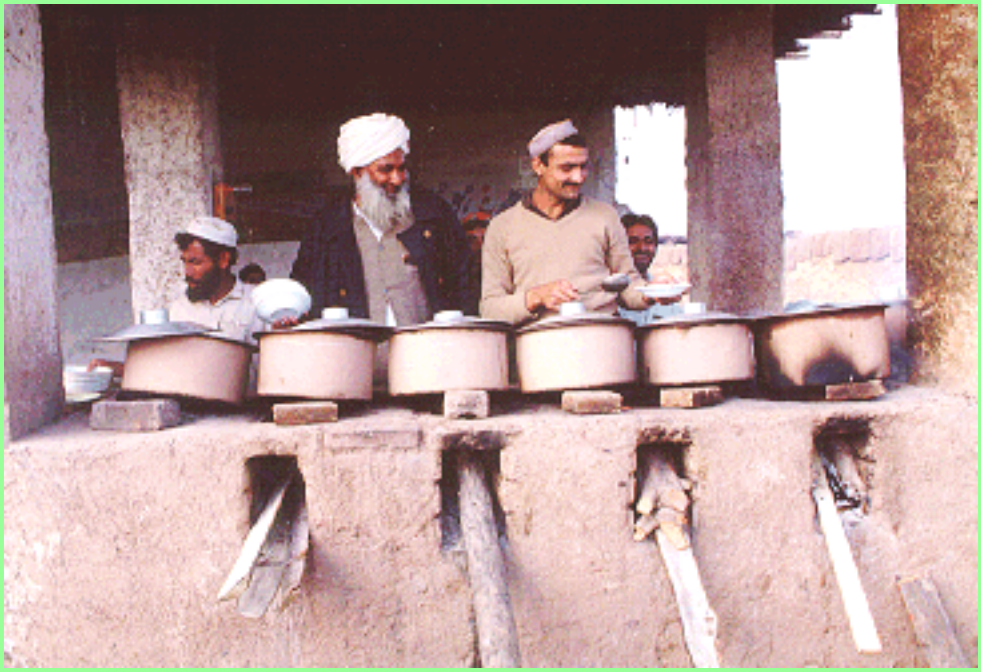
Field Document No.38

REGIONAL WOOD ENERGY DEVELOPMENT PROGRAMME IN ASIA
GCP/RAS/154/NET

MARKETING OF WOODFUEL IN PESHAWAR CITY

(A CASE STUDY)

PAKISTAN



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FOREWORD

Improving the woodfuel distribution systems in its member countries is one of the important objectives of the Regional Wood Energy Development Programme in Asia. Understanding the conditions that determine the flow of woodfuels from producer to consumer is a first step towards developing policies and programmes for sustainable use and affordable access to this renewable source of energy.

Most surveys on woodfuel consumption have been carried out in rural areas and woodfuel use in urban areas has received little attention in the past. Energy policies for urban areas were nearly always supply driven in the expectation that urban economic development would allow for an upward fuel switching to fossil based fuels or electricity within a relatively short period. However there is increasing evidence that wood and biomass will continue to be one of the main sources of energy for the urban poor. But unlike in the rural areas market forces will determine to a large extent the volume and type of fuels to be used in the urban households, food processing and other industries.

In order to plan any development assistance which may be required, it is essential to assess the current market situation and marketing systems for its strengths and weaknesses, and for possible opportunities and threats in the future. For this purpose, RWEDP initiated a series of micro level studies on the marketing system of wood fuels in several cities in Asia. The present study is part of this series and focuses on marketing of wood fuels in Peshawar City of Pakistan.

Dr. K.M. Siddiqui and Mr. Mohammad Amjad of the Pakistan Forest Institute in Peshawar present the outcome of a survey that provides an insight in market mechanisms and consumer attitudes towards different sources of energy in Peshawar, including their preferences for fuelwood from different tree species. Pricing of alternatives will be a dominant factor in future woodfuel use in Peshawar and other urban areas.

This project wishes to express its sincere thanks to the authors for their very significant contribution to the understanding of the problems and potential of woodfuel use in Pakistan. I also wish to thank Dr. Aroon Chomcharn, Wood Energy Conversion Specialist of this project and Mr. A. Koopmans, who provided respectively supervision and assistance in the technical editing of the report. Ms. Pimpa Molkul and Ms. Panpicha Issawasopon provided editorial support and text lay out.

It is hoped that this document will be useful to energy and forestry planners in Pakistan and other parts of Asia, when considering various policies and strategies for affordable access to sustainable sources of energy. Any comments and feed back from the readers will be highly appreciated.

Egbert Pelinck
Chief Technical Adviser

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LIST OF ABBREVIATIONS AND CONVERSION FACTORS

TOE	=	Ton oil equivalent (metric)
TWE	=	Ton wood equivalent (metric)
KJ	=	Kilojoule = 1,000 joules
MJ	=	Megajoule = 1 million joules (10^6)
GJ	=	Gigajoule = 1 billion joules (10^9)
Kg.	=	Kilogramme
Km.	=	Kilometre
M^3	=	Cubic metre
Cft.	=	Cubic feet
Rs.	=	Pakistani rupee
LPG	=	Liquified petroleum gas
Ton	=	Metric ton = 1,000 kg.
1 Rs.	=	0.04 US$; 1 US$ = 25 Rs.
1 TOE	=	44.2 GJ
1 Ton kerosene	=	1.026 TOE
1 Million cft gas	=	23.4 TOE
1 Ton of charcoal	=	0.662 TOE
1 Ton of wood	=	0.4026 TOE
1 Ton dung	=	0.1975 TOE
1 Ton LPG	=	1.016 TOE
1 GWH electricity	=	238 TOE

EXECUTIVE SUMMARY

The marketing of wood fuels in urban areas has received little attention in the past as it was primarily a sellers' market where effective demand exceeded the availability of supplies. In order to plan any assistance which may be required, it is essential to assess the current market situation and marketing system for its strengths and weaknesses, and for possible opportunities and threats. For this purpose, FAO's Regional Wood Energy Development Programme for Asia-Pacific region initiated a series of micro level studies on the marketing system of wood fuels in major cities of Asia. The present study is a part of this series and focuses on marketing of wood fuels in Peshawar city of Pakistan.

The main characteristic features of the energy situation at the national level in Pakistan are:

- A low per capita energy consumption. In 1990-91 this was 11.45 GJ per capita, or equivalent to 715 kg fuelwood.
- A rapid growth in national energy consumption. This increased by 68% during the eighties and reached a level of 29.2 million TOE in 1990-91, reflecting an annual growth rate of 5.3%.
- An increasing reliance on commercial fuels. The share of commercial fuels has increased from 62% in 1980-81 to 74% in 1990-91.
- A heavy reliance on imports. Imports of oil and petroleum products amounted to 8.4 million tons in 1990-91 costing 37 billion rupees.
- An apparent declining role of wood fuels. These accounted for 15% of the national energy consumption in 1990-91 against 21.6% in 1980-81. However, by volume the consumption of wood-fuel has increased.

Wood fuels are mainly used by the domestic sector to meet energy needs for cooking and heating. Its overall consumption was estimated at 16.8 million m^3 in 1980-81 and reached 19.4 million m^3 in 1990-91, reflecting a growth rate of 1.5% per year. In contrast, the consumption of gas and kerosene in the domestic sector increased at an annual rate of 14.2% and 5.5%, respectively during the same period.

Gas and kerosene are mainly used in urban areas and are replacing wood fuels. However, in rural areas fuelwood is the predominant fuel and the demand is increasing. In urban areas, the demand for fuelwood is either static or declining. Ideally, wood fuels can replace gas and kerosene which would release natural gas for more productive alternative uses and do away with imports of kerosene amounting to about 3.3 billion rupees per year. This will lessen the burden on the balance of payments, provided that a sustainable fuelwood/tree production system materializes and is adopted widely by farmers.

A sample survey of households in Peshawar city conducted in 1992 have revealed that 38.7% of the households use natural gas, 33.8% use kerosene, 13.4% use wood fuels, 7.8% use LPG and 6.3% use cow dung. A household's choice of cooking fuel is influenced mainly by the availability of natural gas supply in the area. Other factors include household income level and occupation of the head of the household. The choice of fuelwood is associated with the non-availability of gas and a low level of household income.

The average per capita energy consumption for domestic cooking and heating was found to be 4.578 GJ (286 kg fuelwood or 103 kg oil equivalent). Energy use is influenced mainly by the household income level. The per capita energy consumption in households with high income was found to be 7.9 GJ, with medium income 4.8 GJ and with low income 4.2 GJ. Energy use is also influenced by household size. Large households tend to have lower per capita consumption. Small households with only 1-3 people were found to have a per capita energy consumption of 8.1 GJ (506 kg fuelwood equivalent) while households with 13 or more members were found to have a per capita consumption of 4.1 GJ. The per capita energy consumption was also found to be associated with the type of fuel used. Households using natural gas, fuelwood, kerosene, LPG and cow dung were found to have a per capita energy consumption of about 5.9 GJ, 5.4 GJ , 4.1 GJ, 1.8 GJ and 1.0 GJ, respectively.

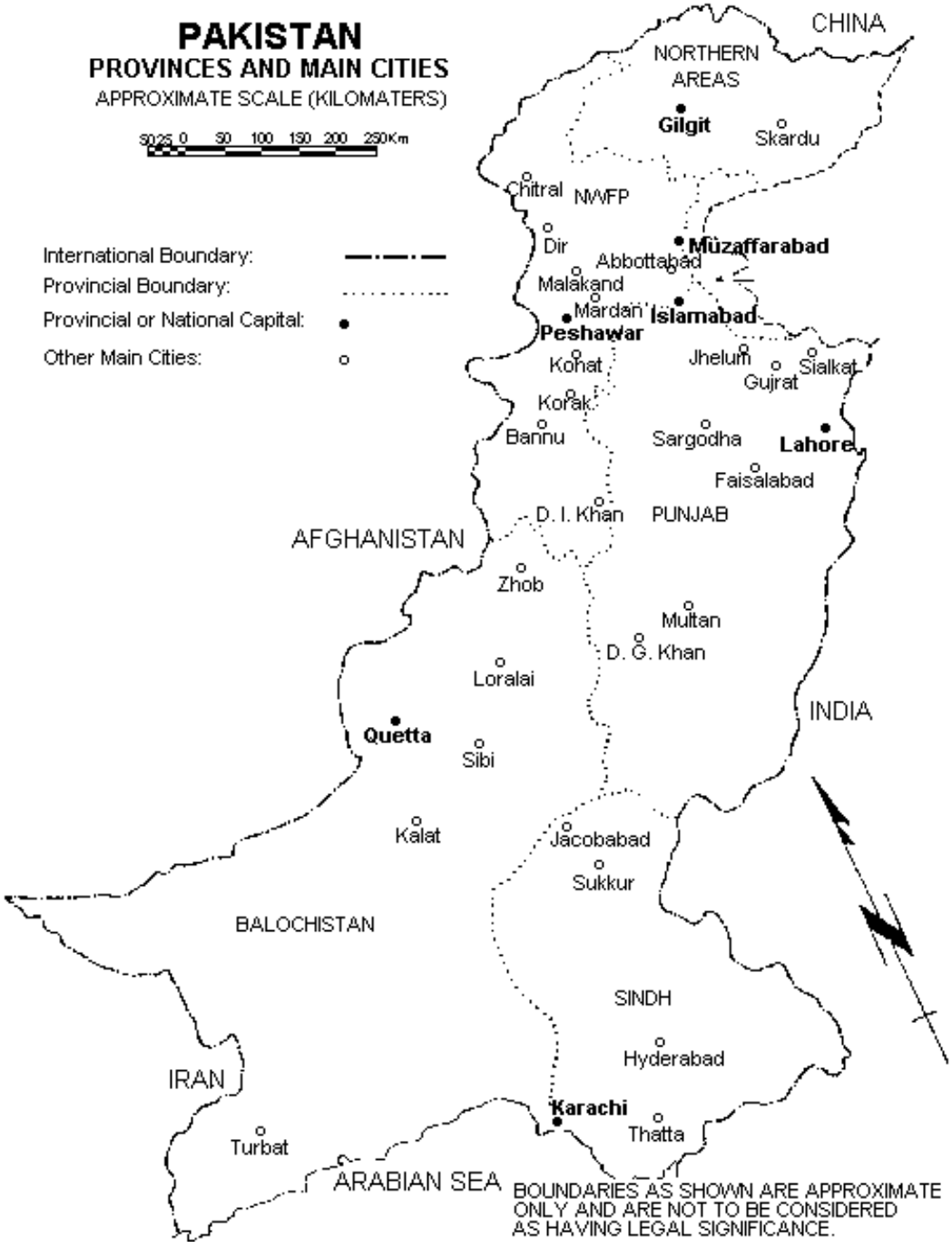
During the winter months, the household fuel consumption increases by about 40% when compared with the summer period. The increase is 16% for households using wood, 42% for households using kerosene and 49% for households using natural gas. The average annual household expenditure on domestic fuel works out to Rs. 3,526. It varies with fuel type. Households using wood spend Rs. 4,636, followed by households using kerosene which spend Rs. 4,065 per year. Households which use gas spend Rs. 3,591, while in the case of cow dung the annual expenditure was found to be Rs. 755 only.

The market demand for fuelwood in the household sector in Peshawar city is estimated at 40,874 tons per annum. In addition to this amount, 3,725 tons is consumed by commercial establishments such as bakeries, restaurants etc. The total market demand for fuelwood works out to be 44,600 tons. Charcoal is mainly used for room heating in government offices during the winter while a small quantity is used by households and in commercial establishments. The total consumption has been estimated at 3,500 tons/yr. Most of the fuelwood supplies come from the natural forests in tribal areas (50%), some from the Punjab (16%) while the remaining 34% is derived from local farmlands, sawmill offcuts, etc. The future demand for wood fuels in Peshawar market will largely depend upon the supply of natural gas. If the gas supply system were to be extended to all areas, the demand would be expected to drop drastically. However, even under the most optimistic scenario, the fuelwood demand is likely to remain steady at the present level.

