2nd Draft

Desk Study

on

National Woodfuels and Wood Energy Information Analysis

PAKISTAN

Prepared by: Muhammad Iqbal Sial *PhD*
Director, Research and Development
NWFP Forest Department
Peshawar

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LIST OF ABBREVIATIONS AND ACRONYMS

ADB	Assian Development Bank
AJK	Azad Jamun Kashmir
AKRSP	Aga Khan Rural Support Programme
DMCs	Developing Member Countries
FSMP	Forestry Sector Master Plan
FSP	Forestry Sector Project
FST	Fuel Saving Technology
GoP	Government of Pakistan
HESS	Household Energy Strategy Study
KIDP	Kalam Integrated Development Project
LPG	Liquid Petroleum Gas
MSFP	Malakand Social Forestry Project
MTOE	Million tons of soil Equivalent
NWFP	North-West Frontier Province
PCRET	Pakistan Council for Renewable Energy Technology
SFDP	Siran Forestry Development Project
SFSDP	Sindh Forestry Sector Development Project
SWMP	Suketar Watershed Management Project
TWMP	Tarbela Watershed Management Project
VLUP	Village Land Use Planning
WPMP	Watershed Planning and Management Project

1. COMPILATION OF WOODFUEL RELATED DATA

1.1 Woodfuel Consumption

Based on the estimated per capita consumption of woodfuel of 0.208 m^3/year, the official statistics for wood consumption have been traditionally calculated using projection of 1981 population census figures and population growth rate of 3.4 percent. The results are reported each year in the Annual Forestry Statistics issued by the Pakistan Forest Institute. The population census of 1998 has, however, shown a reduced population growth rate of 2.6 percent, which is declining further at a rate of 0.1 percent per year. Accordingly, the yearly estimates of population and woodfuel consumption have been recalculated (Table-1).

Table-1 Yearly estimates of woodfuel consumption in Pakistan

Year	Population estimates (millions)	Woodfuel required (million m^3)
1990	106.06	22.10
1991	109.03	22.68
1992	111.88	23.27
1993	114.80	23.88
1994	117.79	24.50
1995	120.87	25.14
1996	124.02	25.79
1997	127.26	26.47
1998	130.58	27.16
1999	133.84	27.84
2000	137.05	28.51
2001	140.20	29.16
2002	143.14	29.77

Source:
1. Pakistan Census Report 1981, 1998
2. Pakistan Economic Survey 1998 to 2001.
3. Forestry Sector Master Plan, 1992.

1.2 Woodfuel Production

Unlike the woodfuel consumption, no time series data of woodfuel production is available, except for a negligibly small fraction supplied from the state forestlands (Table-2). Forestry Sector Master Plan (FSMP) and Household Energy Strategy Study (HESS) are the two reliable studies conducted in 1991-92, which report total woodfuel production of 29.5 million m^3 (20.7 million tons) and 32.4 million m^3 (22.7 million tons), respectively.

Information given in Table-2 indicates that the state forest lands, on an average, yield 187500 m^3 of woodfuel per year. Thus the state forestlands contribution to the total woodfuel supplies is not only insignificantly small, but also there is a declining trend in supplies from this source. In addition to the reported (recorded) supplies, unrecorded quantity of about 1.2 million m^3 of woodfuel is also removed annually from the state forests (Qazi, 1993).

Table-2: Production of firewood from state forests (000m³)

Year	Production	Year	Production
1978-79	294	1988-89	301
1978-80	204	1989-90	188
1980-81	230	1990-91	158
1981-82	251	1991-92	173
1982-83	249	1992-93	140
1983-84	291	1993-94	120
1984-85	198	1994-95	116
1985-86	202	1995-96	111
1986-87	185	1996-97	146
1987-88	164	1997-98	132

Source: Khan and Hakim 1996

1.3 Woodfuel Import and Export

Woodfuel is neither imported nor exported. Entire production is consumed locally.

1.4 Charcoal

The HESS study indicates total consumption of 118,999 TOEs of charcoal in the country. Entire quantity is consumed locally. Hence, annual production is also assumed to be of the same level. Apart from that, no time series data is available. Despite the fact that the trade statistics of the country report occasional import of negligibly small quantities of charcoal, it is safer to assume, for practical purposes, that no charcoal is imported, keeping in view the insignificant quantities involved.

1.5 Black Liquor

No production or consumption of black liquor is known in the country.

2. TRENDS IN CONSUMPTION

According to the HESS survey conducted in 1991-92 the woodfuels dominated the household sector and accounted for 53.3 percent and charcoal, another 0.6 percent of the total household energy consumption in the country. The current total demand, as per HESS study, amounts to 29.5 million m³ per annum. About 79 percent of all the households in the country use this fuel. Woodfuels account for 94 percent of energy used by households in rural areas and 58 percent in urban areas. Whereas urban households purchase 86 percent of their woodfuel needs, over 69 percent of the total consumption is collected free mostly by women and children in rural areas. Cooking consumes 82.1 percent, space heating 7.3 percent and water heating 9.8 percent of total woodfuel used in domestic sector.

2.1 Consumption by Geographical Location

According to population census of 1998, 67.5 percent of the country's population lives in rural areas and is almost entirely dependent on biomass as a source of energy for cooking and heating. Results of the Housing Census of 1980, indicated that as many as 70 percent of the rural households used wood as a principal source of fuel for cooking and heating, whereas in urban areas 48 percent of the households used woodfuel as the main source of domestic energy.

The estimates of woodfuel consumption in urban areas showed a steady growth. It increased from 4.4 million m^3 in 1971-72 to 5.2 million m^3 in 1981-82. Thereafter, it started declining and reached the minimum of 3.1 million m^3 in 1991-92. Per capita woodfuel consumption shows a steady declining trend: it has gone down form 0.26 m^3 in 1971-72 to 0.12 m^3 in 1993-94 in urban areas.

On the other hand, woodfuel consumption has been expanding steadily in the rural areas. It went up form 9.3 million m^3 in 1971-72 to 17.0 million m^3 in 1992. The steady trend in growth of woodfuel consumption in rural areas is attributable to static fuel consumption pattern. As a consequence, the per capita woodfuel consumption for rural population has remained static at 0.2 m^3 (Siddiqui, 1996).

The relative share of urban areas in total woodfuel consumption has declined from 32 percent in 1971-72 to just 22 percent in 1992. The share of rural areas has gone up from 68 percent in 1971-72 to 78 percent over the same period (Siddiqui, 1996). It clearly suggests that increasing supplies of woodfuel are needed in rural areas rather than in urban areas. The household distribution according to fuel used for cooking in urban and rural areas is given in Table-3.

Table –3: Comparison of fuel use in rural and urban areas.

Cooking fuel	Urban areas (%)	Rural areas (%)
Wood	55	76
Coal	1	-
Kerosene	16	1
Natural gas	17	-
Electricity	-	-
Cow dung and crop residues	11	23

Source: Siddique, 2001

The households in Balochistan consume the most woodfuel per household, probably due to lack of alternate fuels and cold weather. Punjab has the highest consumption of crop residues and the lowest consumption of firewood per household, because it has the largest farm area. On the other hand, Sindh has the highest consumption of electricity per household due to high level of urbanization and dominance of Karachi.

2.2 Consumption By Type Of Appliances

No reliable information is available on the woodfuel consumption by type of appliances, except that the Pakistan Council of Renewable Energy Technology (PCRET) alongwith a number of other development projects, including Agha Khan Rural Support Programme (AKRSP), Tarbela Watershed Management Project, and Environmental Rehabilitation Project have made efforts to introduce fuel-efficient cooking stoves as a measure of conserving wood energy.

The research conducted by the PCRET indicates that the non-band stoves developed by the project save woodfuel energy form 23 percent to 40 percent, when various types of improved stoves were compared with the traditional ones. The project has so far disseminated 45,414 improved stoves of various designs and specifications[1].

