The Wood Shortage in Pakistan: Hypothetical Contradictions

Charles W. McKetta, *Consulting Forest Resource Economist, GOP-USAID Forest Planning and Development Project*

The Malthusian Premise

Pakistan is a country with one of the highest rates of population growth in the world. Its current population of 104 million was expanding at 3.08% between 1980 and 1985 (World Resources Institute 1986). The Indus Valley is irrigated and heavily cultivated, but due to aridity elsewhere, Pakistan has one of the lowest forest areas of any country in the world. Forests cover from 4.0 to 5.1% of the total land area according to different sources, although the Pakistan Statistical Yearbook (Federal Bureau of Statistics 1989) shows 2.9 million hectares (3.6% of total and 5.1% of reported land area). This compares with averages in Asian countries of 21%, Africa of 23%, North America of 32% and South America of 53% (World Resources Institute 1986).

Many observers automatically invoke a Malthusian resource futures model for developing nations. This holds that populations rise exponentially over time and that increasing people need the same per capita resources so that resource consumption also rises at the same exponential rate. This puts increasing pressure on fixed food and fiber production capacity so that standard of living, quality of life and condition of primary natural resources (especially nonrenewable or slowly renewable components) all decline, eventually reaching a point where the system is incapable of providing the necessary minimum requirements for existence. This point is called omega.

The combination of high exponential population growth and initial low or depleted resources accelerates the Malthusian prediction into a terrifying premonition of a country's future. Pakistan 3.1% population growth implies a doubling of population in 23 years and the 4% forest coverage suggest little renewable biofuel or fiber resilience. The relevant question for such a country is how long before omega, how to avoid omega, or in some cases, whether the simple Malthusian assumptions actually hold in all resource sectors.

Although the last scarcity question is the least asked, it is the most appropriate starting point when evaluating a society's resource condition. Does the Malthusian Hypothesis hold? Economic indicators, not physical models, are the definitive tests of whether increasing or decreasing resource scarcity exists.

Pakitan's Wood Production

There are three primary sources of wood in Pakistan. These are imports, public sector forests and private farm forests. Imports are significant and averaged 852 thousand cubic metres per year from 1982 to 1986 (Amjad and Khan 1988). Of this, only about 10% of the volume and 6% of value is solid timber. Most, 91% of value, is pulp, paper, and paperboard. Imports of the pulp and paper component have been rising 12.2%/year since 1975.

The public sector forests are principally managed to produce large coniferous cants from relatively slow growing montane reserve forests on long rotations and high value hardwoods on irrigated plantations for use in the furniture and sports equipment industries. The average annual harvest was 306 thousand cubic metres from 1982 to 1986. Although fuelwood might be considered only a by-product of a timber oriented forest, its volumes are significant, averaging 205 thousand cubic metres per year (Amjad and Khan 1988). Most of the fuelwood officially sold goes to urban markets, but the volume collected by local residents may be twice this amount (Khattak and Amjad 1980).

Private farms produce fuelwood, construction wood, and specialty products wood from fast growing block and linear plantations. These are intermingled with agricultural lands throughout the irrigated and dry crop zones of the low elevation Indus river system. There is no measurement of farm wood harvests, although Amjad and Khan (1988) multiplied an estimated per capita timber consumption of 0.0239 m^3/capita by population

to estimate nation-wide consumption. From this they subtracted known public sector production and imports to derive farm timber availability figures. Although this technique is seriously limited by the assumption of a fixed household consumption rate, timber from the farm sector may be 1.2 million m^3/year (51% of total timber production).

Skeikh (1990) used consumption estimates to place total timber production at 2.67 million m^3 annually, and estimated that fuelwood production may be 22.40 million m^3. Private lands which are unmeasured may provide 85%, perhaps 20.16 million m^3 from average consumption, of this production.

Pakistan's Wood Consumption

Wood, especially fuelwood, is a resource of great concern in Pakistan, but estimates of Pakistan's nationwide current annual wood consumption volume are approximate and no time series data are available. Forecasts of future wood consumption typically rely on a population driven Malthusian logic and various omegas are predicted. Direct household use is expected to increase and industrial fiber use could expand to offset pulp imports. This hypothesis expects wood demand to grow faster than population rates to create a wood supply "crisis" sooner than the 23-year doubling that a 3.1 % annual exponential growth rate implies.