Fuelwood is a highly variable product. It is differentiated by species, diameter of the billet, and moisture content. The main species available in Peshawar are *kao* (Olea cuspidata), *phulai* (Acacia modesta), oak (Quercus sp.), *kikar* (Acacia nilotica) and *shisham* (Dalbergia sissoo). The first 3 species come mainly from the forests in the tribal areas. The latter two are either transported from Punjab or produced locally. Fast growing species like poplar and eucalyptus do not find favour with consumers at present.

Distribution takes place through middlemen which include local assemblers and retailers. There are about 200 retail fuelwood depots in Peshawar city. Trucks are the preferred transport mode for wood fuels from the production sites to Peshawar. The transport distances involved are far, with 200 km. in the case of supplies from the tribal areas and about 350 km. in the case of supplies from the Punjab. The current retail price per *maund* of 40 kg. varies with species, with *kao* fetching 65 rupees, oak 62 rupees, *phulai* 60 rupees, *kikar* 60 rupees and *shisham* 50 rupees. Charcoal sells at 5 rupees per kg. The profit margin of local assemblers and retailers was found to be about 12-14%. The middlemen rely on non-institutional sources for finance.

In the future the marketing effort, will have to be directed towards retention and expansion of the existing market system. This may have to be done through promotional efforts and by improving the competitiveness of wood fuels vis-a-vis other commercial fuels. Local production by farmers should be encouraged to minimize the transportation cost which accounts for 25% of the retail price. The use of improved cookstoves in domestic and commercial establishments and fuelwood from fast growing species, not popular at present, should be promoted among consumers.



1. SCOPE AND METHODOLOGY

1.1 Introduction

In most Asian countries, the population depends to a large extent upon non-commercial fuels to meet their energy needs. In rural areas, in particular the people normally do not purchase fuel from the market as fuelwood is, in most cases, collected by the users themselves. Land owners obtain their supplies from their own farmlands while other people collect it as a free good from the community and wastelands and public forests. The situation in urban areas is altogether different. Here people normally purchase fuels to meet their energy needs. They may use commercial fuels such as natural gas, kerosene and liquified petroleum gas (LPG), electricity, etc. Those who use fuelwood and charcoal, obtain it normally through retailers or traders. Thus in the strict commercial sense a market for wood fuels exists only in urban areas where a number of fuelwood depots offer the product to the consumers. In some cases these fuelwood depots also sell charcoal. A number of people are employed in the marketing chain of wood fuels such as wholesalers, retailers and ordinary workers. Although the marketing of wood fuels in urban areas is an activity of sizeable proportion, very little information is available about it. This is partly due to the nature of trade for wood fuels which is part of the informal sector of the economy. Because of numerous difficulties in collecting data from the informal sector, the statistical organizations usually do not cover it.

However, information on the trade and use of wood fuels, especially in Pakistan and other South Asian countries, has become more important in recent years in the wake of the implementation of large scale social forestry programmes. As a result of these programmes, the fuelwood availability has increased substantially in rural areas. Some areas have become self-sufficient or even have a surplus of fuelwood. The future planning of these programmes must also take into account changes in the urban fuelwood markets because the price and consumption trends of fuelwood and charcoal have a direct influence on fuelwood production programmes. An apparent declining consumption trend may not augur well for these programmes. The success of these programmes to a large extent depends on stable or expanding wood fuel markets.

The Regional Wood Energy Development Programme (RWEDP) of FAO has initiated a series of micro-level studies in some urban centers of Asian countries with the purpose being to improve understanding on how the market operates. As a part of this series, the present study on the marketing of wood fuels in Peshawar was undertaken. The study focuses on the size of the wood fuel market, fuel consumption patterns, market demand for wood fuels, marketing channels, infrastructure and the operating environment.

1.2 Plan of Work

In order to carry out the study, the investigators had to rely on primary data collection because the required data were not available from records. On the demand side, a sample survey of randomly selected households was undertaken to determine the energy consumption and energy mix. Another sample survey was designed to collect information on the energy needs and mix in commercial establishments. On the supply side, a sample survey was conducted of fuelwood sales depots to collect information on prices, sales and marketing outlook. The information on the inflow of fuelwood by train was collected from the Railways Department while data on fuelwood transport by road was obtained from the forest check posts which are located at various entry points to the city. The data on the city population was collected from different census reports.

1.3 Peshawar City

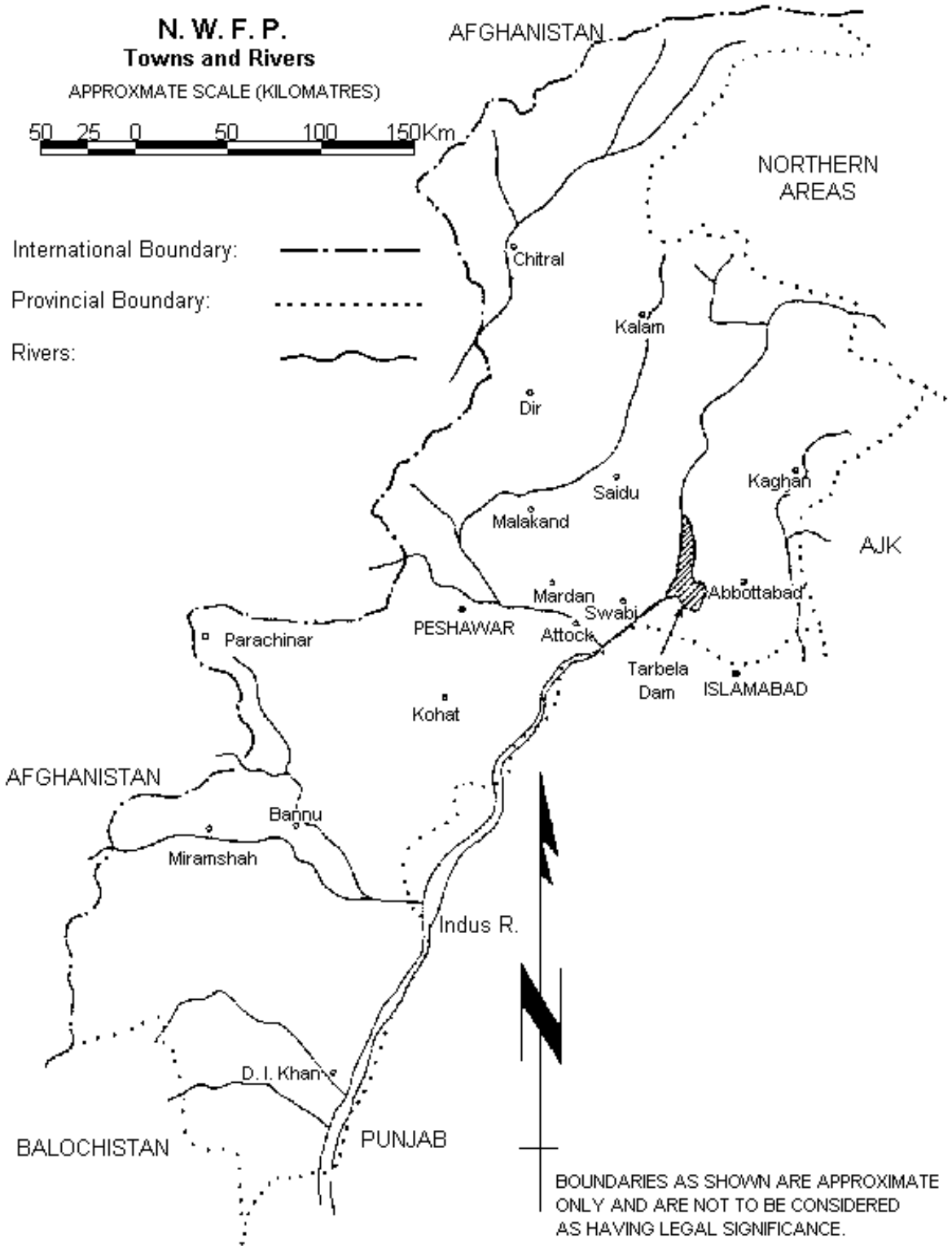


Figure 1.1 North West Frontier Province showing towns and rivers

Peshawar city and its cantonment constitute the study area for this investigation. Peshawar is an ancient city of great historical importance. It lies in the extreme north-west of Pakistan, about 30 km. from the border between Pakistan and Afghanistan (see figure 1.1). In former times trade caravans from the Central Asian Republics to India used to pass through this city. Peshawar is the capital of the North Western Frontier Province (NWFP) of Pakistan. It is the seventh largest city of Pakistan. It has expanded considerably over the years and presently it covers an area of about 130 Km^2, of which the city accounts for about 118 Km^2 and the cantonment covers the remaining 12 Km^2. Peshawar has road, rail and air connections.

The population of Peshawar city has been expanding rapidly. According to the 1951 census, the population was 151,776 persons. It registered an increase of 43% between 1951 and 1961 to 217,885 persons in 1961. Between 1961 and 1972 it increased by 25% to 272,697 persons in 1972. In 1981 the population stood at 566,248 persons. The inter-census growth rate has been 3.67% between 1951 and 1961, 2.05% between 1961 and 1972 and 8.45% between 1972 and 1981.

However, there are two sources of growth in the population of Peshawar: growth of the population and/or an increase in the size of the area covered. The high growth rate experienced during 1972 and 1981 was mainly due to the addition of new areas to the municipal limits of the city.

In order to estimate the present population of the city, both factors have to be taken into account. The number of city wards has increased from 31 in 1981 to 45 in 1991. It signifies that new areas have been added to the municipal limits of the city during this period. However, to be on the conservative side, against 8.45% growth rate during 1972 and 1981, the growth rate between 1981 and 1991 is estimated at 6% per annum. On this basis, the population of Peshawar city in 1991 can be estimated at 1,014,000 persons which does not include the large number of Afghan refugees who live on the outskirts of the city. Assuming a household size of 8 persons, the number of households works out at 126,750.

Peshawar city has a sub-tropical climate. It is hot in the summer and cold during the winter. The summer lasts from April to October with minimum temperature averaging 15.7°C in April and 25.9°C in June. On the other hand, the maximum temperature averages about 29.7°C in April and 40.7°C in June with temperatures sometimes going as high as 47°C. In January the temperature drops to an average minimum of about 4°C and maximum of 17°C. Sometimes frosty days are also experienced in January. Cold winds from the west make the weather chilly during the winter time. During the last 10 years, the average annual rainfall was about 400 millimeters, with the period from December through March accounting for about two thirds of the total annual rainfall.

The people of Peshawar are mostly engaged in commerce and trade. The handicrafts of Peshawar are well known the world over. Small scale industries are also flourishing. There are about 130 industrial units which engage 20 or more workers. The standard of living of the people of Peshawar city is quite comparable to that of the people of other big cities of Pakistan.

1.4 Sampling Procedure

As very little data was available on woodfuel use in Peshawar city, sample surveys had to be carried out. However, in order to have statistically reliable results the sample size for the survey of household energy use, commercial establishments and fuelwood sales depots had to be determined.

The questionnaire designed to collect data on domestic energy consumption was pretested with 10 households. The data so collected showed that the co-efficient of variation was approximately 80%. Using a 10% relative degree of precision, the required sample size was worked out to be 250. The 250 households gave a sampling intensity of 0.002 or 2 households out of every 1,000 households.

A two-stage sampling procedure was used. The 45 electoral wards of the city were grouped into 3 classes on the basis of the social and economic status of the majority of the population living in a given ward. Out of the 45 wards, 10 were identified as high status wards, 10 as middle status wards and the remaining 25 as low status wards. From each group, 10% of the wards were selected at random for inclusion in the sample, resulting in the selection of one high status ward; one from the middle status wards and 2 from the low status wards. The second step consisted of the division of the selected wards into housing clusters. As there were over 13,000 housing units in the selected wards, the cluster size was fixed at 50 units so as to have about 250 clusters. From each cluster, one house was selected at random for inclusion in the sample, resulting in an actual sample size of 264 households. Table 1.1 shows the total number of households and the number of households included in the different wards in the sample.

Table 1.1 Total number of households in the selected wards and the number of households included in the sample survey

Name of ward	Status	Number of households	
		Total	Surveyed
Gulbhar	High	1,963	39
Yakatoot	Middle	3,485	69
Kakshall	Low	3,668	73
Shaheen Muslim Town	Low	4,160	83
Total		13,276	264

With regard to the energy consumption by commercial establishments, it was decided to include all the commercial establishments in the 4 selected wards. A complete enumeration was undertaken and data were collected from all the commercial establishments. The same was done with all the fuelwood sale depots with data collected on the amount of wood fuels traded, trends, etc. from all depots in the 4 selected electoral wards. During the survey, care was taken to account for obvious seasonal influences. Data was collected through personal interviews with housewives interviewed by female enumerators while male enumerators were used to collect the data from the commercial establishments and the woodfuel depots.

1.5 Data Processing

The data collected was checked for discrepancies, coded and entered into the computer. By making use of a spreadsheet programme as well as a SAS statistical package, the data were checked, processed and analyzed. Variables such as per capita consumption and monthly household fuel expenditure were calculated and analyzed. In general only descriptive statistics were computed but, where necessary, relationships between the different variables were also examined.

2. WOOD FUELS AND ENERGY CONSUMPTION ON A NATIONAL BASIS

2.1 National Energy Consumption

Pakistan is experiencing a rapid increase in its national energy consumption due to increases in the population as well as economic development. The total national energy consumption has increased from 17.4 million TOE in 1980-81 to 29.5 million TOE in 1990-91, equal to an average annual growth rate of 5.3%. The consumption of commercial fuels has grown faster than the consumption of non-commercial fuels. The consumption of commercial fuels doubled during the period between 1980-81 and 1990-91 from 10.8 million TOE to 21.8 million TOE in 1990-91, giving an average annual growth rate of 7.2%[1]. In contrast, the consumption of non-commercial fuels registered only a modest increase during the same period. It increased from 6.6 million TOE in 1980-81 to 7.7 million TOE in 1990-91 showing an average annual growth rate of 1.5%[2].