2.3 Patterns of Woodfuel Replacement

HESS estimates give share of woodfuel including charcoal in domestic sector to be 53.9 percent, dung 18.1 percent, agriculture waste 14.1 percent and natural gas 7.1 percent, kerosene and Liquid Petroleum Gas (LPG) 2.7 percent and electricity 4.3 percent. Thus, woodfuel supply more than two times the energy supplied by agriculture waste and dung. The usual preference ladder for common fuels is as follows:

Firewood $\Rightarrow$ Kerosene $\Rightarrow$ LPG $\Rightarrow$ Natural Gas

Various alternatives to woodfuel are discussed below:

2.3.1. Dung

Dung is a widely used a household fuel, particularly in rural areas. The Economics of Woodfuel for Individual Families in *Barani* (Rain-fed) Areas (PFI, 1989) showed that about 60 percent of the households visited used on an average, 3.2 kg of dung per day. The Baltistan

[1] Personal communication by Dr. Habib Gul, Deputy Director, PCRET, Peshawar

Energy Survey Expedition in 1988 found that 68.3 percent of sampled households used dung cakes to the extent of 2 kg/day.

The important role of dung as a fuel in the household sector has been confirmed by the HESS demand survey. Its results show that 66.3 percent of households use dung as fuel, consuming 13.3 million tons, in 1991; one third of the total dung production of 39.4 million tons. More than 85 percent of dung used as fuel is consumed by rural households and the rest is traded in the nearby towns.

Dung cake is the cheapest fuel in financial terms. The current average market price of dung cake is Rs. 0.95 per kg. Firewood prices are almost 174 percent higher. In terms of delivered energy, dung is still cheaper at Rs. 0.52/MJ compared to Rs. 1.49/MJ for firewood (Table-8). However, burning dung prevents its use as manure.

2.3.2. Crop residues

Crop residues supply the largest amount of energy to household sector after firewood and dung and account for 8.3 million tons equivalent to 2.82 MTOE. Of the crop residues, the major kind of biomass used as energy in Pakistan are cotton sticks which account for 5.15 million tons (64 percent). Other crops and grasses account for a further 1.7 million tons (20 percent) of consumption (Table-4)

Table-4: Total consumption of selected crop residues as fuel

(Thousand tons/year)

Biomass Type	**Consumption**	**Percentage**
Cotton sticks	5,148	64.0
Local biomass	1,678	20.9
Bagasse (sugar-cane)	298	3.7
Kahi grass	293	3.6
Rice straw/husks	211	2.6
Corn husks/stalks	201	2.5
Wheat straw	159	1.9
Tobacco husks	29	0.4
Coconut shells	29	0.4
Total	**8,046**	**100.0**

Source: Siddique *et al,* 1997

2.3.3. Natural gas

Natural gas consumption in Pakistan in 2000 stood at 774,410 MCFt (equivalent to 16.26 MTOE). In the household sector, its consumption stood at 140,899 MCF (3.3 MTOE).

Cooking is the major end-use for natural gas, followed by space and water heating in the domestic sector.

The average price paid by households in 2001 for natural gas was Rs. 132 per thousand cft. In terms of energy, the price of natural gas was Rs.0.42/MJ while its nearest substitutes for cooking, LPG, kerosene and woodfuel have prices of approximately Rs. 0.86, Rs. 0.89 and Rs. 1.49/MJ, respectively. These estimates suggest that even at full economic cost, natural gas would still be by far the cheapest fuel for cooking. Cleanliness and ease in use are its added advantages. These are the obvious reasons for its high demand, particularly in urban areas. Current levels of production, consumption by domestic sector and price are given in Table-7. There has been an increase of 6.7 percent in the number of domestic consumers and 5.1 percent in total domestic consumption during last six years.

2.3.4. Kerosene oil

The HESS survey has estimated kerosene consumption in the household sector at 550.87 million liters (442.5 thousand TOE) in 1991, which is 2 percent of total household energy consumption or, 15.6 percent of total household modern fuel consumption. In terms of the price per unit of delivered energy (for cooking), kerosene remains by far the most expensive modern fuel. With the expansion of natural gas supplies and increase in price of kerosene oil, its consumption has considerably declined. Kerosene is primarily used for lighting in households, which are not electrified; additionally, it is used as a standby cooking fuel in urban centers. With the increase in its prices, however, its consumption is declining (Table-5). Other factors responsible for decrease in use of kerosene are increased supply of LPG and expansion in electrification.

2.3.5. Liquid petroleum gas

Total LPG consumption in the household sector in 1991 was 85.3 thousand tons (92.2 thousand TOE), which is less than one-half percent of the total household energy consumption and 3.2 percent of modern fuel consumption.

LPG is primarily used for cooking (97.7 percent of total household consumption) while the rest is used for lighting. In 1991, only 4.4 percent of the households used LPG and averaged 121.6. kg/year (HESS, 1993).

Current level of LPG supply in given in Table-6 which show a growth rate of 9.3 percent during the period 1995-96 to 2000-01.

2.3.6 Charcoal

Charcoal is a derivative of woodfuel and is used for special purposes like blacksmithing, laundry shops for ironing where electricity is not available, *tikka*[2] shops, tea bars and for room heating. Charcoal making is concentrated mainly in plains of Punjab and Sindh provinces, where the trees like Babul (*Acacia nilotica*), Kandi *(Prospis spp.)* and Shisham *(Dalbergia sissu)* grew in abundances. As all these tree species come mainly from private forests, the conversion of wood to charcoal does not affect natural forests.

Table-5: Kerosene consumption in recent years in Pakistan

Year	Consumption (Tons)	Average retail price (Rs. Per liter)	Remarks
1995-96	613,531	8.45	-
1996-97	522,591	10.78	-
1997-98	514,088	11.91	-
1998-99	500,528	12.06	-
1999-00	478,155	13.62	-
2000-01	457,223	14.51	Rs. 16.69 per litre with GTS*

* GST = General Sale Tax
Source: Pakistan Energy Yearbook 2001.

Table-6: LPG supplies in recent years in Pakistan (Tons)

Year	Supply (Tons)
1995-96	204,641
1996-97	186,745
1997-98	206,108
1998-99	234,939
1999-00	255,839
2000-01	318,723

Source: Pakistan Energy Yearbook 2001.

Table-7: Production, consumption and prices of natural gas for domestic sector

Year	Production (million cft)	Consumption by domestic sector (million cft)	Number of gas consumers in domestic sector	Price* (Rs./thousand cft)
1995-96	566580	110103	2562613	69.30
1996-97	697763	115488	2789514	69.50
1997-98	699709	134500	2985764	79.70
1998-99	744942	181656	3170847	79.70
1999-00	818342	139973	3392979	103.11
2000-01	875433	140899	3544215	131.98

The prices are actually fixed by slots. Indicative prices of median slot of 7.10 to 10.64 mcft have been taken here, in order to depict the trend. For details see Table 3.10 page 50 of Pakistan Energy Yearbook 2001.

Source: Pakistan Energy Yearbook 2001.

[2] Barbecue

2.4. Efficiency of common fuels

Woodfuel is a cheap source of energy in comparison to other sources. In energy equivalence, about 3kg of woodfuel are equal to 1 kg of kerosene oil. In price, one kilogram of woodfuel, kerosene, LGP and dung cost Rs.2.60, 16.34, 27.00 and 0.95, respectively. The price of wood is about 12 percent of kerosene oil and 7.4 percent of LPG; but 2.75 time that of dung (Table-8).

Table-8. Comparison of efficiency of common fuels

Fuel type	Price (Rs/kg)	Colorific value (MJ/kg)	End-use efficiency (percent)	MJ of useful heat per Re. spent	Energy Cost (Rs./MJ)
Wood	2.60	15	2.25	0.87	1.49
Kerosene oil	16.34	45.6	18.24	1.12	0.89
LPG	27.0	47.8	31.07	1.15	0.86
Dung	0.95	12	1.80	1.89	0.52

Source: Adapted with modification from Siddique, K.M. et al (1997)

Superficially, woodfuel seems to be the cheapest source of energy after dung, but when looked in the perspective of useful heat energy generated and its cost, the picture changes somewhat drastically. For each one Rupee spent, the useful energy obtained becomes 1.15 MJ for LPG compared to 0.87 MJ for wood. Similarly, when we look at the cost of one MJ of energy, LPG costs just Rs. 0.86 compared to woodfuel that costs Rs. 1.49, more than 1.7 times what we pay for LPG. The investment on appliances, however, has not been accounted for in these calculations. In terms of price per useful energy, LPG and kerosene are almost at par at current price levels.