At least two studies have used this logic. Ahmed (reported in Mathtech 1988) combines a 0.04 m^3 per capita fuelwood requirement with population growth to predict 56 million m^3 annual fuelwood consumption by 2008. The plantation area necessary to provide that volume would be approximately 2.8 million hectares. This implies an unlikely conversion to fuelwood of 14% of all the cultivated land in Pakistan. Sheikh (1990) used a similar approach to estimate 30 million m^3 by 2000. The two estimates are consistent and use the same constant population growth rate assumption and constant per capita use consumption. Both imply a near future omega.

Consumption-Production Relationships

One materials balance approach suggests that the Pakistani wood omega may have already occurred. Siddiqui 1990, found in three separate districts that necessary consumption already exceeds production by from 33% to 85% of population-based consumption levels. Immediate shortages would presumably compound with time and increasing populations.

As production has to equal consumption in equilibrium, a calculated wood shortage imbalance would suggest one of the following events: (1) inventories are indeed being depleted, (2) there are missing transactions or measurement errors, (3) the normative estimate of consumption needs exceeds actual consumption behavior, and/or (4), that a narrowly defined wood balance may ignore potential substitutions in sources or uses.

The Pakistan Forest Service and many international agencies, including the GOP-USAID Forestry Planning and Development Project, have based their forestry, social forestry, and agroforestry programs on the supply side of the increasing scarcity premise. There is considerable effort directed at increasing the growth and availability of forests, particularly to increase domestic fuelwood. The assumptions behind this scarcity premise must be tested and understood if these programs are to achieve their objectives.

Testing the Malthusian Premise

What if, however, the simple Malthusian assumptions were changed to represent development conditions that have been witnessed elsewhere? What if population growth were sigmoidal instead of exponential? Instead of fixed per capita consumption, what if people used less wood as it became more scarce and expensive or they used less as they became more wealthy and more educated? Finally, what if the availability of alternative fuels was not constant but increasing?

If any of the Malthusian assumptions fail to hold, the future wood use picture for Pakistan could be radically different from the extreme wood shortage that is currently predicted. Rather than resimulate the wood future with revised assumptions, in this paper, I make inferences from the economic behavior of the wood and related sectors. These inferences are based on empirical techniques that use historical trends to test whether the Malthusian model has been functioning and we may infer from the results how well that model might function in the future.

Wood and Other Sources of Domestic Energy

The fuelwood energy focus of forestry development projects is understandable. In Pakistan household energy is primarily from bioenergy sources particularly in rural areas. A study reported by Siddiqui (1990) of four districts in the NWFP Punjab provinces shows that fuelwood is the largest component of household energy use (Table 1:)

Table 1
Rural Household Fuel Consumption

Energy Source	*%*
Fuelwood	40.3
Fuelwood with dung	35.3
Dung only	08.0
Kerosene	01.9
LPG	01.9
Mixd fuels	12.6
Total	100.0

The purchased fuel consumption pattern is sharply different between rural and urban areas as shown in table 2. Even though rural households may gather much of the fuel they use, they still spend 51% of their cash energy budget on biofuels. They are almost three times more dependent on purchased bioenergy (wood and dung) than urban households. The urban household energy sector is currently only 21% wood dependent, second to electricity (35%) and only slightly ahead of gas (19%). Biofuel dependence could decline with urbanization and increasing per capital incomes. Regardless of arguments about the renewability of various fuels, this difference provides the first hint that Pakistan's energy future might not be as wood dependent as many expect.

Table 2
Household Expenditures on Fuel and Lighting 1985-86

	Pakistan	Rural	Urban
Amount Rs./month	103.52	96.52	121.66
Percent spent on fuelwood	40.77	50.41	20.97
dung-cakes	10.40	14.05	2.89
kerosene	12.65	12.21	13.54
gas	6.59	0.35	19.40
electricity	16.54	7.67	34.77

Source: GOP Federal Bureau of Statistics 1988

Wood, especially fuelwood, is an inferior good throughout most of the developed world. In economic terms this means that as income rises the proportion of income spent on wood declines. Table 3 demonstrates that fuelwood is an inferior good in Pakistan as well.