As a result of this imbalanced growth, the share of commercial fuels in the national energy consumption has increased from 62% in 1980-81 to 74% in 1990-91. Correspondingly, the share of non-commercial fuels has declined from 38% in 1980-81 to 26% in 1990-91. This structural change is mainly attributable to rapid urbanization and industrialization of the economy. Figure 2.1 shows the estimated consumption of commercial fuels and non-commercial fuels during the period of 1980-81 and 1990-91.

The per capita energy consumption has also shown an upward trend during the same period. It increased from 9.16 GJ in 1980-81 to 11.45 GJ in 1990-91, or about 25% over the 1980-81 level. The annual average annual growth rate was 2.25%. However, the per capita consumption of commercial and non-commercial fuels has shown diverse trends. The per capita consumption of commercial fuels has increased from 5.73 GJ in 1980-81 to 8.50 GJ in 1990-91 reflecting an average annual growth rate of 4%. In contrast, the per capita consumption of non-commercial fuels went down from 3.44 GJ in 1980-81 to 2.94 GJ in 1990-91, or an average annual rate of decline of 1.6%. It is probable that these trends could be more pronounced in the near future. The per capita consumption of commercial fuels and non-commercial fuels is shown in figure 2.2.

2.2 Sector-wise Consumption

The consumption pattern of energy by the different sectors has also undergone some change over the period from 1980-81 to 1990-91. The share of the domestic and commercial sectors in the total energy consumption amounted to 48% in 1980-81, but this declined to 47% in 1984-85 and to 45% in 1990-91. In contrast, the share of the industrial sector in the total energy consumption increased from 24% in 1980-81 to 26% in 1990-91. The share of the transport sector has also increased from 15% in 1980-81 to 17% in 1990-91. Table 2.1 shows the sector-wise distribution of the consumption of energy during the period 1980-81 to 1990-91.

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[1] Source: Government of Pakistan 1991. Pakistan Economic Survey, 1990-91.

[2] Source: Authors' estimate.

NATIONAL ENERGY CONSUMPTION - Commercial and Non-commercial energy

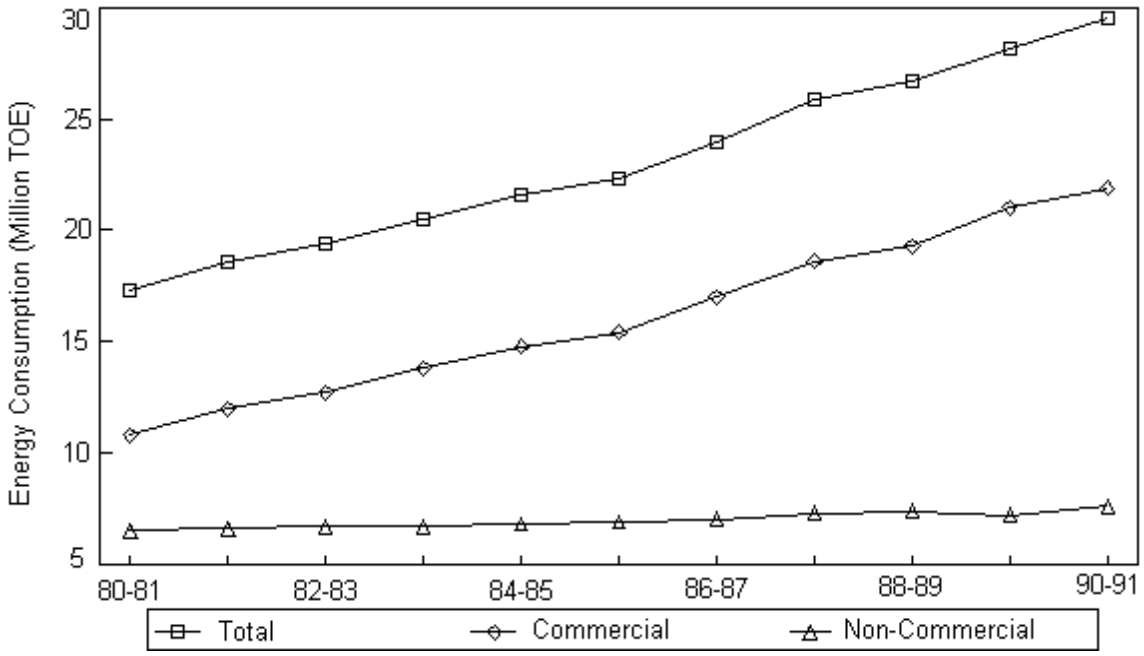


Figure 2.1 National energy consumption

PER CAPITA ENERGY CONSUMPTION - Commercial and Non-commercial energy

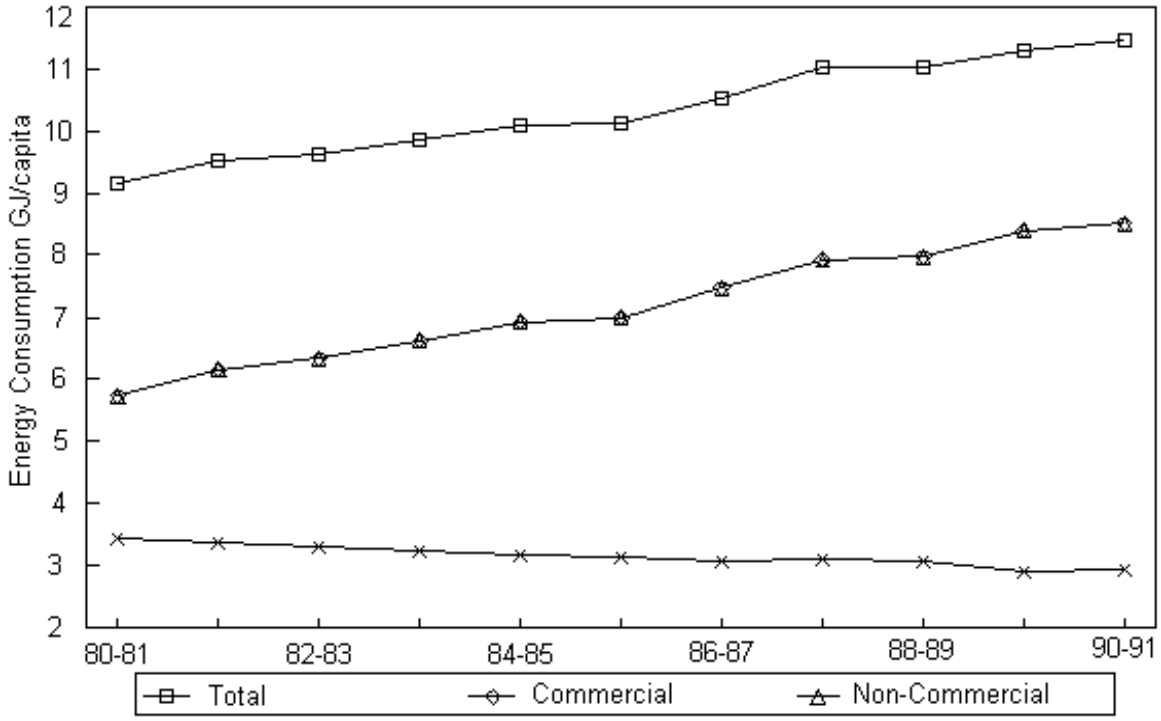


Figure 2.2 Energy consumption on a per capita basis

Table 2.1 Sector-wise distribution of national energy consumption

Sector	1980-81		1984-85		1990-91	
	'000 TOE	%	'000 TOE	%	'000 TOE	%
Domestic & Commercial	8,393	48.3	10,123	46.7	13,185	44.8
Industry	4,255	24.5	5,363	24.8	7,772	26.4
Transport	2,571	14.8	3,350	15.5	4,767	16.9
Agriculture	693	4.0	891	4.1	1,610	5.5
Fertilizer	530	3.0	772	3.6	1,010	3.4
Others	944	5.4	1,143	5.3	912	3.0
Total	17,386	100.0	21,642	100.0	29,256	100.0

Source: Government of Pakistan. 1991. Pakistan Economic Survey, 1990-91

The energy consumption of the different sectors has increased at varied rates during the period 1980-81 to 1990-91. The highest rate of increase, 8.8% per year, has been registered in the agricultural sector. It is followed by the fertilizer manufacturing sector which recorded annual rates of increase of 6.7%. Energy consumption in the transport sector expanded at the annual rate of 4.95% while in the industrial sector the increase was 6.2%. The lowest rate of increase of 4.6% was in the combined household and commercial sectors.

2.3 Energy Consumption by Fuel Type

The main sources of energy used in Pakistan are: oil, gas, electricity, coal, fuelwood and agricultural wastes. The contribution of various fuels to the national energy consumption has varied over the years with commercial fuels showing an increase and the non-commercial fuels a decrease. The country's rapid industrialization and the expansion in the transport sector have tended to bolster the share of oil, coal and electricity in the overall energy consumption. The composition of energy consumption by fuels is shown in table 2.2.

Although all energy types have shown an increase in the amount consumed, the largest increase has been recorded in the amount of electricity consumed. It increased by 170%, rising from 2.71 million TOE in 1980-81 to 7.554 million TOE in 1990-91, equal to an annual growth rate of 10.8%. Although the total amount of wood fuel has increased from 3.759 million TOE to 4.350 million TOE during the period from 1980-81 to 1990-91, reflecting an annual rate of increase of 1.46%, its share dropped from 21.6% in 1980-81 to 14.8% in 1990-91. The same is true for other fuels, mainly agricultural residues and animal dung, which showed an annual rate of increase of 1.6% but a decline in their share in the total energy consumption from 15.8% in 1980-81 to 10.9% in 1990-91.

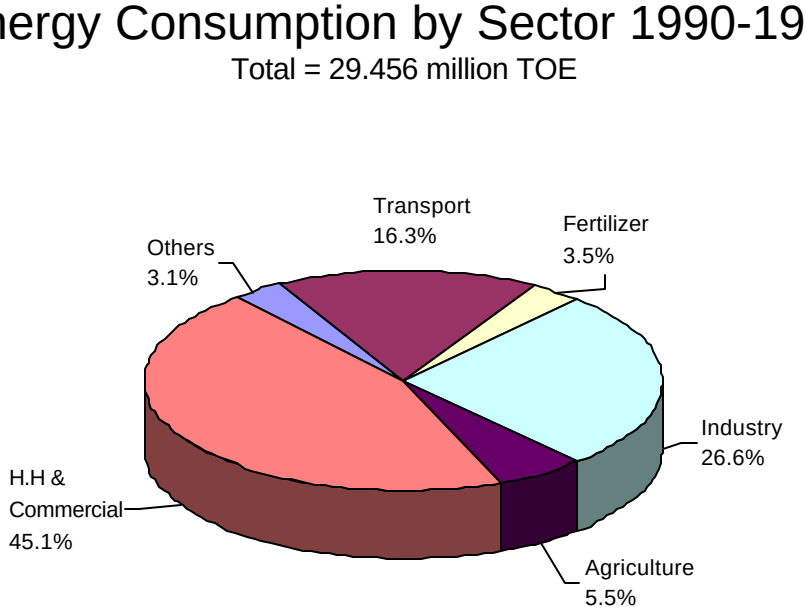


Figure 2.3 National energy consumption by sector (1990-1991)

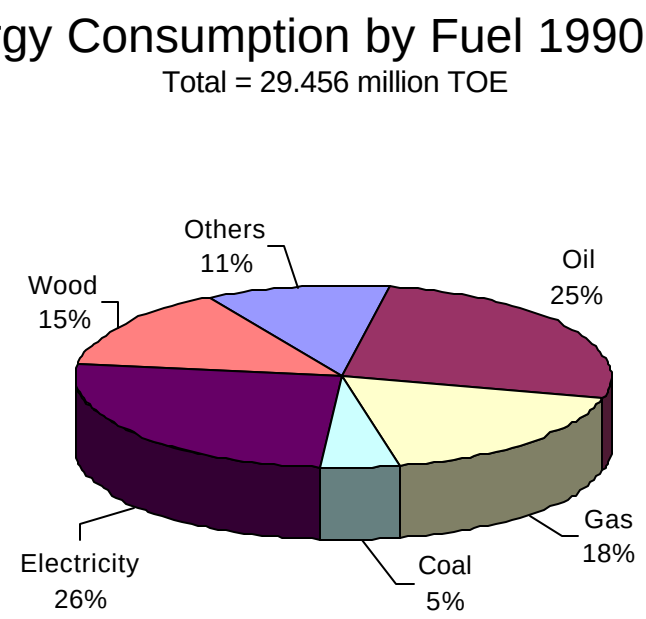


Figure 2.4 National energy consumption by fuel type (1990-1991)

Table 2.2 Composition of the total amount of energy consumed

Fuel type	1980-81		1984-85		1990-91	
	'000 TOE	%	'000 TOE	%	'000 TOE	%
Oil	4,267	24.5	5,866	27.1	7,724	26.2
Gas	3,200	18.4	3,818	17.6	5,245	17.8
Coal	691	4.0	987	4.5	1,357	4.6
Electricity	2,710	15.6	4,184	19.3	7,554	25.6
Wood	3,759	21.6	3,984	18.4	4,350	14.8
Others	2,758	15.8	2,806	12.9	3,226	10.9
Total	17,385	100.0	21,645	100.0	29,456	100.0

Source: *Government of Pakistan. 1991. Pakistan Economic Survey, 1990-91. Both oil and gas figures exclude amounts used for electricity generation*.

2.4 The Role of Wood Fuels

Wood fuels are mainly used in the domestic sector to meet energy requirements for cooking and space heating. In addition, commercial establishments such as restaurants, tea shops, *tikka* shops, bakeries and ovens also use wood fuels, but the amounts are small in comparison with the domestic sector. A limited quantity of wood is used in various industries such as for tobacco curing, brick kilns, lime kilns, preparing evaporated milk etc. It has been estimated that 90% of the wood fuel consumption takes place in households, 5% in the commercial sector and the other 5% in the industrial sector. Thus the main role of wood fuel is to meet domestic energy requirements for cooking and space heating.