3. WOOD PRODUCTION AND SUPPLIES

The information on woodfuel supply and production in Pakistan is based on HESS (1993) study. The known sources of woodfuel supply could broadly be grouped into two main categories: forest sources (forests under the control of Forest Departments) and non-forest sources (private farmlands and wild-lands). Woodfuel supply from state-controlled forests sources has already been discussed in para 1.2.

3.1 Wood Supply From Forests

Pakistan has about 4.8 percent of its total land area under forests (4.26 million ha). The reasons for this low figure of forest area could be many. However, about 27.6 percent of this forest area is managed as productive forest to produce timber and woodfuel and the rest 73.4 percent is meant for protection of the fragile ecosystems. As already discussed in para 1.2,

average annual production from state-controlled forests is 187500 m³, which is quite insignificant when compared to total estimated production of 32.4 million m³.

Although closed for any commercial harvesting, protected forests are also used by the local communities to meet their domestic needs of fodder and woodfuel. As already mentioned in para 1.2, an unrecorded quantity of about 1.2 million m³ of woodfuel is annually removed by the locals from the state forests (Qazi, 1989).

3.1.1 Coniferous forests

Coniferous forests are distributed throughout the northwestern and western mountains of Pakistan. These forests are spread over an area of 1.959 million ha, i.e. about 43 percent of the total forest area. Their importance as the sole source of coniferous timber and the main source of timber production is well recognized.

Among the coniferous forests, moist temperate forests are very productive and are commercially harvested by the forestry organizations for the production of softwood supplies in the county. All the coniferous forests also supply woodfuel to a large number of people who are living in their vicinity, which is though large, but is not properly recorded. Moreover, woodfuel use in these areas is also very high due to harsh and long winters as well as wasteful methods of energy use. Woodfuel collection pressure, legally or illegally, on these forests is very high and is causing a gradual deterioration and depletion of the natural tree vegetation and threatens the very existence of these forests. Woodfuel tree sources are mostly conifers because of their predominance. In addition, hardwood species also form a part of woodfuel supply with oak species as one of the most preferred one.

Coniferous forests of Hazara Civil Division in the vicinity of habitations are under a very high pressure of woodfuel collection by the local people. It is estimated that each year, a total of 1.593 tons of fuel and woodfuel is collected from the reserved forests at the rate of about 1.1 tons/ha/annum. Of this 72 percent is woody and the rest is non-woody fuel. Woodfuel constitutes about 62 percent of the total growing stock and 31 percent of the annual increment (Ayaz *et al*, 1990). Therefore, these forests have limited use other than woodfuel collection. Heavy collection of woodfuel is a socio-economic problem and needs long-term planning for the substitution of woodfuel with commercial fuels and raising extensive woodfuel plantations to save the valuable forest wealth from misuse and destruction.

The Provincial Forestry Resource Inventory (PFRI) study conducted in 1995 by GTZ covered 52.9 percent of NWFP, mainly northern parts of it, where major coniferous forest resources are concentrated. Average annual firewood consumption per household was estimated to be 5.403 m³/household/year. Comparison of supply and consumption estimates indicated that the yields available for firewood and timber were covering about 73 percent of the total consumption in 1995. Thus local use of woody biomass resources in the study area exceeded sustainable supplies by 1.512 million m³. The excess use is met form the growing stock of the remaining forests. Based on the results of this study, it has been estimated that the forests may disappear by the year 2025 (Haenusler *et al*, 2000). A recent study conducted by Khan *et al* (2001) in Hilkot watershed indicates woodfuel consumption estimates of 1.13 tons (2.26 m³) per capita per annum for cooking and heating.

In order to redeem the situation the study emphasizes immediate substitution efforts for firewood energy. Out of the available options, namely oil, natural gas, coal, LPG and kerosene, the PFRI study recommends that LPG must be made available to the majority of rural households within their limits of affordability.

3.1.2 Scrub Forests

Scrub forest cover an area of 1.726 million ha, i.e. up nearly 38 percent of the total forest area. These forests comprise of low trees and shrubs and are adapted to grow under arid conditions in the foot-hills and lower slopes of the Himalayas. They extend throughout Pakistan at suitable elevations; merging downward with tropical thorn forests and upwards with the sub-tropical pine forests.

Scrub forests provide valuable protective cover to the watersheds and are not commercially harvested by the public bodies. However, these are an important source of woodfuel and fodder for the local communities. Under the situations where the Forest Department has some control over the collection and movement of woodfuel, these forests are comparatively safe. In the tribal areas of Balochistan and NWFP where the Forest Departments has no control, this important vegetation type is under heavy pressure of woodfuel collection, both for domestic and commercial purposes. In addition to the tree species, shrub vegetation also forms a considerable part of the woodfuel collected from these forests. In addition to woodfuel supply to local people, these forests in upper parts of the country, are also in use of the nomadic graziers for their forage needs in winter.

3.1.3 Irrigated forest plantations

The irrigated forest plantations are a unique forest type in Pakistan, where trees are raised under irrigated conditions because the natural rainfall is not enough to support tree vegetation of high commercial value. The first irrigated forest plantation of Changa Manga (Punjab) was established in 1866 for the purpose of production of Shisham *(Dalbergi sissu)* woodfuel for the newly introduced steam-driven locomotive system. This experiment remained successful and later on, a chain of such plantations was established throughout Punjab and in some parts of Sindh Province. Total area of these plantations is 234,000 ha forming about 5 percent of the total forest area. Most of the commercial supplies of hardwood timber and a good part of woodfuel produced in the public sector come from these plantations.

3.1.4 Riverain forests

Riverain forests cover an area of 296,000 ha constituting 6.5 percent of the total forest area. These forests, commonly known as *Bela* forests in Punjab and riverain forests in Sindh occur on the flood plains and banks of major rivers, forming the Indus Basin. Flooding for about 6 weeks appears to be necessary for their good growth. River erosion and deposition in succession are a constant feature in this forest type. Shisham (*Dalbergia sisso)* is the main species in *bela* forests in Punjab and Babul *(Acacia nilotica)* in Sindh. These forests provide the remaining part of timber and woodfuel supplies other than irrigated forest plantations in the public sector.

3.1.5 Mangrove forests

Mangrove forests occur in the Indus deltaic swamps on the coast of Karachi and Lasbela covering an area of 347,000 ha, constituting 7.6 percent of the total forest area. These forests comprise of evergreen trees of low height, further reduced by biotic agencies. Timar *(Avicennia marina)* is the dominant tree in these forests. Other tree associates are *Rhizophora mucronata* and *Ceriops tagal*. The adverse edaphic and biotic factors are hindering their natural regeneration. These forests are managed by the Forest Department for protection of coastal lines and serve as a breeding ground for fish, especially shrimps. Mangroves are a source of unrecorded quantity of wood and forage supplies to the rural communities living along coast.

According to the IUCN's socio-economic survey of 1987 along the Karachi coast, 60 percent of the people use mangrove wood for fuel daily, which is the main source of woodfuel for the

coastal population, particularly for the "poorest of the poor". The average household consumption per month is 173 kg; with maximum consumption of 800 kg (Qureshi, 2001).

3.2. Wood Supply From Non-Forest Areas

The non-forest sources are the farmlands and wild lands. Wild lands, popularly known as waste lands, may be the property of individuals, communities or the lands owned by the government but not strictly classified and managed as forests. In addition to agricultural crops, farmlands also produce woodfuel and crop residues in substantial quantities.

