burning rate and higher calorific value (Table 8).

**Table 7.** Monthly Consumption of Dung

| S. No | Cow dung group (Kg) | No. of Households | %Age |
|---|---|---|---|
| **1** | 0 | 4 | 22.2 |
| **2** | 1-100 | 53 | 61.1 |
| **3** | More than 100 | 50 | 16.7 |
| | **Total** | **108** | **100** |

## Monthly Consumption of Fuel Wood

The data analysis confirmed that fuel wood is the most preferred traditional fuel in the study area. Majority (78.7%) of the sample population was using it either exclusively or in combination with other commercial or noncommercial fuels (Table 9). Out of total sampled population majority (78.7%) were on average consuming about 400 kg of fuel wood per month. However about one fifth (2 1 .3%) was consuming more than 400 kg per month to meet their domestic needs for fuel. Under existing pattern of fuel wood consumption one can easily conclude that fuel wood will remain as preferred fuel in the rural areas (Table 9).

**Table 8.** Monthly Consumption of Fuel

| S. No | Fuel wood group (Kg) | No. of Households | %Age |
|---|---|---|---|
| **1** | 0-400 | 85 | 78.7 |
| **2** | More than 400 | 23 | 21.3 |
| | **Total** | **108** | **100** |

## Monthly Consumption of Kerosene

The sample data analysis testifies that majority (41.7%) of population in the area is not using kerosene for cooking purpose. Only 22.2% of the population is consuming about 1-1.5 liters to inflame fuel wood and dung. Those who consuming more than 1-1.5 liters are using kerosene for kindling as well as lighting their lanterns. The main reason for not using kerosene is its' high price, cost of burning stoves and pungent smell it produces during the process of burning. The sample population was of the opinion that they can tolerate both smell and initial cost of stoves but cannot afford to buy the quantum of kerosene required for meeting domestic demand of fuel for cooking.

**Table 9.** Monthly Consumption of Kerosene

| S. No | Kerosene group (Liter) | No. of Households | %Age |
|---|---|---|---|
| **1** | 0 | 45 | 41.7 |

| | | | |
|---|---|---|---|
| **2** | 1-1.5 | 24 | 22.2 |
| **3** | More than 1.5 | 39 | 36.1 |
| | **Total** | **108** | **100** |

## Household Size Vs Fuel Wood Consumption

The classification of the surveyed households based on size, average consumption and per capita consumption was preferred to workout future demand of wood as fuel (Table 9). The data analysis indicates that quantity of fuel wood consumption decreases with the increase of the household size. This proves that one can economize fuel consumption if food is cooked for many persons in one place or use those hearths leading to less energy losses during cooking process. In Pakistan per household's fuel wood consumption in rural area is about 0.7 kg per day (Ahmad. 1995). In the study area of D.I. Khan, the rate of fuel wood per households per day averages to 7.6 kg, which is 13.43 % higher than what was calculated by the national survey. This higher consumption is mainly due to small size of the study but can serve the purpose of projection demand and consumption pattern for fuels in the area.

**Table 10.** Monthly Fuel Wood Consumption Pattern.

| S.No | Size | Household | %Age | Per Household (Kg) | Per Capita (Kg) | Av Size |
|---|---|---|---|---|---|---|
| **1** | 1-4 | 7 | 6.5 | 165 | 41.3 | 4 |
| **2** | 5-8 | 44 | 40.7 | 233.8 | 34.4 | 6.8 |
| **3** | 9-12 | 36 | 33.3 | 315.1 | 30.6 | 10.3 |
| **4** | >12 | 21 | 19.4 | 434.5 | 29 | 15 |
| | **Total** | **108** | **100** | | | |

## Income Group Vs Fuel wood Consumption

It is generally believed that having more income spend more money on having different kinds of food at one time. Therefore such households will consume more fuels than what others do. The data (Table 10) also show that the income status and average fuel consumption by different income group is highly sensitive to increasing incomes. Thus one can safely conclude that with increase in income, the consumption of fuel per capita also increases.

**Table 11.** Income group Vs. Fuel wood Consumption.

| S. No | Income Group | No of Household | %Age | Fuelwood consumption per household |
|---|---|---|---|---|
| **1** | 0-10000 | 39 | 36 | 212.7 |
| **2** | 10000-15000 | 52 | 48 | 296.7 |
| **3** | Above 15000 | 17 | 15 | 439.1 |
| | **Total** | **108** | **100** | **296.5** |

## CONCLUSION AND SUGGESTION

Analysis of data reveals that fuel wood with other cheaper fuels is the major source of household energy in district D.I. Khan. Majority of sample units use fuel wood with other cheaper fuels like dung, LPG, kerosene oil. Income level and household size influence the choice of fuels by a household. Land-holding size has a little influence on the choice of fuel consumption.

As a whole the economy of the sampled population is agriculture based. Therefore almost every one use dung to supplement domestic energy budget. It is a common trend in the area that households are combining cheaper fuels with traditional or commercial fuels to keep the expenditure on fuels to its minimum level. The reason of this trend is the comparative cheapness of fuel wood then kerosene oil, LPG and electricity. The other reason is non-availability of natural gas. The average figure of household size is 7.6 persons. It may be due to low education level and misconceptions towards family planning.

Households living below poverty line are totally depend on those areas that have unhindered access. They often use such areas as free riders and sometimes do not hesitate to beg barrow or steal the fuel wood, agriculture residue and dung to meet their requirement. Therefore area such as designated forests, roadside plantations, rows of trees growing along the canals, and they to meet fuel heavily lop scattered trees on wastelands and fodder needs.

The choice of species made by the forest department for planting on farmland, forest areas, and wastelands does not matches with the fuel wood species preferences of the sample population. They prefer indigenous rather than exotic on account of suitable characteristics, which specie ought to have as fuel wood.

The species that they prefer as a fuel is (*Tamarix aphylla*), because it has more calorific value. The consumption of fuel is different in winter and summer. In winter more quantity of fuels are used than summer. The sources of fuel supply in the area are from their own lands, market, forest, and others.

From the analysis of study results one can safely conclude that the fuel wood and dung will remain major sources of for meeting domestic energy in the future till cheaper fuels or reduction in poverty level is achieved.

## Suggestion

In order to meet the growing demand of wood fuel, it is imperative to develop an effective strategy for wood energy development. The suggestions for the improvement of the situation in the study areas are:

1) Bio-gas plants should be introduced in the area for the solution of the problem.
2) There should be an improved combustion system by using properly designed stoves and wood with low moisture contents.
3) Creation of new energy resources is very necessary.
4) It is important to improve the socio-economic conditions of the population because the income level is highly correlated with the shift in the type of energy use.
5) The fuel wood plantation should be carried out in every possible site regarding the ecological comprehensiveness and water requirement of the species.
6) Fast growing and multipurpose species should be introduced in the study area.

## Conclusion

1. The paper investigated the commonly used and preferred fuel wood consumptions in the rural household, to determine the dynamics of fuel collection.
2. The wood is obtained from the natural forest. Using indiscriminate harvesting and non-sustainable practices which are threat to targeted species.
3. Wood selling is flourishing business.
4. The unit cost of wood varies from one production site to the other in relation to distance, quality of wood and season. Therefore concrete recommendations are required for the sustainable management of forest resources and for reducing wood consumptions.

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