According to the Housing Census of 1980, the majority of households, both in urban and rural areas, depend upon wood to meet their energy requirements for cooking of food. About 79% of rural households and 48% of urban households used wood as the principal fuel for cooking. The distribution of households, according to type of fuel used for cooking is shown in table 2.3. Although recent data are not available, it is clear from the table that the dependence on wood fuels is widespread, particularly in rural areas.

Commercial fuels are gradually replacing wood fuels, especially in urban areas. The overall consumption of gas and kerosene has been increasing at the average annual rates of 14.2% and 5.5%, respectively. The consumption of natural gas and kerosene in the domestic sector is shown in table 2.4.

Natural gas has numerous alternative and more productive uses than as a domestic fuel. Furthermore, kerosene has to be imported and this places a heavy burden on the already precarious balance of payments. The import of kerosene has gone up by 70%, rising at an annual rate of 5.5%, from 337 thousand tons in 1980-81 to 576 thousand tons in 1990-91. The value of these imports has increased by 140% from Rs.1.4 billion in 1980-81 to Rs.3.3 billion in 1990-91, reflecting an annual

rate of increase of 7.9%[3]. The substitution of kerosene and natural gas by wood fuels should therefore be considered wherever feasible as it could relieve some of the burden on the balance of payments while at the same time the gas could be put to more productive use.

Table 2.3 Distribution of households according to type of fuel used for cooking, 1980 census

Fuel type	Percentage of households using the fuel type (%)		
	Rural	Urban	All
Wood	79	48	70
Coal	-	1	1
Kerosene	1	20	6
Gas	-	22	6
Electricity	-	-	-
Cow dung	20	8	17
Total	100	100	100

Source: Government of Pakistan. 1981. Housing Census, 1980.

It is evident that, even though the relative share of wood in meeting domestic energy needs has been declining, in absolute terms the demand for fuelwood is still increasing. Its role in meeting domestic energy needs, in the future, will therefore remain important and hence underlines the need for improving its production and marketing system.

[3] Source: Government of Pakistan. 1991. Foreign Trade Statistics of Pakistan, 1980-81 to 1990-91

Table 2.4 Consumption of natural gas and kerosene in the household sector (whole country)

Year	Gas '000 TOE	Kerosene '000 TOE
1980-81	415	565
1981-82	562	598
1982-83	663	650
1983-84	755	754
1984-85	875	828
1985-86	995	882
1986-87	1,070	968
1987-88	1,110	882
1988-89	1,200	996
1989-90	1,407	1,146
1990-91	1,563	969

Source: Government of Pakistan. 1991. Pakistan Economic Survey, 1990-91.

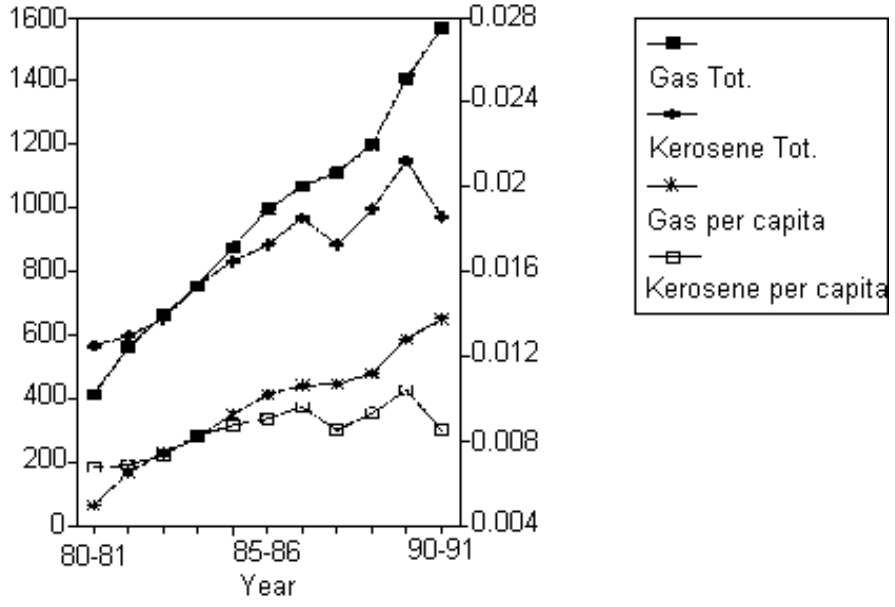


Figure 2.5 Total and per capita consumption of natural gas and kerosene on a national basis

3. DEMAND FOR WOOD FUELS IN PESHAWAR CITY

3.1 Historical Perspective

Wood and charcoal have been traditional domestic fuels for cooking and also for space heating during the winter in Peshawar city. Besides domestic use, restaurants, bakeries, ovens and traditional *kebab* shops also use wood fuels. The situation began to change in the sixties when kerosene stoves were introduced and people began to switch over to this source of energy. At first the change was slow but it gathered momentum with the passage of time. The switching from wood fuel gained further momentum in the mid- seventies when natural gas became available. A large number of households as well as commercial establishments have switched over to gas while thousands of applications for gas pipeline connections are pending.

Figure 3.1 A fuelwood-using *kebab* shop

Very little information is available to quantify this change. The Housing Census of 1980 classified housing units in the urban areas of the North West Frontier Province (NWFP) on the basis of cooking fuel used. Gas became available in Peshawar only in the mid-seventies while the other urban areas of NWFP did not receive it or only at a much later stage. A survey of households in Peshawar carried out in 1992 for the present study shows that the dependence on kerosene and gas apparently has increased as shown in table 3.1.

A main reason for this trend is the comparative "cheapness" of kerosene and gas. The prices of kerosene and gas are controlled and/or subsidized by the government whereas fuelwood prices are determined solely by the open market.

Table 3.1 Fuel types used for cooking in urban areas

Type of fuel	Use by urban based households in %	
	Urban areas NWFP (1980)	Peshawar city (1992)
Wood	49	13.4
Coal	1	-
Oil/Kerosene	28	33.8
Natural Gas	10	38.7
LPG	-	7.8
Cow dung	12	6.3
TOTAL	100	100.0

Sources: Government of Pakistan. 1981. Housing Census, 1980 and present study.

3.2 Factors Affecting Choice of Fuel Type

The choice of fuel type used by a household is mainly influenced by the income level of the household and the availability of fuel types. Households with a high income use predominantly commercial fuels like gas or liquified petroleum gas (LPG). The middle and lower income households tend to use more kerosene or fuelwood as is shown in table 3.2. The income level was set arbitrarily as respondents often did not answer the questions on income. A high income was assumed if the household owned a car, a medium income was assumed where households owned a TV set and refrigerator but no car while in all other cases the income level was assumed to be low.

Table 3.2 Household income level and choice of fuel type in Peshawar

Fuel type used for cooking	Households using this type of fuel in %		
	High income	Medium income	Low income
Wood	-	4	16
Charcoal	-	-	2
Kerosene	2	15	30
LPG	12	3	2
Gas	86	76	40
Cow dung	-	2	10
TOTAL	100	100	100

Source: Survey data

Not surprisingly, the availability of natural gas in an area has also a strong effect on the choice of fuel used for cooking. This is shown in table 3.3. A main conclusion which can be drawn is that fuelwood is an important source of energy for low income households as well as in areas where natural gas is not available.

Table 3.3 Use of fuel type for cooking and availability of gas in Peshawar

Fuel type used for cooking	Households using this type of fuel in %	
	Gas available	Gas not available
Wood	3	23
Charcoal	-	2
Kerosene	7	55
LPG	3	8
Gas	85	-
Cow dung	2	12
TOTAL	100	100

Source: Survey data

3.3 Per Capita Energy Consumption in the Household Sector

The average annual per capita energy consumption (excluding electricity) mainly used for cooking in the domestic sector of Peshawar city has been estimated, based on the survey results, at 4,578 MJ (95% confidence limits 4,090 - 5,066 MJ). However, it varies significantly with household income, household size, fuel type used for cooking, and the availability of natural gas in an area. Households in the high income bracket were found to use more energy on a per capita basis than the medium or low income households. The per capita energy consumption was found to be strongly influenced by the household size with the per capita energy consumption of large households being about half of that in small households.

Those households, which used natural gas, consumed considerably more energy per capita than those which used other fuel types. The reason for this is not known. The ease with which gas can be ignited and its low cost may make it more readily used whereas with other sources of energy people may think twice. However, LPG has similar characteristics to natural gas and it showed a very low per capita consumption. Gas stoves and other gas appliances are generally more efficient than those used with other fuels. Being burnt more efficiently, one would expect a lower per capita energy use with gas when compared to other sources of energy which are burnt with a lower efficiency, notably wood and dung. Unfortunately, insufficient information is available to draw definite conclusions on why consumers who have access to natural gas use more energy than those who use other sources of energy. Table 3.4 shows the main influencing factors and their effect on the average annual per capita energy consumption.

Table 3.4 Factors which influence per capita energy consumption in Peshawar

Influencing factor	Variable	Average annual per capita energy consumption in MJ
Income level	High	7,918 MJ
	Medium	4,831 MJ
	Low	4,163 MJ
Household size	1-3 persons	8,121 MJ
	4-6 persons	6,133 MJ
	7-9 persons	5,475 MJ
	10-12 persons	4,231 MJ
	13 or more	4,166 MJ
Main fuel used	Natural gas	5,876 MJ
	Fuelwood	5,357 MJ
	Kerosene	4,098 MJ
	LPG	1,777 MJ
	Dung	990 MJ
Gas availability	Yes	6,369 MJ
	No	4,960 MJ

Source: Survey results

Besides these factors, there is also a seasonal influence. The average monthly household energy consumption is about 40% higher in the winter (November - March) than in the summer (April - October). However, large variations were found between different types of fuel used. Households which use mainly fuelwood used about 16% more during the winter months when compared to the summer months. The increases during the winter months for the other fuel types such as kerosene, natural gas, LPG and dung are 42%, 49%, 25% and 33%, respectively. The increases in energy use during the winter period is caused by the need for space heating, water heating and a greater consumption of tea and food.

3.3.1 Household fuel expenditure

The average annual household expenditure on fuel (excluding electricity) was found to be 3,526 rupees. However, there are large variations depending on which type of fuel is used by the household. Fuelwood is expensive and those households which use it as their main source of energy pay considerably more than households which use commercial sources of energy. Households which use dung as fuel pay the least. This is probably due to the fact that most of the dung is collected by the people themselves with little bought through market channels. The differences in expenditures on fuel are shown in table 3.5.

Table 3.5 Annual household expenditures on fuel for cooking and heating in Peshawar

Fuel type used	Estimated annual household expenditure on fuel	
	Rupees	US Dollars
Wood	4,636	185
Kerosene	4,065	163
LPG	1,198	48
Gas	3,591	144
Cow dung	755	30
AVERAGE	**3,256**	**141**

Source: Survey data, 1 US dollar is 25 rupees

3.3.2 Regression model for per capita energy consumption

A multiple linear regression model was developed to relate the average annual per capita energy consumption to the variables affecting it. The model can be described as:

Y = 4,960 + 1.402 E - 385 H - 901 K + (1,409)

Y denotes the average annual per capita energy consumption in MJ, E is the total household expenditure on fuel in rupees, H is the household size in number of persons while K is the income level of the household in terms of high (1), medium (2) or low income (3). The last factor of 1,409 depends on whether natural gas is available in the area or not. Where available, the average annual per capita energy consumption has to be increased by this amount of 1,409 MJ. A low-income household with 7 persons which uses cow dung as fuel but in an area where gas is available would use:

4,960 + (1.402 * 755) - (385 * 7) - (901 * 3) + 1,409 = 2,031 MJ

The co-efficient of determination (R^2) is 0.655 which indicates that about 65% of the variations in the per capita energy consumption is accounted for by variation in these variables. The model was found to be highly significant (F value = 122.9).

3.3.3 Composition of energy consumption in household sector

The total consumption of energy in the domestic sector (excluding the use of electricity) in Peshawar city has been estimated at 105,000 TOE. This estimate is based on the proportion of the city population using a given fuel type multiplied by the average per capita consumption of energy of that segment of the population. The result is shown in table 3.6. Both the statistics, i.e. the proportion of the population using a particular fuel type and the average per capita consumption of energy were derived from the sample survey data.

Table 3.6 Estimated annual consumption of energy (excluding electricity) in the domestic sector in Peshawar

Fuel type	Percentage of the population using this fuel type	Estimated size of population using this fuel type	Average annual per capita consumption in MJ	Total energy consumption in TOE 1)	Share of fuel type in % out of the total consumption	Total energy consumption in tons 3)
Fuelwood	13.4	136,000	5,367	16,456	15.7	40,874
Kerosene	33.8	343,000	4,098	31,899	30.4	31,090
LPG	7.8	79,000	1,777	3,160	3.0	2,923
Natural gas	38.7	392,000	5,876	51,136	49.6	2,228
Dung	6.3	64,000	990	1,408	1.3	7,129
Total	100.0	1,014,000	4,579 2)	105,059	100.0	---

Source: Survey data
Notes : 1) 1 TOE equals 44,200 MJ; 2) Weighted average; 3) Natural gas in million cft. For conversion from TOE to actual physical quantities, the average values, shown in column 3 of table 3.7, have been used.

The table clearly shows that kerosene and natural gas are the most important fuel types for the domestic sector of Peshawar city. The two fuels together account for about 80% of the total estimated consumption. Fuelwood, although important, accounts for only 15.7% of the total domestic energy consumption. However, it should be stressed that the energy consumption shown in table 3.6 is in terms of delivered energy. Combustion efficiency of stove types used with the different fuel types normally show large variations from about 0.1 for simple three-stone wood and dung stoves to about 0.6 for very efficient gas stoves. The effective amount of energy used will therefore show even larger differences.