3.2.1 Farm lands

Farm lands cover an area of 2054 million ha or 23.3 percent of total land area of the country. Farming in Pakistan is either through natural rain or irrigation. Irrigated plains of the Punjab, Sindh, NWFP and Balochistan are under intensive agriculture. In addition to the production of a wide variety of food and cash crops, farmlands are also a major and potential source of timber and woodfuel. Farmers grow trees on the farmlands for protection and production benefits. Trees are planted on the edges of the farms in single or multiple rows as shelter belts and wind breaks, or scattered single trees, or in groups. In saline and water-logged areas, trees serve to control salinity, lower water table and improve fertility of the soil. Trees are also planted for aesthetic purposes, shade and a variety of other products. According to HESS study out of trees planted on farmlands, 36 percent were for timber, 36 percent for fuel, 18 percent for shade and 11 percent of other reasons.

These trees when harvested and sold are also a good source of additional income to the farmers. They also meet the substantial national needs of timber and woodfuel. In some irrigated areas in NWFP, parts of Punjab and Sindh, farm forestry is well footed. In NWFP hybrid poplar grown on farms in addition to meeting the local industrial timber needs is also exported to the other provinces. Woodfuel produced on farms in the Punjab and Sindh is generally more than the local needs and is sold to NWFP and Balochistan. Timber grown on farms is mostly used locally. Balochistan being deficient in wood production mainly depends for its woodfuel and timber supplies from other provinces.

Farmland trees cover about 2 percent of cultivated agricultural land. It is estimated that farmers could plant a further 8 to 10 percent of land area with trees along farm boundaries without affecting crop production. With proper choice of tree species and tree management

techniques, synergies between tree and agricultural crops can be enhanced, thereby increasing economic returns to the farmers.

3.2.2 Wild lands

Wild lands (waste lands) may fall under any climate and forest type and cover an area of about 55 million ha distributed over different provinces and territories of Pakistan (Table-9). In addition to their use as a source of woodfuel for the local people, these are also important rangelands providing forage and fodder to a large number and a variety of domestic livestock and wildlife.

Table-9. Province/territory wise distribution of wild lands

Province	Size of wild lands (million ha)	Percentages
1. NWFP	4,987	9.0
2. Punjab	7,420	13.4
3. Sindh	7,572	13.7
4. Balochistan	32,938	59.5
5. Northern Areas/Azad Kashmir	2,438	4.4
Total	55,355	100.0

Source: Siddique *et al,* 1997.

Due to heavy biotic pressure, natural vegetation is very much disturbed on these lands. The absence of any commercially important tree species, complexity of ownership and rights coupled with harsh climate, make these lands of least interest to the Forest Departments. Nevertheless, these wild lands are an important source of fodder and woodfuel to a large number of people living in and around these areas. Main use of the tree vegetation growing in these forests is for woodfuel. In addition, many of the shrubs form a considerable part of the woodfuel collected from this forest vegetation.

Mesquite (*Prospis juliflora* and *P. glandulosa),* an exotic species is coming up naturally and is fast invading whole of the dry tract of Pakistan right form the seacoast to the sub-mountainous areas. Because of its gregarious and aggressive nature, it has invaded almost all irrigated plantations, riverain forest of lower Sindh, wastelands and land along waterways, field boundaries, highways, railroads and urban and rural limits. Interestingly, the foresters had so far viewed it as a weed and efforts were made to eradicate it. Lately, however, due to its increased demand as woodfuel and charcoal, it is being considered as a resource by them.

Although, the quality of mesquite woodfuel is not so good, its availability, low price and abundance have ensured that it has a sizeable market in Sindh. A market survey conducted by

Kerio and Bhatti (2001) indicates that 24-48 percent of woodfuel and 18-55 percent of charcoal market in various cities of Sindh has been captured by mesquite.

4. WOODFUEL TRANSPORT, TRADE AND MARKETING

4.1 Collection

Supply and distribution system of woodfuels differ in rural and urban areas. In rural areas people mostly depend upon the woodfuel and other biomass collected locally. The urban people get their woodfuel supplies mainly from the traded sources. However, the size, nature and sources of supply of woodfuel and other biomass differ with the objectives of collection, namely, household use or trade.

4.1.1 For household use

People in rural areas collect woodfuel and other biomass almost freely form the surrounding supply sources that may be public forests, community forests, wastelands or private farmlands. From the public/community forests and wastelands, people mostly collect woodfuel and other biomass under some recorded or traditional rights. Under these rights, the people can remove the dead and fallen trees with the least use of cutting tools to meet their bonafide domestic needs but not for sale. During collection of woodfuel, however, the people do not observe the restrictions as laid in the legal definition of rights. In addition to collection of dead and fallen trees, they cut or heavily lop standing trees.

Woodfuel and other forest-based biomass comprises of branches, poles, split wood, cones, bark, leaves and needles. It may also include shrubs, cut or uprooted. Tree stumps felled earlier for timber production also serve as a source of woodfuel for the local population. Logging residues of all kinds (tops, branches, broken pieces, chips and bark, etc.) in the mountain forests, irrigated plantations and riverain forests are of low commercial value and are freely collected by the local people.

Biomass fuel supply from farmlands comprises of various tree parts and a variety of agriculture residues and animal waste. Landlord farmers meet their fuel need from their own farms, while tenant farmers collect it free. Landless village people collect agriculture residues freely as gesture of good will from the landlord farmers or purchase it.

4.1.2 For commercial purposes

Traded woodfuel in Pakistan comes from various sources. Important ones are farmlands, public forests and wastelands. The main source of traded woodfuel supplies in the country are from farmlands in the Punjab and Sindh. Government forests (irrigated forest plantations and riverain forests) are the major suppliers of traded woodfuel in the public sector. Their contribution in the overall woodfuel needs of the country is, however, insignificant. This is because of the low forest area under the control of Forest Department.

4.2 Systems of Woodfuel Transportation

In the trade and distribution of a commodity, transportation plays an important role for smooth flow form supply areas to the consumption centers. Means and efficiency of transportation have also an important bearing on the price and marketing. Woodfuel is a bulky material in comparison to its production and utilization value. Therefore, transportation costs make up a good part of its marketing price. The woodfuel transportation system in Pakistan can broadly be divided in the following main categories:

- Off-road Transport
- On-road Transport
- Water Transport

4.2.1 Off-road transport/extraction

This practice of woodfuel transport is common in areas that are not served by a road. Off-road transport of woodfuel is practiced mostly by the woodfuel and biomass collectors living at the fringes of woodfuel and other biomass sources. This system of transport works well for short distances (a maximum of 10 km). General means of transport are head-loads or pack animals. Carriage by head-loads woks well up to a distance of 3 km, but depend upon the age and sex of the collector, size of the load, season of the year and nature of the country. The fuel collected by head loads goes almost entirely in the direct use of the collectors. A part of the woodfuel extracted and transported by pack animals (donkeys, mules and camels) may go in informal marketing for local use.

4.2.2 On-road transportation

On-road transport – as the name indicates – is on the roads of any kind and standard. Different transport means are used depending upon the distance, value of biomass and type and standard of road. Means of transport may be mechanical or by carts., Bullock/camel carts are used in the plain country of Punjab and Sindh province for short distance transportation. Their use is, however, fast replaced by tractor-trolley: certainly a faster means of transport. In mechanical transport, different types of vehicles are employed. Trucks are used for long distance transport of woodfuel. There are about 100,000 Bedford trucks in the country. Most of these are also employed in the transportation of a wide variety of items in addition to woodfuel.

4.2.3 Water transport

Water transport of woodfuel is rather the cheapest and the oldest medium to long distance locations. It can be practiced only where a water body is available near the source of woodfuel. In large rivers in plains, woodfuel is transported with boats over long distances. In hilly regions, the woodfuel is transported in small streams in the shape of billets and splits. Transport by floating is only suited for thick woodfuel. In Sindh province, woodfuel transportation by boats is carried out over as long distances as 160 km. About 450 boats are employed for this purpose. Of these, 250 are big boats and 200 small ones. Big boats carry a woodfuel load of 40-45 tons and small boats carrying 2-8 tons.

4.3 Woodfuel Distribution

Most rural-based wholesalers obtain their supplies directly from private farmers, confirming the importance of these supply source to the woodfuel trade. Urban retailers have the shortest distribution chain and prefer to purchase from local wholesalers.