Table 3
Monthly Fuelwood Consumption Expenditures by Income Class 1985-86 Rs./month/(% of total income)

Income Class	Pakistan (Rs/mo)	Rural (Rs/mo)	Urban (Rs/mo)
<600 Rs./mo	20.92 (7)	21.30 (7)	17.67 (6)
701-800	30.47 (4)	31.37 (4)	24.52 (3)
1001-1500	41.82 (3)	45.54 (4)	28.44 (2)
2001-2500	51.11 (2)	65.04 (3)	25.59 (1)
3001-3500	51.99 (2)	80.84 (2)	22.59 (<1)
4001-4500	39.63 (1)	64.21 (2)	18.77 (<1)

Source: Calculated from Federal Bureau of Statistics 1988

Although fuelwood is clearly an inferior good, absolute expenditures on wood do rise with increasing income to a certain level. Two different behaviors may explain this. One, as rural households become wealthier they may shift into wood from less desirable fuels. Two, they may purchase rather than gather wood so that the expenditure includes wood fuel value, a value reflecting the selection of higher grades, as well as the addition of a labor service component. Over all, the total volume of wood consumed probably declines rapidly with income.

There are local exceptions. Inspection by province shows that in NWFP and Baluchistan, both urban and rural fuelwood expenditure rise with income with rural consumption rising more rapidly. In NWFP, rural fuelwood expenditure by the highest income class is five times higher than the lowest. In Baluchistan it is higher by a factor of two. This may be related to the importance of winter heating in these colder areas.

Rural population currently exceeds urban populations by 2.5 times and both are increasing. The fact that urban populations are rising at 4.4%/yr. and rural populations are increasing at 2.6%/yr. combined with the fact that the rate of increase in rural populations is down from the previous decade (3.3%/yr. between 1961-1972) suggest a shifting out of rural areas and imply a reduction in wood use growth.

Although Pakistan's population is increasing, GNP is rising much faster so that per capita GNP is rising at a significant rate (Table 4). Individual real incomes should increase overall at similar rates. One might expect urban dwellers to be significantly richer so that urbanization would accelerate the shift to lower per capita fuelwood use. Actually, the modal Pakistani income is 1001-1500 Rs./mo in both urban and rural households. Urban income distribution is only slightly skewed higher with 11% of urban households 11% earning more than 4500 Rs./mo. (Federal Bureau of Statistics 1988).

Per capita dependence on wood as an energy source should decline rapidly from population shift, increasing wealth, and increasing preference for, and availability of, alternative energy sources, already few industries are wood dependent for energy and as it becomes available. Other forms of energy are expanding at significant rates well in excess of population growth as shown in Table 4.

There is some question whether the growth rate of the economy and of the energy sectors are real and if they are sustainable. There is reported capital flight from Pakistan, a balance of trade problem and dependence on external sources of funding. Energy is a preferred sector, largely nationalized, so that its development may be subsidized. If this is all true then the current wood displacement behavior could be temporary.

Table 4.
Various Rates of Growth in Pakistan (1971-1987)

Sector	Growth %/yr.
Population (#)	3.1
Economy (real GNP/cap)	3.2
Energy Production	
Domestic Oil (10^6 b.)	11.0
Domestic Gas (10^9 cf)	7.8
Electric (10^3 Gwh)	8.9
Coal (10^6 tonnes)	5.2

(Calculated from Economic Advisor's Wing 1989)

Price Trends as Scarcity Indicators

Price change is recognized as an important indicator in evaluating Pakistan fuelwood scarcity. Sheikh (1990) pointed to price doubling in 11 years as an indicator of market stress. Jan. (1990) used a 14.6%/yr nominal fuelwood price increase to demonstrate that fuelwood was increasingly scarce.

While price changes do signal market changes, nominal prices usually contain other signals as well. Barnett and Morse (1963) demonstrate several less ambiguous economic indicators of changes in resource scarcity over time. Their most indicative tests used unit costs of extractive products, relative costs and relative prices. All of their price and cost indicators had to be adjusted by the general level of prices.

I used real commodity price trends as my indicator of relative scarcity in wood products. Real prices rise indicating increasing scarcity when either demand pressures increase or supply is reduced over time. Real prices should rise quickly when, as hypothesized in the Malthusian model, both conditions exist simultaneously. A declining price trend would suggest decreasing relative scarcity and stable prices suggest a resource in relative balance.

Real prices are nominal prices adjusted for inflation. As inflation is significant in Pakistan, all nominal wood price trends show large price rises, but these rises are misleading demonstrating primarily the

consistent erosions of the purchasing power of the Rupee. My price data were converted from nominal prices by dividing them by the appropriate all commodity consumer or producer price index. These indices show that inflation for the last decade has been between 7.8 to 8%/year.

There are some indications that actual inflation is higher. For example, gold prices, international exchange rates, and loan rates suggest that inflation may be anywhere from 12 to 16% per year. This means that the domestic purchasing power of the rupee may be falling faster than reflected by published price indices. If so, indicators in this paper are conservative and overstate the degree of resource scarcity present.