3.3.4 Comparative prices of different fuels

The present price relationship between different fuels consumed by the domestic sector shows that in terms of delivered energy, natural gas is by far the cheapest fuel type available while kerosene is the most expensive. It should be noted however that comparing only the price paid for fuel can distort the real picture. Different fuel types are used with different appliances which all have different combustion efficiencies. By assuming end-use efficiencies for domestic cookstoves used with the different fuel types, a more realistic picture emerges with regard to the real cost of the different fuel types. This is shown in table 3.7 where both the delivered cost and the effective cost are shown.

It is clear, even after the end-use efficiencies of cookstoves have been taken into account, that natural gas is still by far the cheapest fuel available with 16 MJ effective energy per rupee spent. While kerosene was more expensive than fuelwood in terms of money spent for delivered energy, it becomes considerably cheaper once the combustion efficiency has been taken into account. However, it has to be stressed that this type of calculation does not take into account the costs of the different appliances used. The cost of a gas connection, the gas stoves to be used, the costs of the cylinder used for LPG, etc. are quite high and these costs should also be taken into account in order to derive definite conclusions with regard to the cost of different types of energy to the consumer. Even so, the impression is that the present price structure does encourage the

substitution of fuelwood with gas and kerosene and hence demand for both fuels is increasing at a higher rate.

Table 3.7 Price comparison of different fuel types

Fuel type	Unit	Calorific value MJ/unit	Price Rs./unit	MJ/Rs. of energy delivered	End-use efficiency 1)	MJ/Rs. of effective energy
Fuelwood	Kg.	17.8	1.37	12.99	0.20	2.60
Charcoal	kg.	30.0	5.00	6.00	0.25	1.50
Kerosene	Litre	38.3	3.78	10.13	0.45	4.56
LPG	Kg.	47.8	4.36	10.96	0.60	6.58
Natural gas	m^3	36.5	1.33	27.44	0.60	16.46
Dung	Kg.	8.7	0.50	17.40	0.15	2.61

Source: Survey data
Notes : 1) Average efficiencies of stoves used for a particular fuel have been assumed.

3.3.5 Future trend in market demand for wood fuels

The trend in the market demand in the near future for wood fuels in Peshawar will depend on the population growth rate, the growth rate in the number of natural gas connections, the prices of the different fuel types, the pattern of income distribution as well as the availability of kerosene and LPG. It is difficult to make a forecast about these factors. Past trends may not continue in the future. Moreover, in the absence of data and information from the past, no econometric model can be built up. As an educated guess, it may be assumed that the demand for wood fuels will decline or remain static at best in the near future.

3.4 Energy Consumption in the Commercial Sector

The commercial sector also consumes a considerable amount of energy. The main establishments which use wood fuels or their substitutes (excluding electricity) are the following:

- Restaurants
- Ovens
- Bakeries
- Others
- Tea bars
- *Tikka* shops (meat barbecue)
- Barber shops

The "Others" include milk shops, *kebab* shops, sweet meat shops and *pakora* shops. All establishments, except for barber shops, use energy for cooking food or making tea. Barber shops use fuel for water heating in winter.

In the sampled area consisting of 4 wards of Peshawar city, 224 commercial units were identified. According to the type of business these are distributed as shown in table 3.8. Out of the 224 commercial units in the survey area, 22% used fuelwood, 5% charcoal, 8% kerosene and the remaining 65% used natural gas. The distribution of the commercial units according to the type of fuel used as well as the amount of energy consumed is shown in table 3.9.

Table 3.8 Distribution of commercial units in 4 sampled wards, according to type of business

Type of business	Number of units	% of total no. of units
Restaurants	7	3.1
Tea bars	20	8.9
Ovens	71	31.7
Tikka shops	11	4.9
Bakeries	13	5.8
Barber shops	56	25.0
Others	46	20.6
Total	224	100.0

Source: Survey data

Table 3.9 Distribution and energy use of sampled commercial units according to type of fuel used.

Type of business	Number of units and type and amount of fuel used				Total no. of commercial units	Annual energy use in TOE
	Fuelwood	Charcoal	Kerosene	Gas		
Restaurants	--	--	1	6	7	40.6
Tea bars	1	3	3	13	20	72.6
Ovens	14	--	--	57	71	523.0
Tikka shops	1	9	--	1	11	11.4
Bakeries	3	--	1	9	13	49.9
Barber shops	25	--	--	31	56	122.4
Others	5	--	13	28	46	149.5
Total no. of units	49	12	18	145	224	---
Total amount of fuel in TOE	166.7	8.8	30.1	763.8	---	969.4

Source: Survey data

Assuming that the survey area is representative of the whole of Peshawar, the total amount of energy consumed by the commercial sector of Peshawar city can be calculated, using the population size as the basis. The estimated population of the survey area is 106,000. This results in a per capita energy consumption in the commercial sector of 0.0091 TOE or 404 MJ. The whole

of Peshawar city has an estimated population of 1,014,000 people and the total consumption of the commercial sector can then be estimated as 9,227 TOE. Again assuming that the composition of energy consumption of the commercial establishments in Peshawar city is the same as in the survey area, the total consumption of the different fuel types can be calculated and is shown in table 3.10.

Table 3.10 Estimated annual amount of energy consumed by fuel type in commercial sector of Peshawar city

Fuel type	Energy consumption in TOE	Energy consumption in physical units
Wood	1,587	3,725 tons
Charcoal	83	186 tons
Kerosene	286	280 tons
Gas	7,271	311 million cft
Total	9,227	---

Source: Survey data

3.5 Wood Fuel Consumption in the Government Sector

The government sector, consisting of the civil and military establishments, also consumes a considerable amount of energy, mainly for room heating during the winter. Charcoal is the main fuel used. Enquiries made from the charcoal dealers indicated that about 2-3,000 metric tons of charcoal is used per year by the government sector.

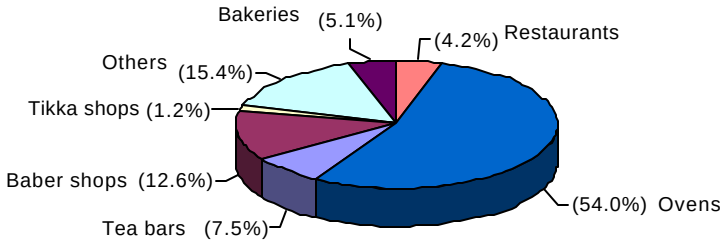
3.6 Total Market Demand for Wood Fuels

The total annual demand for wood fuels in all sectors of Peshawar, based on the survey data, has been estimated at almost 45,000 metric tons of fuelwood and 3,500 tons of charcoal. The sectoral distribution is shown in table 3.11.

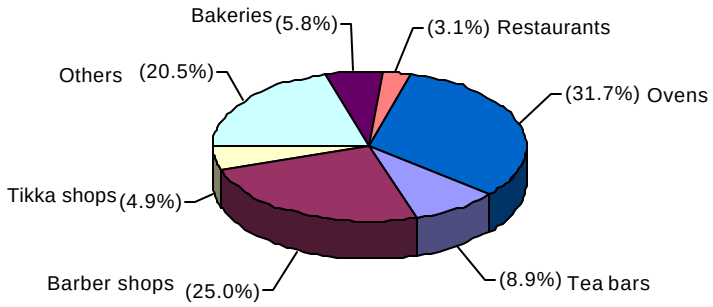
Table 3.11 Total demand for wood fuels by all sectors in Peshawar city

Sector	Wood fuel demand in metric tons	
	Fuelwood	Charcoal
Domestic sector	40,874	300
Commercial sector	3,725	186
Government sector	--	3,000
All sectors	44,599	3,486

Distribution of Commercial Units
224 units in the whole survey area



Quantity of Energy Use in the 224 Commercial Units
Total energy consumption 969.4 TOE/year



Type of Energy Use of the 224 Commercial Units
Total energy consumption 969.4 TOE/year

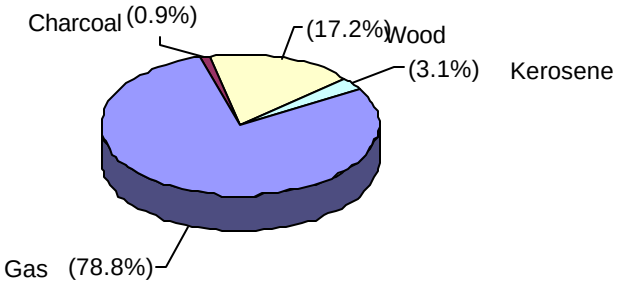


Figure 3.1 Distribution of the commercial units and their energy consumption quantities and types

Figure 3.2 A traditional oven for baking *nan*

Figure 3.3 Roasting meat on charcoal in a *tikka* shop

4. WOOD FUEL SUPPLY AND MARKET SYSTEM

4.1 Wood Fuel Supplies

Peshawar city has always depended for its wood fuel supplies on the mountainous and sub-mountainous natural forests in the adjoining tribal areas. Besides the supplies from the tribal areas, considerable amounts are derived from farmlands surrounding the city. The remaining shortfall, if any, is met through imports from Punjab province. With regard to charcoal, the city depends largely on imports from Punjab province.

4.1.1 Natural forests of tribal areas

Little information is available about the extent and magnitude of the forests in the tribal areas. Due to the huge influx of Afghan refugees in the eighties who settled in these tribal areas, a lot of uncontrolled tree cutting has been going on in these forests, both for local use and commercial purposes. Data collected from the various forest check points bordering the tribal areas indicate that the amount of fuelwood supplies to Peshawar city was 14,990 tons in 1989 and 26,960 tons in 1990. The annual average for the last 3 years was about 21,440 tons. About 75-86% of the total fuelwood supplies from tribal areas end up in the Peshawar city market as shown in table 4.1. Fuelwood species from the tribal areas consist mainly of oak (Quercus spp), *kao* (Olea cuspidata) and *phulai* (Acacia modesta).

Table 4.1 Fuelwood supplies from tribal areas destined for the North West Frontier Province (NWFP) and Peshawar city (tons)

Checkpost	NWFP			Peshawar city			Total		
	1989	1990	1991	1989	1990	1991	1989	1990	1991
Kohat	3,060	6,950	1,180	14,180	26,110	20,990	17,240	33,060	22,170
Rustam	1,430	1,560	1,870	520	470	710	1,950	2,030	2,580
Bara	80	50	80	140	200	370	220	250	450
Shabqadar	50	230	400	0	0	10	50	230	410
Islamia college	120	50	200	150	180	290	270	230	490
Total	4,740	8,840	3,730	14,990	26,960	22,370	19,730	35,800	26,100

Source : Data collected from the respective forest check posts.

4.1.2 Imports from Punjab

A considerable amount of wood fuel is imported from the Punjab into NWFP. In Punjab, the production of fuelwood takes place on irrigated forest plantations, riverine and scrub forests under

the control of the Forest Department as well as on private farmlands. The forests, which are under the control of the Forest Department of Punjab, produce about 150,000 tons annually. The bulk of the fuelwood production, however, takes place on farmlands. Farmers grow trees to meet their requirements for timber and fuelwood. A survey carried out in 1991 revealed that the farmlands in Punjab had a standing stock of about 200 million trees with an estimated standing volume of 46 million m^3. Each year the farmers fell about 14 million trees, equal to the removal of about 9 million m^3 of wood. The bulk of the wood removed is used by the farmers themselves and only a fraction finds its way to the market.

Most of the fuelwood imports from the Punjab into NWFP are destined for the tobacco curing industry and only a small fraction finds its way into the city market. The imports of fuelwood into Peshawar Valley (Peshawar Civil Division + Mardan Civil Division) totalled 50,230 tons in 1991, of which only 7,230 tons (about 15%) ended up in the Peshawar city market. Fuelwood imports from the Punjab mainly consist of *kikar or babul* (Acacia nilotica) and *shisham* (Dalbergia sissoo) which are raised mainly on farms and in plantations.

4.1.3 Local production

The farmlands in the rural areas around Peshawar city also produce a considerable amount of fuelwood but most of it is used by the rural households themselves. A small quantity however finds its way into the Peshawar city market such as poplar tops after harvesting for saw-logs and poles. In addition, sawmills operating in Peshawar city produce a considerable quantity of wood waste which is partly consumed by households and partly by commercial units. The supplies from these sources are estimated to be equal to the difference between the estimated consumption of fuelwood in Peshawar city and the supplies from tribal areas and imports from Punjab. Thus in 1991, the supplies from these sources can be estimated to be about 15,000 tons.

4.1.4 Charcoal supplies

As mentioned earlier, all the charcoal is imported from Punjab. The estimated 1,000 charcoal production units, located mainly in Punjab and Sindh provinces, produce about 100,000 tons of charcoal annually. The charcoal dealers in Peshawar city obtain their supplies from units located in the cities of Multan, Bahawalpur and Chichawatni of Punjab province. The estimated supplies in 1991 totalled 3,500 tons.

4.1.5 Total wood fuel supplies of Peshawar city

The total amount of fuelwood and charcoal supplied to Peshawar city in 1991 by source is given in table 4.2. It is evident that the Peshawar city market obtains about 50% of its supplies of fuelwood from the natural forests in the tribal areas, about 16% through imports from Punjab, and the remaining 34% is obtained from local sources.

Figure 4.1 Local fuelwood supply from private farm forestry

Table 4.2 Estimated fuelwood and charcoal supplies and sources for Peshawar city (1991), tons

Source	Fuelwood	Share in %	Charcoal	Share in %
Tribal areas	22,370	50.2	--	--
Punjab province	7,230	16.2	3,500	100.0
Local supplies	15,000	33.6	--	--
Total	44,600	100.0	3,500	100.0

Source: Survey data

4.2 Economics of Fuelwood and Charcoal Production

4.2.1 Fuelwood

The economics of fuelwood production is influenced by a variety of factors. These include, among other things, species, rotation, site quality, management intensity, spacing, irrigation requirements, input and output prices, etc. In natural forests no inputs are required. The only cost is that of management and extraction. The extraction cost is affected by the method of extraction, availability of roads, distance from the forests, forwarding to the consumer, etc. Since the natural forests of the tribal areas are not under the management of the forest department, no records are available to determine the economics of fuelwood production there.