According to traders' perceptions, supply problems exist particularly for those located along the metalled roads. Unlike other commercial products, woodfuel does not have easily traceable, standard distribution routes. It is supplied from either private wood producers or government forests. Upon entry into the market, it weaves its way to the final consumer after number of intermediate levels of exchange between traders.

Nearly 90 percent of the farmers in the Punjab are critical players in supplementing woodfuel supply to traders. Wood producers generally tend to be large land-holders. There is only marginal involvement of tree producers in the woodfuel trade. Their role is primarily in woodfuel production. For marketing they mostly depend on traders. Except in Balochistan, most farmers sell their wood on a standing tree basis. The sale prices of wood producers vary on the basis of tree type and quantity sold. The prices for all the sales ranged from Rs. 125 to 1000/ton during 1991-92, with an average price of about Rs. 450/ton. Babul *(Acacia nilotica)* prices were the lowest, fetching about Rs. 350/ton, while assorted pieces of other species fetched roughly 50 percent higher prices; Rs. 530/ton. Mostly the provinces are self sufficient in woodfuel supplies except Balochistan, where woodfuel is drawn mostly from the neighboring Sindh province.

4.3.1 Distribution System of Woodfuel in Hilly Regions

In hilly regions the woodfuel trade and distribution system depends on whether it is collected locally or obtained from outside. The locally collected woodfuel (head-loads) goes direct in the domestic use of collectors. However, some locally collected wood may go to the nearby towns and sold in the bazaars. The sale price is decided through direct bargaining. In some town markets, locally collected woodfuel is brought by means of pack animals or mechanical transport and is sold to the retailers mostly on load basis. Retailers further sell it to the consumers on the basis of weight.

Most of the traded woodfuel in the urban and rural markets in the hilly regions come from farmlands and forest areas in the plains bordering hill regions. Farmers act as producers selling woodfuel direct or through a middleman to the retailers, wholesalers and transporters. Forest Department sell woodfuel to the wholesalers, transporter and retailers through open auction of standing trees or converted material.

4.4 Woodfuel Trade

Trade and marketing of woodfuel in Pakistan is free and well organized, working under the dynamic principles of supply and demand. Woodfuel trading businesses are generally small-scale that remain open year round. The number of woodfuel businesses pertaining in the country is about 40000. Of these, about 32 percent operate in urban centers, 52 percent in rural areas and the remaining 16 percent are located along metalled roads. Retailers dominate the

woodfuel market and constitute about 91 percent of the total. Three types of traders can be distinguished in Pakistan: assemblers; wholesales; and retailers

4.4.1 Assemblers

The assemblers purchase standing trees from the individual farmers. They also participate in wood auctions of the govt. agencies, where they may purchase standing trees or converted material. The farmers have no experience to estimate the volume, nor the tools to do so. Moreover, they have hardly any knowledge of market prices. As a result the assemblers, having a kind of monopsony in the area, benefit from the situation.

The assembler fells, cuts, converts and transports the trees at his cost. Some assemblers have their own sale depots in the city or at the roadside, where they stock the timber as well as woodfuel. Some of them also make charcoal from the wood.

Transportation is the major item of cost, involving 30-40 percent of the total cost. The profit of the assemblers ranges from 17-20 percent of sale price. The profit range increases to 35 to 50 percent of the sale price in the case of charcoal making.

4.4.2 Wholesalers

In Pakistan the wholesalers are concentrated along the roadsides, thus indicating the over-riding importance of transport factor in their business. Sometimes they themselves also act as retailers simultaneously. The profit margin of the wholesalers is estimated at 8-18 percent of the sale price, depending on the areas in which they are conducting their business.

4.4.3 Retailers

Retailers are situated close to their clients (consumers), indicating the over-riding importance of proximity to the end-use market. The profit of the retailer is estimated as 13 to 20 percent of sale price in various regions of Pakistan. Seasonal variations in supply-demand structure of woodfuel trade are more pronounced for retailers, whose summer trading activity drops to approximately 38 percent of winter sales.

It is estimated that the producer receives a share of about 50 percent for the cut woodfuel at the farmgate.

4.5 Woodfuel Marketing

In Pakistan about 41 percent of the total woodfuel consumed is traded on the market, whereas more than half of the woodfuel is not traded and is either collected or produced for own consumption. Figure 1 presents the existing wood fuel marketing structure in Pakistan, and the manner in which it flows from the producers to the consumers.

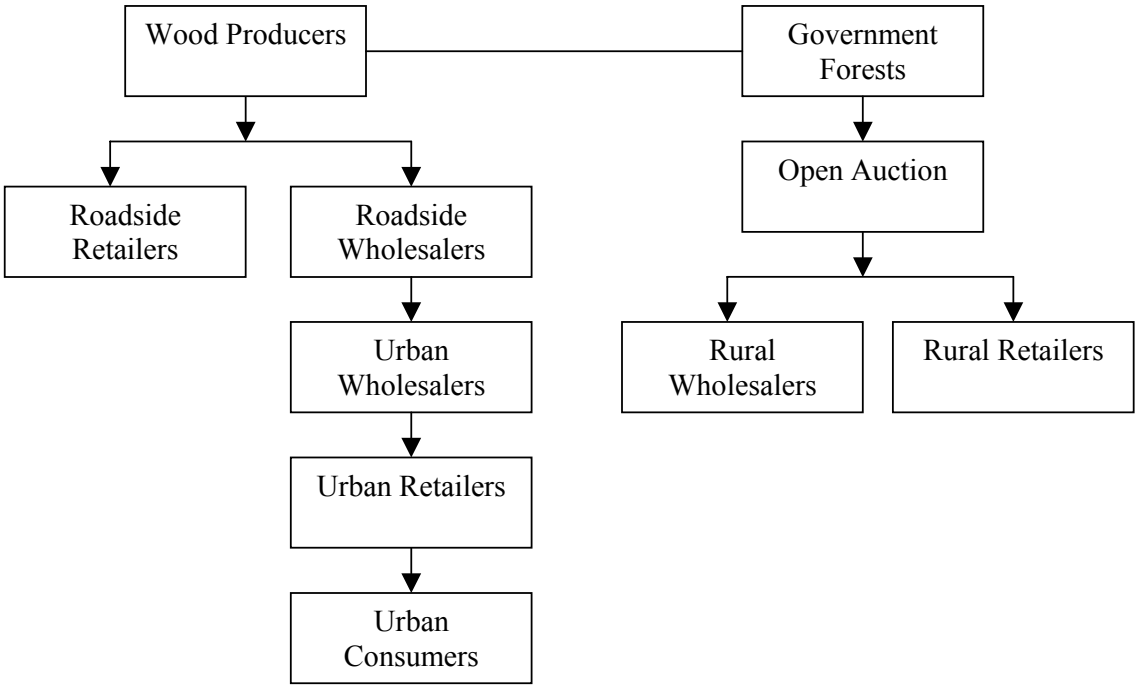

Figure 1. Monthly wood flows during winter 1991-92 (Source: Haider, 1996)

5. CONTRIBUTION OF WOODFUELS TO THE COUNTRY'S TOTAL ENERGY SUPPLY MIX

Pakistan is deficient in energy supplies because of poor development of domestic energy resources. As shown in Table 10, the total energy consumption both form commercial and non-commercial sources in the country was estimated as 32.205 million tons of oil equivalent (TOE) during 1994-95 (Siddique 1996). The per capita consumption of commercial energy during the same year was 11.44 GJ that showed a very slow growth of only 0.97 GJ over a period of 15 years since 1980-81. The increase in per capita energy consumption is due to

expansion in the industrial and transport sectors. However, per capita energy consumption in Pakistan is very low in comparison to many other developing and industrialized countries. The per capita energy consumption from commercial sources in Pakistan during 1982-83 was ½ of the average for low-income developing countries, 1/9th of the world average and ¼ of the USA averages. During 1994-95, the total energy consumption in the country showed a growth rate of 3.9 percent per annum, which is not very high if population growth rate of almost 3 percent is taken into account.