Fuelwood Price Trends

There are numerous different wood products and their markets and scarcity behavior should not necessarily behave the same. Table 5 demonstrates the annual rate of real (constant rupee) fuelwood price changes for several markets throughout Pakistan.

Table 5

Real price changes in Pakistani Fuelwood Prices

Wood Product	Market Location	Years	Real Price %/yr. change
Fuelwood (wholesale)			
Shisham-select	Changa Manga	1972-86	1.5
Shisham-thick	Changa Manga	1972-86	1.0
Shisham-med	Changa Manga	1972-86	1.4
Fuelwood (retail)	FBS Average	1956-86	1.2
	Quetta	1971-86	1.7
	Karachi	1967-86	1.8
	Lahore	1967-86	2.1
	Rawalpindi	1967-86	2.3
	Peshawar	1967-86	4.2

Data Sources: Amjad and Khan 1988
Federal Bureau of Statistics 1989

If published inflation indices are accurate, there is increasing scarcity in fuelwood but the degree varies. In general, the price increases are much smaller than would be expected from the rate of population growth. With Malthusian constant per capita use assumptions and a unitary elasticity of supply one might expect real fuelwood prices to rise at the same rate as population, but they have not. A log linear regression in retail values suggests that for every 10% rise in population, the price rises only 6%. Either fuelwood production increases substantially with price, or per capita consumption is falling, or both.

Some retail fuelwood values demonstrate more scarcity, and the scarcity varies geographically. However, the pattern is counter intuitive. Nearer Karachi and Quetta, where there are few forests and wood has to be hauled long distances, nominal prices are lower and real price indicated scarcity is increasing slowly. In the north, closer to both the farm forests and public forests, fuelwood prices are higher and scarcity is increasing at over double the southern rate especially near Peshawar. There is no obvious explanation for this although the Afghan refugee influx, increases in wood used for drying poppies, and possible collusion of wood wholesalers have been hypothesized as factors.

The fact that wholesale values in the north at Changa Manga are rising slowly while nearby retail values are rising quickly suggests a consistent widening of the marketing margin. This could be due to an increased percentage of labor, transport or other distribution costs. However, there may be data consistetency problems as Rock and Gee (1987) showed that wood price statistics might differ 14% in a single collection period between collection agencies.

Changa Manga's wholesale prices are the only

price series where a single species, Shisham (*Dalbergia sisso*) also known as rosewood, is differentiated by grade. While select shisham is worth 170% more than medium grades in absolute nominal prices, the rates of real price change show little difference in indicated scarcity by fuel wood grade.

Where there are low rates of increasing fuelwood scarcity, a wood energy panic is inappropriate. The overall results are consistent with a growing society substituting alternative energy sources as it urbanizes, industrializes and as its per capita income rises. In northern Pakistan, there is more cause for concern. Rates of price increase do confirm a combination of demand pressures and tight supplies, but at levels below expectation. However, the price increases themselves are part of the solution, at least in private wood decisions. Consistently increasing prices do two things. They cause consumers to slowly reduce consumption, either reduce absolute energy use or switch to alternative fuels, and encourage growers to invest in additional trees.

The issue of extreme poverty in some areas and the possibility of energy market distortions may cloud the fuelwood prices interpretation. Wood gathering by the under employed and the existence of non-cash markets may cause very different pressures of the wood resource. There is no direct data available that could be used to test this consideration, but normally cash market trends are sensitive to changes in the non-cash sector even if spot price level are distorted.

There may also be some wood subsidization occurring in the public sector which distorts local prices. When subsidization in kind rather than income redistribution is used as a tool to correct fuelwood scarcity, usually higher wood consumption rates and increased dependence on wood fuels result.

Large artificial perturbations, such as tree planting promotions, further distort cash fuelwood markets. These types of activities increase wood production, lower prices and lower private wood production returns, but they are direct influences on relative wood scarcity and price indicators of scarcity function correctly in this case.

Timber Price Trends:

Timber markets are behaving differently from, and in some cases inconsistently with, fuelwood markets. Certain quality wood species and grades are clearly increasingly scarce (Table 6) and some coniferous construction woods exhibit large decreasing scarcity (Table 7).

In quality furniture woods such as Shisham, and in the specialty sports equipment woods such as mulberry (*Morus alba*), there is a clear rise in real prices (Table 6). As would be expected this rise is highest in the premium log grades. Quality woods grow slowly and the significantly increasing scarcity is probably due to both increase demand and depleted growing stocks. This large rate of price rise almost assures that return on an investment in planting and holding these species would compensate for their slower growth rate and for Pakistan's relatively high interest rates.