With regard to irrigated plantations in the Punjab, a number of studies have been conducted on their economic viability. Quite recently a study, conducted by the Pakistan Forestry Sector Master Plan, found that the internal rate of return (IRR) in the existing plantations was only 3% against the average rate of return of about 12%, if invested elsewhere. The reason for the low rate of return is the very low productivity level. The actual annual productivity was found to be 3-4 m^3 per hectare against the potential productivity level of 10-12 m^3.

However, growing trees (for various products) can be financially attractive. A study carried out by the Punjab Economic Research Institute on farm forestry, carried out from 1981/82 to 1983/84 showed that the net return from tree growing on farmland was more attractive compared with that from growing agricultural crops. This is shown in Table 4.3.

It should be noted that not all of the trees grown on farmlands will end up as fuelwood. A considerable amount of it will be used as timber which commands a higher price than fuelwood. Besides tree plantations, many farmers also grow trees in rows along their farm boundaries, etc. which provide them not only fuelwood and timber for their own use but also for sale.

Table 4.3 Comparative returns from tree growing and selected agricultural crops

Tree species and crops	Net annual return per hectare in Rs. (1983/84 price)
Kikar (Acacia nilotica)	5,804
Shisham (Dalbergia sissoo)	4,814
Sufaida (Eucalyptus camaldulensis)	6,098
Sumbal (Salmania malibarica)	6,975
Poplar (Populus sp.)	7,544
Other trees	6,430
Wheat + cotton	4,320
Wheat + rice	761
Sugarcane	462

Source: *Punjab Economic Research Institute. 1985. Evaluation of farm forestry projects in the Punjab 1981-82 to 1983-84.*

4.2.2 Charcoal

Charcoal is made using the so-called earth-mound kilns. Fuelwood billets are piled up in the form of a stack. This stack is then covered with a layer of grass and leaves, about 10 cm. thick, which is then plastered with a mud layer about 15 cm. thick. On one side of this mud cover a hole is left to start the fire. A small kiln holds about 2.4 tons of wood while the larger kiln can hold 4.6

tons of wood. The charcoaling process takes about 4-7 days, depending upon the size of the stack. The average recovery of charcoal is about 27% by weight. The cost of production of charcoal is greatly influenced by the cost of wood which accounts for nearly 60% of the total production cost. The average cost of production of one ton of charcoal is around Rs.3,400. The breakdown of the production cost is shown in table 4.4. The price of charcoal at the production site is about Rs.3,600 per ton, resulting in a net profit per ton of about Rs.200 or about 6% only.

Figure 4.2 Charcoal bags unloaded at a fuelwood depot in Peshawar

4.3 The Marketing System of Wood Fuels

The marketing system of wood fuels in Peshawar city market has evolved over a long period of time. Although working primarily in the informal sector, it is well organized. The main parts of the marketing system are: the product, the distribution system and market channels and finally the price.

4.4 The Product

Wood fuels are used by the domestic as well as other sectors such as commercial establishments, small industries, etc. both for cooking and/or providing a source of heat. In the case of the domestic sector, the amounts bought are normally quite small. The different sectors in general need different sizes of fuelwood and all have their own preference with regard to quality, species, etc.

Table 4.4 Estimated production cost of one ton of charcoal

Cost item	Production cost	
	Rs.	US $
Wood 3.6 tons @ Rs. 540	1,944	77.76
Cutting and stacking, 2 man-days @ Rs. 40	80	3.20
Covering of stack, 6 man-days @ Rs. 40	240	9.60
Kiln control during burning, 6 man-days @ Rs. 40	240	9.60
Unloading and bagging, 4 man-days @ Rs. 40	160	6.40
Gunny bags 28 pcs. @ Rs. 12	336	13.44
Overhead charges	400	16.00
Total production cost	3,400	136.00

Source: Adapted and updated from Sheikh, M.I. 1987. Forest Based Rural Enterprises in Pakistan. 1 US $ = Rs.25

4.4.1 The quality of fuelwood

The domestic and other sectors all want to have wood fuels which are slow burning since the heating value of oven-dried wood does not differ much regardless of the species involved. This is because the chemical compositions of the woody substance are similar. The density and calorific value of some species commonly used in Peshawar city are presented in table 4.5.

Table 4.5 Density and calorific value of some selected species

Specie		Bulk density kg/m^3 (air dry)	Calorific value kJ/kg. (oven dry)
Local name	Latin name		
Babul/Kikar	Acacia nilotica	864	20,366
Phulai	Acacia modesta	992	20,386
Shisham	Dalbergia sissoo	800	21,221
Oak	Quercus sp	768	19,258
Kao	Olea cuspidata	1,120	20,933
Poplar	Populus sp	560	20,993
Mulberry/*Toot*	Morus alba	672	20,226

Source: S.M. Ishaq. 1960. A study on fuelwood problem in Pakistan.

The wood structure of a given species does have an influence on the burning characteristics. Wood with a low density which is more porous than the higher density wood burns more rapidly than heavy wood. Consumers, in general, prefer slow burning woods. Therefore, from the point of view of the consumers, *babul or kikar*, *phulai* and *kao* are considered better even though their calorific values are more or less the same as that of the lighter woods such as poplar and mulberry.

However, the quality of wood as a fuel is most affected by its moisture content. Oven-dried wood may have a calorific value of about 19,770 kJ/kg. but this drops to 17,670 kJ/kg. if the moisture content is 10% (dry basis) while with 30% moisture the calorific value drops to 14,890 kJ/kg. Wet wood also gives out more smoke and soot due to incomplete combustion. The users therefore prefer air-dried wood.

4.4.2 The size of fuelwood

Fuelwood is generally graded according to species and thickness of the billet. Heavier woods are considered more valuable than light woods. In addition, a premium is also placed on the thickness of the billet. In the irrigated plantations of Punjab where a considerable amount of fuelwood is transported to Peshawar city, the size classes shown in table 4.6, are used. Wood stacks vary considerably in terms of weight and consequently also in terms of price: for example a stack of 1,000 cft (28.3 m^3) of selected wood is 4, 2, 1.33 times more expensive than a stack of thin wood, medium sized wood and thick wood, respectively.

Table 4.6 Size class and weight in kg. per stacked cubic meter of fuelwood as used in the irrigated plantations of the Punjab

Size class	Dimensions of thin end in cm.	Weight in kg/m^3 stacked	
		Dalbergia sissoo	Acacia nilotica
Under-size	Under 2.5 cm.	---	---
Thin	2.5 - 5.0 cm.	164	268
Medium	5.0 - 15.0 cm.	237	291
Thick	15.0 - 25.0 cm.	311	---
Selected	Over 25 cm.	328	---

Source: Working Plan for Changa Manga Plantation (unpublished record)

At the retail shops, however, wood is sold by weight and not by volume. Thicker billets, usually about 0.9-1.0 meter in length, are split into billets of about 5 cm thick using an axe. Billets for use by owners of ovens are cut into shorter pieces of 20 - 25 cm. length and 10 - 15 cm. thickness.

The charcoal sold in Peshawar city is neither graded nor is any quality class recognized, except for dust. As a result it sells at a uniform price.

Figure 4.3 Weighing of fuelwood for sale

Figure 4.4 Thick fuelwood billets are split before sale

4.5 Marketing and Distribution Channels

Traders and retailers are an integral part of the wood fuel market system. They buy fuelwood from the producers, store it, process and handle it in conformity with the needs of the user, arrange transport to the consumption centres and maintain stocks to ensure a timely supply to the consumers. They operate in the informal market, provide credit where needed, by-passing established institutions such as banks, etc. In short, they are an indispensable link between the fuelwood producer and consumer.

In the case of wood supplies from the tribal areas, there is a two-level market system. A local middleman or assembler buys fuelwood from the villagers who cut the wood and transport it to his place. There are a number of local assemblers in the tribal areas such as in Tirah Bazar, Tarri, Khawadarra, Khuz, etc. These assemblers then sell fuelwood to the retailers in Peshawar. The channel is as follows:

Villager ---> Local Assembler ---> Retailer ----> Consumer

The fuelwood retailers in Peshawar buy fuelwood from assemblers and transport it to the depots in Peshawar. The transaction is usually in cash but in some cases the middlemen sell on short-term credit. The retailer then splits the billets into the desired size. He stores the product and sells it to the ultimate consumer as and when required. Fuelwood retailing is an attractive business in Peshawar. In the 4 sampled wards, 18 fuelwood retail depots were identified. The total number of fuelwood retail depots in the whole of Peshawar city market is estimated at 180. Each depot employs 2 - 3 persons. In this way, fuelwood retailing generates about 450 man-years of employment. Fuelwood depots are normally located in the low and medium income areas of the city while very few are found in the high income areas.

With regard to fuelwood supplies from Punjab, only fuelwood retailers are involved. The retailer purchases wood in the periodic auctions held in the irrigated plantations. He transports it to Peshawar and sells it to the consumer. The same system is valid for fuelwood supplies from the farmlands. In the case of wood waste from saw-mills, the consumer normally buys directly from the saw-mill owner.

With regards to charcoal, this is normally handled by wholesalers who purchase charcoal directly from the producers in Punjab. They transport the charcoal to Peshawar and sell it directly to the big consumers such as government offices, etc. A part is sold to the fuelwood retailers who then sell it to the smaller customers like households and tea-bars. There are no separate retail stores for charcoal.

All types of transport are used. The villagers in the tribal areas normally transport fuelwood from the forests to the assemblers' depots. The distances involved are relatively short and as there are very few roads because of the mountainous terrain, the villagers use pack animals such as donkeys or camels. From the assemblers' depots, trucks are used to transport fuelwood to Peshawar over all-weather roads which connect with Peshawar. A retailer, who buys fuelwood from an assembler, normally will hire a truck to transport the load to Peshawar. Several trucking companies exist and transporting of fuelwood is not a problem. An average truck holds about 10 tons of fuelwood. The transport costs are relatively high because of the mountainous terrain and

amount to Rs. 3,000 - 5,000 per truck load, depending on the distance involved. The transportation cost normally accounts for 20-30% of the total cost of fuelwood at the sale depot.

Figure 4.5 Loading fuelwood on a truck at the Changa Manga plantation auction depot

Figure 4.6 Transport of logs by camel (log residues for fuelwood)

Fuelwood from the farmlands around Peshawar are normally transported by tractor trolleys. In the irrigated plantations of Punjab, fuelwood is transported to the roadside auction depots on bullock carts, tractor trolleys and, in one plantation, by rail. The retailers, who purchase wood during the auction, arrange transportation of the fuelwood to Peshawar by truck but some fuelwood is also transported by train. Transport by truck costs from Rs. 4,000 - 6,000, depending on the distance involved. Transport by train is only about half of the trucking rate but this involves some formalities for obtaining railway wagons. Besides, the wood has to be transported to the loading platform on trucks and again at the destination from the unloading platform to the retail depot. These costs offset the advantages to a considerable extent and most of the retailers therefore prefer trucks as they are fast, reliable and efficient even though they are more expensive. Charcoal is transported, usually in gunny bags, by trucks from the producer site to the retail depots in Peshawar. A truck usually carries a load of about 8 tons of charcoal.

After the fuelwood has been transported from the points of origin to the retailers' depots, it is split and stored before selling to the consumers. Fuelwood from the irrigated plantations is normally quite dry, as after cutting it is left in the plantation area for up to half a year before it is auctioned. In the tribal areas, fuelwood is also normally left in the forests to dry as the fuelwood harvesters will receive a lower price from the assembler for wet wood delivery. In the case of fuelwood from the farmlands, the retailer will store it himself at the depot for about 6-8 months, normally in the open without a roof. This storage period is sufficient to bring the moisture content down to about 15-20%, or air-dry. A retailer has a stock, on average of about 40-50 tons of fuelwood, sufficient to meet the regular demand. Charcoal is normally stored under a roof to protect it from the rains.

The small purchaser usually carries the fuelwood from the retail store to the household himself. For larger amounts, hand carts can be hired from the retail depots. Commercial establishments normally buy fuelwood on a daily basis from the depots and they expect the depots to transport the load to their places.

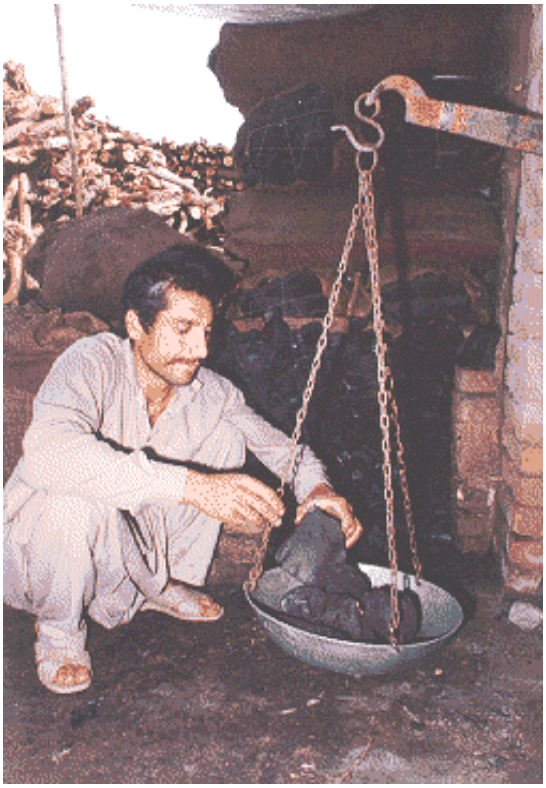


Figure 4.7 Charcoal selling, often in small quantities directly to users

4.6 Wood Fuel Prices

The wood fuel prices are affected by a number of factors. Among the most important ones are the species, the size of the billets, moisture content, the distance from the production point to Peshawar and the users, the mode of transportation, mark-ups at wholesalers and retailers, etc. On the whole, it is the interaction of the supply and demand forces which determine the price. All prices mentioned below were valid during the survey at the beginning of 1992.