Table-10: National Energy Consumption by Source

(Thousand TOE)

Source	1980-81	percent	1994-95	percent	percent of Total for 1994-95	Avg. annual growth rate (percent)
Commercial	10.868	55.6	20,355	63.2	63.6	4.9
Oil	4,267	21.8	9,667	30.0	30.3	6.5
Gas	3,200	16.4	6,082	18.1	19.7	5.0
Coal	691	3.5	1,562	4.8	4.0	6.5
Electricity	2710	13.9	3,044	9.5	9.6	0.9
Non-commercial	8660	44.4	11,850	36.8	36.4	2.4
Wood	4,939	25.3	6,506	20.2	19.9	2.1
Agriculture residues	3,721	19.1	5,334	16.6	16.5	2.8
Residence						
Total	19,528	100.0	32,205	100.0	100.0	3.9

Source: Siddiqui (1996)

6. IMPROVED STOVE PROGRAMME

The Pakistan Council of Appropriate Technology (PCAT), now renamed as Pakistan Council of Renewable Energy Technology (PCRET), has developed improved designs of both cooking stoves and aluminium cooking utensils, which have reportedly achieved an overall fuel saving of 40-50 percent over the traditional patterns (stoves 30-40 percent; utensils 10 percent).

The traditional stoves are estimated to have a heat use efficiency of 6.5 percent. The improved design stoves are of different sizes and are constructed on-site from a mud mixture of clay, sand, animal dung and straw. A family member at little or no cost can easily construct them, which is an added benefit. Chimneys can be fitted as required, although this tends to reduce efficiency slightly. The mud stoves are more popular due to their low price compared to metallic ones.

The GTZ/GOP Fuel Efficient Cooking Technologies Project, 1984-93, based in Peshawar, has also carried out the development and promotion of the use of more fuel-efficient cooking stoves. More than 25000 stoves have been distributed by the project. The technology has now been picked up by the manufactures in private sector and the stoves are now readily available in the market.

The metal multi-pot stoves, developed by the project are said to have an efficiency of 20-40 percent depending upon operational conditions and the expertise of the cooks. Although the acceptance of these improved stoves is encouraging, the main constraints to a much wider use are:

- The current price of Rs. 130 –150 per unit is a significant amount for many of the lower income households, although it is not suggested that their cost be subsidized in any way;

- Their effective life is only 12-18 months maximum, after which they require replacement;

- All woodfuel used must be chopped into small pieces which is a laborious task for the women, and the stoves require more frequent feeding with fuel than with traditional cooking methods;

- Perhaps the women who use the stoves are less concerned with the fuel savings than the male household heads, who have to actually pay for the fuel.

The use of commercial or communal bakery ovens *(tandoor)* can save up to 60 percent of the woodfuel needed when individual families prepare their own *nan* bread. The improved design bakery oven developed and promoted by the project costs Rs. 700-1200 to construct and is more fuel-efficient (up to 30 percent) than the traditional design. It is understood than some 700 ovens have been established for the Afghan refugees, plus another 1000 for rural Pakistani populations during the 7 years of the project.

According to an Impact Analysis Paper dated April 1989, the GTZ project calculates that its bakery programme alone saves over 3.2 million kg of wood (approximately 4571 m^3) per month.

Presently Fuel Saving Technology (FST) Project being implemented by the Pakistan Council for Renewable Energy Technology (PCRET) is working on dissemination of fuel-efficient cooking stoves.

7. SOCIO-ECONOMIC IMPORTANCE OF WOODFUEL PRODUCTION, UTILIZATION AND TRADE.

7.1 Contribution In Agricultural Production

Leach (1993) has carried out an extensive review of the economics of farm tree production, under the HESS. The results of these investigations indicate that the trees on farms are either scattered or arranged in rows typically along field boundaries, where they cause minimal competition with the agricultural crops, especially if they are well spaced and harvested on short rotations. However, the farmers generally plant rather small number of trees; 73 percent of farmers planting fewer than 20 each and a further 14 percent planting 21-50 trees (average:37).

On this small scale, trees are only a minor part of the main farm enterprise. They hardly occupy 2 percent of the field area. As such they do not significantly displace other crops. The commercial benefits from this form of tree growing should, therefore, be regarded as a supplement, not as an alternative, to the income from conventional agriculture.

Trees are harvested at six years since this is the rotation, which gives the highest annual revenue when revenues are discounted at 10 and 15 percent. When no count is made for land rents, one hundred border trees give a discounted annual revenue of 5 to 6 percent of the net returns from cotton-wheat double cropping, the most profitable crop combination. For rice wheat and sugarcane the return from the trees are much greater at 10-11 percent and 16-17 percent of the discounted revenues from the crops (Leach, 1993).

However, when land rents are included (and a 15 percent discount rate is applied) the income from trees becomes relatively much greater. The annual revenue from the trees increases to 10 percent of the returns from cotton-wheat and 60 percent from rice-wheat, while returns from sugarcane are found to be negative if land rents are included in the cost (Leach, 1993).

7.2 Impact On Rural Income And Employment

The benefits of farm trees become even greater when one considers that much of the wood from trees grown on this fairly small scale will be used by farm households as fuel, particularly when one prices their wood production in terms of firewood which would otherwise have to be purchased. On this basis even a few border trees can provide very attractive savings on family budgets and perhaps also a source of income from firewood sales to neighbours and village firewood traders.

A further important factor for small farmers, who are typically less able than large farmers to diversify their crop and livestock patterns, is that trees have a much lower risk of failure in bad crop years, because of drought and other problems. Trees sales can also be postponed for a year or more if wood prices are low or income from other sources is sufficient; a strategy, which obviously cannot be used for crops. For the small farmer particularly, owning even a few trees can be an important risk reduction strategy and a form of living bank, which provides a means of raising cash when it is needed.

The average farm in the HESS survey obtained 5.6 tons of wood per year from their own trees, including 3.2 tons of woodfuel. This is substantially more than the 2.5 tons of woodfuel consumed by the average household, thus indicating that many farms are self-sufficient in woodfuel and may produce a small marketable surplus.

Woodfuel trading businesses also generate lot of employment. About 72,000 people were working on permanent basis during the winter of 1992: roughly 87 percent in retail trade. A further 27,000 people were employed as part-time staff. Altogether, 99,000 people were engaged in wood markets: about one out of every 1,185 people in Pakistan.

7.3 Key Enterprises And Industries Dependent On Woodfuels

Rural industries rely heavily on wood and /or agricultural residues. However, it is extremely difficult to delineate specific use of wood, agriculture residues and other biomass since the prime factor for determining the use is the “availability” and cost. Rough estimates of woodfuel and other substitutes consumed in village rural industries and village applications of Pakistan with their specific energy consumptions are given in Table-11.

Table-11: Estimated biofuels use by rural industries and village applications

Rural Industry/Village Application	Specific energy consumption (Kg/unit product)	Amount of wood or equivalent (1000 tons)	Remarks
Brick making	0.5 Kg/brick	6,170	(1)
Lime manufacturing	2.3 Kg/kg lime	125	(1)
Pottery making	--	20	--
Khoya[3] production	10 Kg/kg *khoya*	1,750	--
Tobaco curring	8 Kg/kg dry tobacco	770	(4)
Turmeric curing	0.87 kg/kg dry turmeric	20	--
Groundnut curing	0.25 kg/kg cured groundnut	14	--
Black smithy	--	240	(3)
Gold smithy	--	4	(3)
Dyeing and washing	--	12	--
Silk cocoon processing	15 kg/kg dry cocoon	4	--
Local medicine making	--	2	--
Rural bakeries and ovens	0.29 kg/kg chhohara	76	(4)
Food vending and restaurants	--	100	--
Animal fat processing	--	3	--
Chhohara[4] making	--	6	--
Pop corn and gram roasting	--	60	(1)
Road tarring	--	8	--
Treatment of fishing nets and boats	--	3	--
Hammam's (bath)	--	1	--
Water heating in mosques	--	60	--
Social ceremonies/occasions	--	1,000	--
Gur making	2 kg/ 1kg gur	3400	(2)
Total for all activities		12848	--

Source: Qazi (1989) and updating by the consultant

1. Woodfuel and/or woodfuel substitutes.
2. Bagasse used instead of wood.
3. Woodfuel, converted in charcoal using a recovery factor of 25 percent
4. Estimated specific energy consumption.