4.6.1 Fuelwood prices for supplies from tribal areas

The villagers who cut fuelwood from the forests sell it to the local assemblers. The 40-50 assemblers in the area have considerable influence on the price paid to the wood cutters as only the assemblers have links to the buyers. During the first half of 1992, when the survey was conducted, the price paid to the producers by the local assemblers for Acacia modesta, Olea cuspidata and Quercus fuelwood billets was, on average, about Rs.800 per ton.

The assemblers have to compete with each other in selling the fuelwood to the retailers who are estimated to number about 200. The assemblers normally approach the retailers and sometimes even offer credit in order to sell their fuelwood lots. The selling price of assemblers is, on average, about Rs.900 per ton, resulting in a gross margin of about 12.5%. Because their turnover is quite high, they can afford a small mark-up.

The retailer then transports the purchased lot, handles and processes it into smaller sizes, stores, and then sells fuelwood to the users. The average costs of the retailer is shown in table 4.7.

Table 4.7 Fuelwood retail costs

Cost item	in Rs. per ton
Purchasing cost	900
Transport cost	350
Handling/splitting of the billets	125
Rent for the storage area	50
Stock holding cost	10
Total	1,435

Source: Survey results

The selling price averages from Rs. 1,600 - 1,650 per ton, resulting in a gross profit margin ranging from 11-15% (excluding management cost). As fuelwood is an essential commodity, its demand is highly inelastic and for that reason the consumers have little say in determining the price.

4.6.2 Fuelwood prices for supplies from Punjab

A considerable amount of fuelwood is derived from the irrigated forest plantations owned and managed by the Forest Department of Punjab. Fuelwood lots are sold through open auctions, which are periodically held. Fuelwood is sorted according to species and size class (see table 4.6) and then stacked, each containing 1,000 cft (28.3 m^3). The main species are *shisham*, *kikar* and mulberry. The price realized at previous auctions serve as a base or reserve price. The retailers of Peshawar prefer *kikar* which fetches a price of about Rs.750 per ton. To this price the retailer has to add the transportation cost which amounts to Rs. 400 per ton for an average distance of some 350 km. to Peshawar. Other expenses such as for splitting the wood, etc. amount to Rs. 200 per ton. The retail price is about Rs. 1,500 per ton, resulting in a gross profit margin of about 11%.

4.6.3 Charcoal prices

The manufacturers, mainly located in the Punjab, sell charcoal at Rs. 3,600 per ton to the wholesalers. The transportation cost from the production site to Peshawar averages Rs. 500 per ton. Thus the wholesaler's cost price works out at Rs. 4,100/ton. The wholesaler sells the charcoal to large consumers and retailers at Rs. 4,400 per ton, resulting in a gross profit margin of about 22%. The retailers in their turn sell to the consumer at Rs. 5/kg or Rs. 5,000/ton, resulting in another mark-up of about 14%.

4.6.4 Overall value of the wood fuel traded in Peshawar city

Based on the prices mentioned, the overall value of the wood fuel trade in Peshawar has been estimated at roughly Rs. 78 million (3.1 million US $), with fuelwood accounting for Rs. 61 million and charcoal for the remaining Rs. 17 million.

4.6.5 Price trends

Both the prices received by the producers and the prices paid by the consumers have shown a strong upward trend in the late eighties. The prices realized for *shisham* at the fuelwood auctions at the Changa Manga irrigated plantations in Punjab are shown in table 4.8. and figure 4.8a. The prices of medium, thick and selected classes of fuelwood have increased at an average annual rate of 6.6%, 10.4% and 9.5%, respectively, during the 10 year period. The same trend is discernible in retail prices at Peshawar where the price of fuelwood and charcoal rose on average about 6.5% per year. The prices of *kikar* fuelwood and of charcoal in the last 10 years are shown in table 4.9 and figure 4.9a.

However, the actual price paid by the consumer or received by the producer only tells part of the story. Inflation also plays a considerable role in the price of fuelwood. By making use of the General Price Index for the fuelwood prices which the producer receives at the Changa Manga Plantation and the Consumer Price Index for the retail price of fuelwood at the Peshawar market the prices were deflated to show the real trend of the fuelwood prices. These deflated prices are also shown in tables 4.8 and 4.9 as well as in figures 4.8b and 4.9b.

Table 4.8 Actual and real *shisham* fuelwood prices at the Changa Manga plantation (producers price).

Year	Price in Rs./ m^3 and quality class (see table 4.6)					
	Actual prices			Deflated prices		
	Medium	Thick	Selected	Medium	Thick	Selected
1980-81	124	212	275	124	212	275
1981-82	119	201	285	111	187	265
1982-83	124	203	283	109	179	250
1983-84	143	212	325	115	170	261
1984-85	141	247	363	108	188	277
1985-86	159	232	384	116	169	280
1986-87	143	259	386	99	180	268
1987-88	142	282	501	89	178	317
1988-89	185	445	593	107	256	341
1989-90	221	508	622	119	273	334

Source: *Actual fuel prices - State of Forestry in Pakistan, 1990. Deflators - General Price Index, Government of Pakistan. 1992. Pakistan Economic Survey, 1991-92.*

Table 4.9 Actual and real retail prices of fuelwood (*kikar*) and charcoal at the Peshawar market

Year	Price in Rs. per *maund* of 40 kg.			
	Actual price		Deflated (real) price	
	Fuelwood	Charcoal	Fuelwood	Charcoal
1980-81	27.10	75.73	27.10	75.73
1981-82	32.50	96.04	29.25	86.44
1982-83	33.98	109.38	29.22	94.05
1983-84	37.28	112.50	29.88	90.17
1984-85	39.64	104.77	30.07	79.47
1985-86	40.00	110.00	29.07	79.95
1986-87	40.17	115.86	28.19	81.29
1987-88	40.20	121.04	26.53	79.90
1988-89	45.00	120.00	26.91	71.76
1989-90	47.94	133.48	26.50	75.27

Source: *Actual retail prices - Government of Pakistan 1990. Pakistan Statistical Year book, 1990. Deflators - Consumers' Price Index. Government of Pakistan 1991. Pakistan Economic Survey 1990-1991.*

It is clear that the real or deflated price has increased only a little during the period 1980-1990. In fact, in some cases the real price has even shown a decrease. This is particularly the case with the retail prices of fuelwood and charcoal and to a lesser extent in the case of the price the producer receives for medium and thick sized fuelwood. In the case of the retail prices this

phenomenon may have been caused by the increased use of natural gas which may have exerted a downward pressure on the price of wood fuels. With regard to the fuelwood price trend in real terms at the supply area it is worthwhile to note that only the prices of the thick and selected fuelwood classes have gone up.

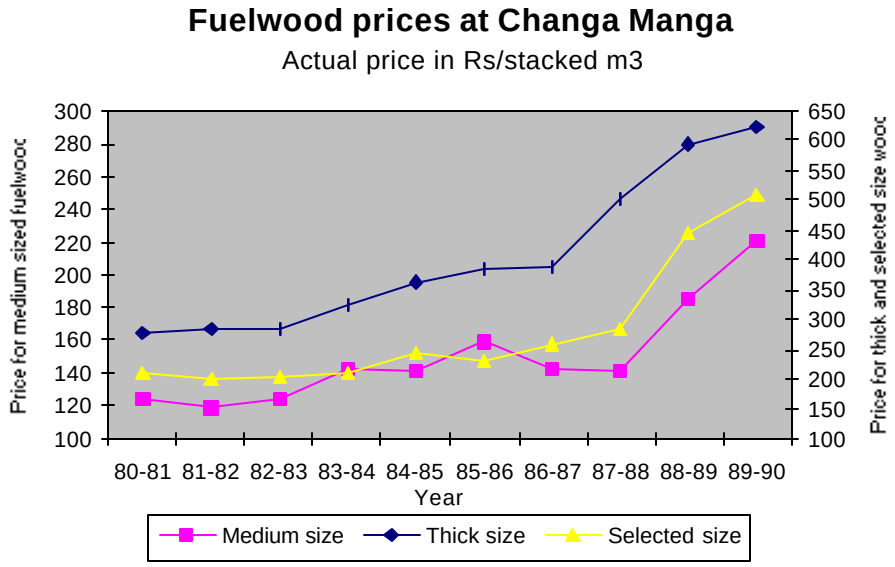


Figure 4.8a Actual fuelwood prices at the Changa Manga wood plantations, Punjab

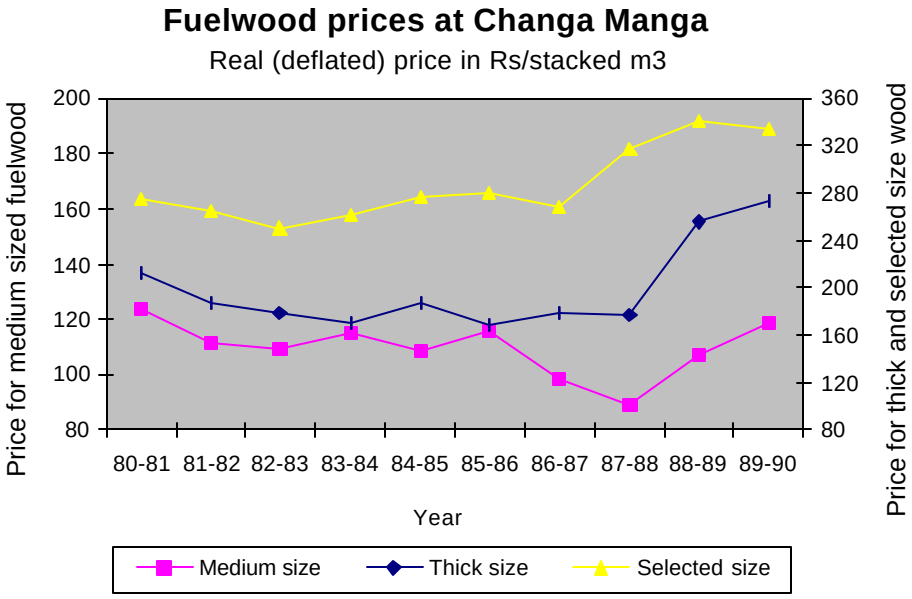


Figure 4.8b Real (deflated) fuelwood prices at the Changa Manga plantation

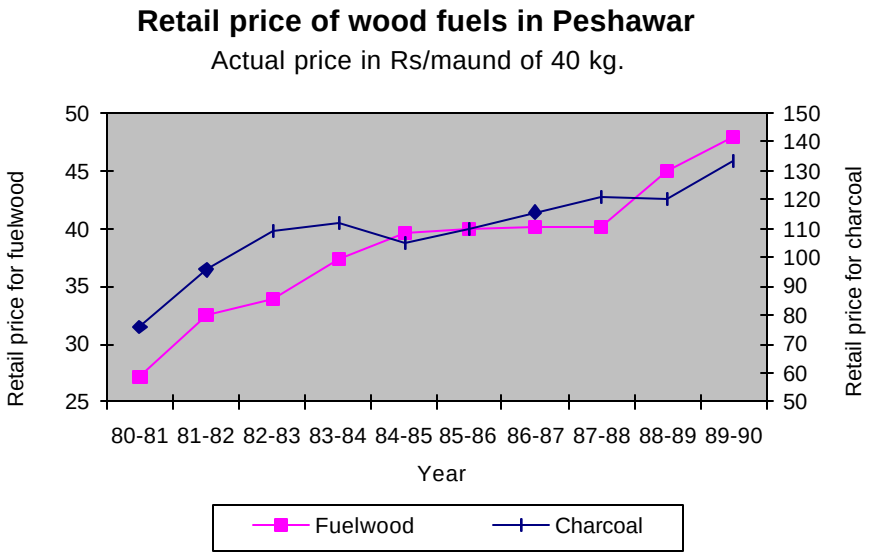


Figure 4.9a Actual retail wood fuel prices in Peshawar

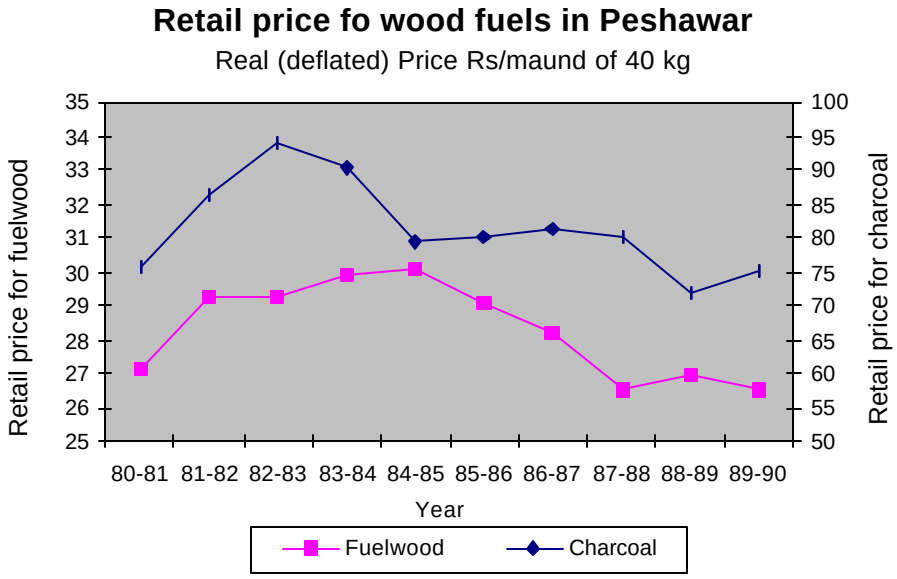


Figure 4.9b Real (deflated) retail wood fuel prices in Peshawar

5. SUSTAINABILITY OF THE WOODFUEL TRADE

The woodfuel market is governed by a complex set of internal as well as external factors. These include the availability of financing and/or credit, skilled manpower, competition from other energy sources, technological changes, demographic patterns, economic conditions of consumers, etc. The woodfuel trade, besides having to operate within a competitive market system, is often faced with more handicaps and constraints than other comparable businesses.