If the *bagasse*[5] fuel used in *gur* making is excluded from the above calculations, total woodfuel consumption in rural industries is reduced to 9.45 million tons. Latest estimates of industrial woodfuel consumption conducted by FSMP and HESS in 1991-92, however, report 2.95 million tons and 3.1 million tons per annum, respectively. One reason for the discrepancy

[3] A kind of sweet prepared from milk.
[4] Unripe dates soaked in boiling water and dried.
[5] /Sugarcane fibre/left-over after extraction of juice from it

could be that some of the commercial sectors indicated in Table-11 might have been excluded in the latter surveys.

7.4. Foreign Exchange Savings Due To Foregone Importation Of Petroleum Fuels

The HESS estimates of consumption of traditional fuels are of the order of 17,185,478 TOE per year with the following detail:

Type	Quantity (TOE)
Firewood	10,637,394
Charcoal	118,999
Dung cake	3,613,187
Crop residues	2,815,898
Total	**17,185,478**

End-use efficiency of wood fuel is 15 percent, which will improve to 40 and 65 percent in case of its substitution with kerosene and LPG, respectively, or an average of 50 percent, implying that the requirement for traditional fuels will be halved to 8,592,739 TOEs or 8.326 million tons of kerosene.

Thus, on the basis of an average price of Rs. 16.34 per liter of kerosene, and exchange rate of Rs. 60 to one US$ total value of bio-fuels, in terms of import substitution comes to US$ 269 million. The import substitution effect, however, may not be as simple and straight forward as depicted here, because a number of externalities have not been accounted for.

8. ENVIRONMENTAL AND HEALTH IMPACTS

The use of biomass fuels in household cooking dos not concern for desertification and soil erosion, because relatively small faction of land area in Pakistan is devoted to forestry. Thus deforestation *per se* may not be as important as the issue of land and resource management generally (Campbell, 1992). However, as woodfuel becomes scarce in relative sense, households resort to using larger quantities of crop residues and dung. The use of these biomass resources as fuels results in flow of nutrient away from soil and leads to environmental degradation.

Because of the high component of biomass and petroleum fuels in the household energy sector, developments in household energy have clear-cut implications for green house gas

emissions and global warming. Total net emissions per cooking task have been found to be highest for charcoal, followed by natural gas, kerosene and coal. For wood, the net carbon effect depends upon whether or not the wood is sustainably managed or not. If it is sustaibably managed, the use of wood represents no net carbon emissions. If wood is not drawn from sustainbably managed supplies, then the net carbon emission effect is caused (Hoiser, 1993).

In the context of Pakistan, biomass fuels make less of a net contribution to green house gas emissions than do petroleum fuels. If they can be produced sustainably instead of from the harvesting of old growth trees, the uses of biomass fuels are environmentally benign in this regard.

An environmental problem of different sort, that of indoor air pollution due to the combustion of biomass in cooking has already aroused concerns. Emission from wood fires can be at least 10 times greater than particulates from oil and gas fires, and cause lung and eye diseases and may even be a carcinogen. It is also well known through some studies done in India that toxic fumes emitted by ordinary cook stoves used in the common households in villages, are very hazardous to the cooking women. The studies have suggested that these fumes impart toxicity levels equivalent to smoking upto several packs of cigarettes a day (Masihuddin, 1991).

9. FORESTRY EXTENSION PROGRAMMES

A number of forestry extension programmes have been executed in the country. Profiles of important projects are summarized over here:

9.1 Malakand and Dir Social Forestry

The Malakand and Dir Social Forestry (MSFP), covering Malakand and Dir districts of NWFP was implemented in various phases for a period of ten years (1987 to 1997). The project sought to reforest denuded hills and marginal farmlands, raise the standard of living of local communities and build the extension capacity of the local forestry agency. The project's activities focused primarily on private and communal lands. A key part of the project was Village Land Use Planning (VLUP) process, involving step-by-step approach for preparing on action plan. The project has fostered greater capacity and confidence among the provincial Forest Department staff to implement social forestry strategies.

9.2 Kalam Integrated Development Project

Kalam Integrated Development Project (KIDP) was an area development project, covering the whole of Kalam and Behrain tehsils in the north of Swat. KIDP started in 1981and its fourth phase ended in 1998. The main aim of the project was to "improve the socio-economic conditions of the population in the project area through people's participation in forestry, agriculture and village development, taking into consideration the ecological, social, economic and institutional sustainability of all means and activities at all levels". The project identified various factors as exerting heavy pressure on the natural resources: increased population pressure, change from subsistence to cash crops (e.g. off-season vegetables), increasing number of grazing cattle, and the fast growing tourist industry.

During 1993-95, the main focus of the project was to strengthen village organizations, channel income generation activities, and develop close interactions with the service delivery departments. The second important task was to streamline innovations in forestry, agriculture and human resource development.

9.3 Siran Forest Development Project

Siran Forest Development Project (SFDP), was located in the Hazara Civil Division of NWFP and extended to most of the Siran Watershed. It evolved out of a series of collaborative activities initiated by the NWFP Forest Department and GTZ in the early 1980s to respond to deforestation. While the initial project involved road building, nursery establishment, timber harvesting and field staff training, by 1991, the SFDP began to adopt a joint forest management approach. This strategic shift emphasized forest management in collaboration with local people, dealing with both state-owned reserve forest lands as well as communally managed private (*guzara*) forest lands.

SFDP is the first project in Pakistan to adopt joint forest management. New legal rules at the provincial level allow local people living near state-owned forests to be involved in their management. A joint forest management committee brings landowners and tenants together to prepare a management plan, execute harvesting operations, control uses and resolve conflict. JFM Committee members maintain an agreement with the provincial Forest Department to harvest firewood, timber, fodder, and medicinal plants.

9.4 Aga Khan Rural Support Programme

Aga Khan Rural Support Programme (AKRSP), one of the largest NGOs in Pakistan, was established in 1982 to work in the Northern Areas. Today it covers three districts; Gilgit, Baltistan and Chitral and has formed more than 1,500 Village Organizations (VOs) and almost 1,000 Women's Organizations (WOs). The broad objective of AKRSP is to *"...increase the capacity of local people to identify and utilize opportunities and to solve their own problems, so that they can plan and implement development programmes leading to increased incomes and employment; to improve health, nutrition, education and living conditions; and to improve the sustainability and productivity of the environment".*

In aiming to secure economic, social and environmental objectives, AKRSP has always embodied a sustainable development approach. The key to AKRSP's approach is the VO – a broad-based coalition of all those village residents whose common interest is best served by forming a multi-purpose development organization. The VO is the executing agency for all village-level projects sponsored by AKRSP and its collaborators.

9.5 Watershed Planning and Management Project

The primary objective of Watershed Planning and Management Project (WPMP) is to plan and implement programmes for the rehabilitation of seriously degraded watersheds, particularly in northern Balochistan. WPMP is part of the Integrated Area Development Programme (IADP) that integrates the ongoing development efforts and inputs of UNDP/FAO and the Government of Balochistan. The IADP is expected to cover 380 village communities in five districts with an estimated beneficiary population of almost 700,000 people. WPMP will implement all watershed rehabilitation works on IADP sites, in close co-operation with two other FAO-UNDP projects: the Integrated Range-Livestock Development Project and the Feed Resources Development Project.

The project emphasizes the preparation and implementation of management plans for watershed rehabilitation. Upland grazing and agricultural lands will be managed and rehabilitated; and improved land-use practices will be promoted, which may compensate for a considerable proportion of the present overuse of groundwater. It is envisaged that, through these, and dune stabilization works, contour ridging, construction of earth dams, spreading of seeds of indigenous grasses and planting of fodder shrubs on gravel out-wash, the project would assist in achieving improved vegetation cover, increased fodder supplies, increased groundwater recharge, and reduced damage by run-off and moving sand dunes.