5.1 Finance and Credit Arrangement

The woodfuel business, like any other, also needs credit to carry out its various marketing activities. The local assemblers need cash and/or credit to make fuelwood purchases from the villagers, pay wages to the labourers for stacking of wood, pay rent for the land where the fuelwood is stored, other overhead expenses, etc. The retailers also need money/credit to procure wood from the assemblers and/or wholesalers, ensure fuelwood transport to the depots, pay wages to the labourers for stacking and splitting of the billets, rent land for storage facilities, etc. The capital required to set up a woodfuel business varies from Rs. 20,000-25,000 in the case of a retailer to about Rs. 40,000-50,000 in the case of a local assembler. Besides such a direct investment, working capital is also required which varies from Rs. 15,000 for a retailer up to Rs. 30,000 for an assembler or a wholesaler.

The main source of credit for the commercial sector in Pakistan is commercial banks. These banks generally provide short term credit facilities to businessmen in the form of credit limits, overdrafts, etc. Unfortunately, the people involved in the woodfuel trade, in general, can not make use of these facilities because they operate their business informally and hence the business documentation is almost non-existent. As a result, most fuelwood traders or retailers are not qualified and/or unable to comply with the elaborate formalities of the banks.

Most of the financing needs for the wood fuel trade therefore are met by informal sources such as loans from relatives, friends and money-lenders, with the latter group, in particular charging high interest rates. In some cases the retailers get supplies from the local assemblers on credit and payment is made when the supply has been disposed of. However, this happens only when stocks pile up with the assembler, compelling him to approach the retailers to offer them supplies on credit.

5.2 Manpower Skills

The workers engaged in the production, processing and marketing of woodfuel in Pakistan are generally from the weaker sections of the society. They use simple skills acquired either from their elders or on the job. The tools normally used for fuelwood preparations consist of axes and hand saws. Modern equipment like bow saws, chain saws, splitting wedges, etc to enhance labor productivity is rarely used.

Charcoal making is a job that requires skills. Over- or under-burning of the wood stack will result in poor yield and/or poor quality. Charcoal workers learn the trade either from their elders or from experienced co-workers.

Formal training facilities in tree harvesting, fuelwood preparation and charcoal making do not exist. The Pakistan Forest Institute in Peshawar and other Forestry Schools do provide some training in these techniques but the students, on completion of their training, normally join the Forest Service and do not work in woodfuel enterprises. Perhaps imparting some of these techniques should be done through an extension service and demonstration on the spot, instead of through formal training.

The woodfuel entrepreneurs, in general, have little knowledge about the principles of business management, eg. book keeping, financial management, inventory control, market forecasting, etc. Providing them with such knowledge could help to improve their running of the fuelwood business.

5.3 Demographic Pattern

There are basically two demographic factors which may have an influence on the woodfuel trade and consumption. The first and most important one is the growth rate of the population. The population growth rate in Pakistan is currently estimated at 3.1% per year, which is one of the highest in the world. At this rate, the population will double in about 25 years. The second is a notable trend in the urban migration in search of employment, better life styles and/or security. As a result, the urban population growth, estimated at 4.4% per year, is much higher than the estimated growth rate of 2.2% of the rural population.

With an increasing population size, the potential market demand for woodfuel is also increasing. The demographic pattern poses a challenge as well as an opportunity for the woodfuel trade which may require not only an expansion of the production systems (natural forests, plantations, farm forestry, etc.) but also a more efficient physical distribution system to cope with the growing demand.

5.4 Economic Conditions of the Consumers

The woodfuel market is also affected by the prevailing economic conditions, especially the level of household income and inflation. As shown earlier, high income households have a preference for non-wood fuels, especially gas and kerosene for cooking and heating while the lower income households use more woodfuel. Even though recent data on the distribution of households by income level in urban areas is not available, it is generally acknowledged that the proportion of middle and low income households in urban areas has been growing as is evident from the *Kachi Abadis* (slum areas) which are proliferating in most, if not all, cities.

At the same time, due to the high inflation rate, the purchasing power of the people is falling. The rate of inflation during the eighties averaged 9% per year while during the last two years it averaged 12%. Even though fuelwood is an essential commodity, the demand for it is responsive to changes in real income. With a reduction in real income, consumers tend to purchase smaller amounts of consumer items. This also applies to fuelwood even though the price of fuelwood in real terms has actually declined from the real price of 1980 (see fig. 4.9b). The inflation rate is expected to remain high. In spite of many drastic measures undertaken by the government during the last two years, the budget deficit is still rising.

Both factors have an influence on the overall woodfuel trade. On one hand, due to the increasing number of households in the lower income brackets, the total woodfuel demand may be expected to rise. However, on the other hand, due to the decrease in purchasing power, the actual use of woodfuel by the household may drop. No definite conclusions can be drawn on the overall combined effect these two factors will have on the total amount of wood fuel used in the future.

5.5 Cooking Fuel Competition

Wood fuels, both fuelwood and charcoal, are facing competition from kerosene, natural gas and LPG, particularly in urban areas with the consumption of gas and kerosene increasing much faster than the population growth. There are two main reasons for this situation. First of all these fossil-based fuels are cheaper and more convenient to use than fuelwood. The low price of gas and kerosene is mainly attributable to government control. Even a small increase in the prices of these fuels results in strong protests by the people. For political reasons the prices are therefore kept low and probably well below the price which would be expected under perfect competition. Woodfuel prices, on the contrary, are established by the free market forces of supply and demand. They move freely in response to changes in market conditions. The low price of gas and kerosene results in a gradual, but continuous shift away from wood to these fuels. Furthermore, despite higher replacement costs (of fuelwood trees) and transportation costs, the fuelwood price can not be adjusted upward to compensate for the increased costs.

Most of the households, which still use fuelwood, reported that they also would like to shift, once natural gas becomes available. Gas is considered a clean, convenient and modern fuel and in fact can be considered a status symbol while most users consider the use of fuelwood to be inconvenient. Because of being bulky, transport from the retailer to the home is problematic as the retailer normally does not deliver small quantities.

In the absence of gas, large households prefer fuelwood over kerosene as the kerosene supply is even more problematic than that of fuelwood. Small households, however, have a slight preference for kerosene over fuelwood as their energy requirements are quite small.

The competition from kerosene and gas is affecting the woodfuel markets and most of the people involved with the woodfuel trade in Peshawar anticipate that the size of the market will decline in the future. However, some food items are normally always prepared by using wood fuels. A case in point is the use of charcoal for roasting meat (*tikkas*). The general belief is that charcoal imparts a special flavour to the meat as compared with any other fuel. Charcoal in *tikka* shops is therefore unlikely to be replaced by other fuels in the near future.

5.6 Environmental and Political Factors

The world wide movement for the protection of the environment has created an awareness of the importance of trees and forests at all levels. The political parties, nowadays, particularly during election times, stress the need for preservation of the environment, including measures for combating deforestation. At the same time they exploit the demand for gas pipeline connections. In order to win votes, the restrictions on gas connections are relaxed and areas, which formerly did not have gas, are connected to the system. Besides the political parties, non-governmental

organizations are also stressing the need for halting and reversing the rate of deforestation. They propose reforestation programmes, a ban on cutting of trees in mountainous and sub-mountainous areas and more stringent and punitive laws related to the cutting of trees. Although these measures may reduce the wood fuel supplies from the forests, they probably will have little effect on the supplies derived from farm lands. As was shown earlier, farmlands around the city of Peshawar already supply about 34% of all the fuelwood and, in addition to this, a considerable amount of wood fuels from farmlands in Punjab ends up in Peshawar. At the same time this may give an added impetus to farmers to grow more trees for timber and woodfuel.

Another factor which is affecting the woodfuel trade and is resented by traders is the imposition of taxes by various local bodies on the movement of wood out of their jurisdiction. This adds to the cost of wood supplies and results in a higher price for the consumer.

5.7 Technological Factors

Among the technological factors, the most important factor is the introduction of fast growing species such as *poplar* (Populus sp.), *eucalyptus* (Eucalyptus camaldulensis) and *robinia* (Robinia pseudoacacia). These species are capable of yielding several times more wood compared to the traditional species such as *kao* (Olea cuspidata), *phulai* (Acacia modesta), *kikar* (Acacia nilotica), *shisham* (Dalbergia sissoo) and *mulberry* (Morus alba).

The introduction of these fast growing species will increase the availability of timber and fuelwood and also reduce the cost of supplies. However, the present market demand for these fast growing species is at present very limited. However, this could gradually change with time as the market becomes more familiar with the new species and as the scarcity of traditional species increases.

Another technological factor is the introduction of more efficient stoves. The improved woodstoves, such as those introduced by the Fuel and Energy Conservation Technologies Project (FECT) supported by the Pakistan and German governments, save substantial amounts of fuelwood as it is burnt more efficiently. Once more improved models are developed, introduced and widely accepted by the population the demand for woodfuel could be significantly reduced.

With regard to woodfuel users, there is also a need for providing more information on the efficient use of fuelwood such as preparing it in smaller pieces and properly drying it, etc. In addition, there is a need for the introduction of more efficient end-use devices, such as non-domestic cook-stoves, furnaces, kilns, bakery ovens, etc. that are popularly used in commercial and small industry sectors.

5.8 Long Distance Transportation Cost

Only about 34 % of the woodfuel supplies in Peshawar is produced locally. The majority of the supply comes from the tribal areas and from Punjab with transport distances of some 200-300 km, or sometimes more. The truck transportation cost at present is high and in general amounts to Rs. 3,000-5,000 /truck load of 10 metric tons or Rs.300-500/tons. When compared with the fuelwood cost at the assembler or auction point of Rs. 800- 900/ton , the transport cost has already

added some 35-55 % to the original cost of the fuelwood. At Peshawar, the transportation cost was calculated to be about 25 % of the total cost price incurred by the retailer. The price of fuelwood, therefore, is quite sensitive to the transportation situation. Should the transportation cost substantially increase in the future, the fuelwood competitiveness might decrease even further when compared to other commercial fuels. Alternatively, the local production sources in and around Peshawar may become more important.

6 CONCLUSIONS

The marketing of fuelwood and charcoal in Peshawar is characterized by high cost when compared with other commercial energy sources like natural gas, LPG and kerosene. An extensive network of fuelwood producers, collectors, assemblers, wholesalers and retailers exists. Out of the estimated total number of 126,750 households in Peshawar, about 17,000 use woodfuel for household activities such as cooking, water heating and space heating. In addition to the domestic sector, a large number of commercial establishments also use woodfuel. The annual consumption of fuelwood and charcoal is estimated at 44,600 and 3,500 metric tons, respectively.

There are 3 main supply sources: the natural forests of the tribal areas (50%), irrigated forest plantations of Punjab (16%) and local production (34%). Wood fuels are mostly transported by truck over long distances, especially from the tribal areas and Punjab. Short distance transport inside the city is done mainly with carts and pack animals. The transportation cost accounts for about 25% of the retail sale price of fuelwood in Peshawar.

There are about 200 retail fuelwood sale depots in Peshawar which cater to consumers throughout the year. Retailers get the fuelwood supplies in the form of thick logs or billets which are then split into pieces of the desired sizes. Fuelwood is sold by weight and is graded by species and diameter class. The main species are *kao* (Olea cuspidata), *phulai* (Acacia modesta), *oak* (Quercus sp.), *kikar* (Acacia nilotica) and *shisham* (Dalbergia sissoo). Fast growing species like *poplar* and *eucalyptus* find less favour with the consumers as they burn out faster. Charcoal is used to a limited extent in the household but is favoured by the food establishments like *tikkas* shops. Charcoal is not graded and no attempts so far have been made to enhance the product quality and yield through the introduction of improved charcoaling methods.

Due to the increase in freight charges as well as wages, the prices of woodfuels have increased sharply since 1988/89. At present it is the most expensive fuel for domestic use. The price of fuelwood ranges between Rs. 1-1.50/kg., depending upon species and size class. The price of charcoal is Rs.5 /kg. However, the real prices, after taking inflation into account, have changed very little, if at all, during the last 10 year period. The profit margin of the woodfuel trade at the retail level varies between 12- 15%. The lower prices of gas and kerosene are fostering the replacement of woodfuel.

Woodfuel consumption, under the most optimistic scenario of the fuel consumption pattern remaining unchanged, will grow proportionally to the fast increase in the urban population. However, if the prices of gas and kerosene remain low, this will result in the continuous replacement of wood fuels. In this latter case, the demand will perhaps remain steady at the present level or may even decline in the foreseeable future.

7. RECOMMENDATIONS

- In order to save the natural forests in the tribal areas from indiscriminate cutting, the growing of trees for timber, fuelwood, etc. in settled areas should be encouraged through the provision of various incentives to farmers. The social forestry programmes in these areas may need special support due to the low level of existing development and infrastructure.

- A scheme of price incentives should be devised to improve the price competitiveness of woodfuel with other commercial fuels. In particular, efforts should be made to rectify the apparent imbalance between the woodfuel and gas and kerosene prices. The real (opportunity) cost of the latter sources of energy should be charged as they are non-renewable and to ensure economic efficiency in energy use.

- An extension effort should be arranged to demonstrate more efficient techniques of tree harvesting, fuelwood preparation and handling and charcoal processing to the tree growers at village level.

- Charcoal manufacturing practices should be improved and more efficient methods should be introduced through a programme of adaptive research and extension training.

- Improved wood/biomass burning cookstoves should be actively promoted and at the same time household energy conservation measures should be introduced to housewives, schools and local teaching institutions in order to build up sufficient awareness of the development issues.

- Research and development for the improvement of traditional large stoves and other wood combustion devices (kilns, furnaces, ovens, etc.) generally used in the commercial and industrial sectors should be fully supported by public funding.

- Woodfuel retailers in each major urban center should be encouraged to form an association or cooperative so that they can be formally recognized by the government and be entitled to loans from financial institutions as well as to discuss pertinent fuelwood problems with the concerned authorities.

- As fuelwood is an essential commodity, it is proposed that *octroi* charges and *zila* tax on its movement be abolished to bring down its price.

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