9.6 Suketar Watershed Management Project

The Suketar Watershed Management Project (SWMP) is a development project jointly undertaken by the Government of Azad Jammu and Kashmir (AJK), UNDP and FAO. The World Food Programme provides project support in the form of food commodities that are used to help pay for labour required by the project. The project focuses on Suketar Watershed located in Mirpur District.

The project area is a typical example of the highly eroded watersheds of AJK. It is located in the sub-tropical, semi-evergreen vegetation type, but has been stripped of trees and grasses to meet grazing and fuelwood requirements. The main objective of the project is to reverse the process of land degradation and soil erosion in the Suketar Watershed through sustainable production of food, fodder, timber and fuelwood, involving public motivation and education through extension services, practical demonstration for better land-use, participation of the local people and strengthening the Forest Department of AJK.

9.7 Sindh Forestry Sector Development Project

Main objectives of Sindh Forestry Sector Development Project (SFSDP) are: (i) to build up Sindh's forest resources to help meet the acute shortage of fuelwood and timber in the province; and (ii) to improve the quality of the environment through afforestation to stabilize river flood plains (mainly along the Indus) and to reduce damage to crops and communities caused by flood waters, strong winds and high temperature. The project pursues a sustained-yield system of management, whereby harvest of mature trees is followed by replanting and/or provision for natural regeneration. It covers, *inter alia,* about 10 percent of Sindh's existing riverain and inland forest resources identified as urgently requiring rehabilitation. The main components are as follows:

- Social Forestry: Assistance to farmers by establishing private farm wood lots and tree plantations in shelter belt areas, on eroding embankments and along waterway covering 12,000 hectares. The project provides assistance in the form of seeds and seedlings and technical advice on site selection.

- Rehabilitation of Government Reserved Forests: Rehabilitation of 21,000 hectares of selected forests which are seriously degraded due to lack of regular water supply and silvicultural treatment.

- Institutional Support: Strengthening of the institutional capabilities of the Sindh Forest Department (SFD) through the provision of staff training, research facilities, and consulting services.

- Private Sector Credit Component: Provision of credit on a pilot basis for private sector participation in the development of upto about 3,000 ha of selected Government Reserved Forests, in combination with the production of agricultural corps and/or industrial wood. However, this component has now been dropped because of government restrictions on lease of state land.

9.8 Forestry Planning and Development Project

Farm forestry in Pakistan received a major boost from the USAID-funded Forestry Planning and Development Project (FP&DP). The project operated from 1983 through 1994 with a primary goal of helping increase Pakistan's indigenous energy supplies, while improving the condition of the country's forests. The project largely dealt with private property, either individually or communally held, rather than state land with a strong emphasis on farm forestry.

The project was careful to emphasize public participation in assessment, planning, implementation, and monitoring. It is, however, reported that intra-village conflicts, especially those between landowners and tenants became important issues. The project contributed to a marked development of farm forestry extension programs within provincial Forest Departments. In addition, the project reported assisting with the establishment of 5,000 private farmer nurseries, producing over 150 million seedlings, and training 20,000 farmers. This USAID Project worked extensively with NGOs, funding 70 organizations involved in farm forestry and natural resource management, and reforested 5,000 hectares in Pakistan.

While FP & DP made a significant contribution in placing farm forestry and extension strategies on the agenda of many provincial Forest Departments and NGOs, the project was less successful in being proactive "in formulating and directing a farm forestry policy agenda for Pakistan". While some policies had been revised by 1998, the new laws and administrative regulations to implement a national farm forestry strategy have not been forthcoming. Nor has there been significant progress in creating "coherent incentive structures, and associated regulations and co-ordination with the agricultural departments".

9.9 NWFP Forestry Sector Project

The Forestry Sector Project (FSP) was launched in 1996 with the collaboration of the Asian Development Bank, Government of Netherlands and Government of Pakistan in NWFP. The project aims at enhancing productivity of public, private and communal lands with the active involvement of the local population. It is to be achieved through an elaborate process of institutional reform so that the Forest Department replaces traditional approaches with participatory ones. This also necessitates active involvement of all the stakeholders.

The project builds upon the experiences of the MSFP. Thus the VLUP is central to the organization of the communities at the village level. During current phase of the programme, 35 Integrated Resources Management Plans (IRMPs) and 423 VLUPs are to be developed, of which 20 IRMPs and 40 VLUPs have been finalized and work on their implementation has been started.

9.10 Environmental Rehabilitation in NWFP and Punjab

The Environmental Rehabilitation in NWFP and Punjab (ERNP) is being financed jointly by the Government of Pakistan (GOP) and the Commission of the European Communities (EEC) for a period of seven years from 1997 to 2003 in three upland locations, namely: Dir-Kohistan and Galiat in NWFP, and Murree-Kahuta in Punjab. The Project aims at halting and reversing ongoing processes of environmental degradation through integrated measures of conservation of natural resources and sustainable socio-economic development involving community mobilization and social organizations.

9.11. Tarbela Watershed Management Project

Tarbela Watershed Management Project (TWMP) was started on pilot basis in 1964-65 to retard soil erosion on private lands through afforestation, check damming and terracing with a view to reduce sedimentation of Tarbela reservoir. The project was expanded in scope during 1971-72 with the collaboration of Water and Power Development Authority (WAPDA) and World Food Programme (WFP). Second phase of the project started during 1993-94 with collaboration of the Govt. of Pakistan, WFP and KfW (Germany). This phase terminated on June 2001.

Achievements of the project include afforestation over 432,000 acres; distribution of 5,000,000 fruit plants; improvement of 11325 acres of rangelands; terracing of 4400 acres of

agricultural fields; repair of existing terraces over 8100 acres; construction of 311 kilometers of jeep roads and 931 kilometers inspection paths; check damming over 266,000 acre; consumption of 727 kilometers water courses and 159 water ponds.

10. POLICY REVIEW

The following legislations are pertinent:

a. Punjab.

i. The Pakistan Forest Act 1927
ii. The Punjab Land Preservation (Chos) Act 1900.
iii. Guzara Rules of Rawalpindi District.
iv. The Cutting of Tree (Prohibition) Act 1975.

b. Sindh

i. The Pakistan Forest Act 1927.
ii. The Cutting of Tree (Prohibition) Act 1975.

c. NWFP

i. The Pakistan Forest Act 1927
ii. The NWFP Hazara Forest Act, 1936
iii. Hazara District Protected Forest Rules 1973
iv. The Cutting of Tree (Prohibition) Act 1975

d. Balochaistan

i. The Pakistan Forest Act 1927.
ii. The Pakistani Balochistan Forest Regulation 1890.
iii. The Cutting of Tree (Prohibition) Act 1975.

e. Northern Areas.

i. Gilgit Private Forest Regulation 1970
ii. Gilgit Private Forest Rules 1970

The forest laws were enacted long ago. These were adequate at the time of their enactment because:

a. Population levels were low;
b. Living was simple and the needs of the local inhabitants were limited.

c. Markets for timber did not exist near the source of production, i.e. forests;

d. People were law abiding; and

e. Law enforcement was easy and effective

This forest legislation is no longer effective under the changed conditions and circumstances. The reasons are numerous but a few deserve special mention. Human and livestock population have increased manifold, rights and concessions of individuals have multiplied and price of timber has appreciated so much that wood is now much more costlier than other items of daily use. Forests are exposed treasures, within the grasp of greedy and unscrupulous persons who have scant respect for the law. The existing forest legislation is no longer adequate to protect and safeguard the forests and to promote expansion of forest resource (Jan, 1992).

Accordingly efforts are underway to develop new laws, which are in line with the present day requirements and ground realities with more emphasis on participatory forest management. One such example is in case of North West Frontier Province (NWFP), where all the existing forestry related laws have been revised and combined into one legislation, namely, NWFP Forest Ordinance, 2001. However, over-riding emphasis remains on timber production, rather than on woodfuels and other non-wood forest products. One important policy shift noticed in the new legislation is that the emphasis of management has non shifted from generation of revenue for the state towards meeting requirements of the people.

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