The quality woods' price rises are consistent with increases with imported quality woods, such as teak (*Tectona grandis*). However, the difference in implied scarcity between shisham source at Changa Manga where it seems to be increasingly scarce and in the use market at Karachi where prices are dropping rapidly can not be explained with the data available.

Table 6
Real Price Changes in Pakistan's Furniture and Sport Equipment Woods

Wood Product		Market Location	ears	Real Price %/yr. change
Shisham	Gr 1	Changa Manga	1972-86	10.2
	Gr 3	Changa Manga	1972-86	4.7
	ave	Karachi	1980-87	–10.3
Mulberry	Gr 1	Changa Manga	1972-86	6.7
	Gr 3	Changa Manga	1972-86	1.4
Teak	ave	Karachi	1980-87	8.4

Data Sources: Karachi Federal Bureau of Statistics 1989
Other markets Amjad and Khan 1988.

It is in the coniferous species such as deodar (*Cedrus deodara*) and pine (*Pinus roxburghii and Pinus wallichiana*) that real price behaviors are strange and completely contrary to foresters' observations that conifer forests are declining. At best, some grade and species prices are declining, some at significant rates in both source and use markets. Unless there is consistently increasing collusion or a constant rate of product quality reduction, the economic scarcity of this resource is apparently declining. If coniferous forests are actually in decline, then the demand for these woods must be decreasing at a faster rate

Table 7
Real Price Changes in Pakistan's Coniferous Woods

Wood Product		Market Location	Years	Real Price %/yr. change
Deodar	scant 1	Havelian	1977-86	−1.7
	scant 3	Havelian	1977-86	−1.2
	ave	Karachi	1980-87	0.0
Pine	scant 1	Havelian	1977-86	−5.7
	scant 3	Havelian	1977-86	−5.9
	ave	Karachi	1980-87	−7.9

Data Sources Karachi Federal Bureau of Statistics 1989
Other markets Amjad and Khan 1988.

Although Pakistan's transacted wood markets do seem to be diverse and competitive, a condition which must hold if real price trends are to be interpreted correctly, there may be hidden distortions in wood markets. Distortions caused by imperfect property rights, government intervention, political instability, uncertainty, collusion etc. can mask actual scarcity conditions. Further, I assumed that the published data is credible and represents conditions beyond the point of collection.

Conclusions on wood Scarcity:

Calculated indices of wood scarcity were much lower than what would be expected from anecdotal evidence frequently presented by wood users and forestry officers. In fact, if actual inflation is only two or three percentage points above the inflation rates assumed in this analysis, most of the scarcity findings are neutralized except for a few northern fuelwood areas and for high grade specialty hardwoods.

The fact that household fuelwood prices are relatively low in real terms and that there is uncertainty about future price increases will have two behavioral effects. There is less pressure for households to shift into alternative energy sources unless those relative prices drop significantly. Further, a lack of price increase expectation deters private farmers from investing in fuelwood production except as a by-product. This may explain some of the reluctance of Pakistan's existing and potential wood using industries to invest in their own plantations.

Sharply increasing prices on slow growing specialty woods suggest that private growers find the future uncertain and are heavily discounting this type of time intensive investment. Expanding the awareness of increasing prices for these species and grades will begin to increase investments to produce them. Reducing market and resource tenure uncertainty would do the same.

The finding of declining real prices in public forest softwoods and the implication of decreasing economic scarcity there as well is also inconsistent with the widely held hypothesis of physical declines in public forest inventories. This anomaly should be examined closely to discover its causes before additional public forest policy is formulated.

Pakistan may be wood poor relative to other nations, but the recent market-based use of wood by this culture seems to be surprisingly well-adapted to the current rate of wood growth and production although there are some exceptions. Pakistan's Malthusian wood scarcity model needs to be replaced with more realistic wood futures scenarios that integrate wood with the energy, agricultural and industrial sectors in order to formulate appropriate policy to guide the future of Pakistan's wood sector.

REFERENCES

1. AMJAD, M. and N. KHAN (1988). The State of Forestry in Pakistan. Pakistan Forest Institute. Peshawar. 103 pp.

2. BARNETT, HAROLD J. and CHANDLER MORSE (1963). Scarcity and Growth: The Economics of Natural Resource Availability. Baltimore: Johns Hopkins University Press. 288 pp.

3. ECONOMIC ADVISOR'S WING (1989). Economic Survey 1988-89. Finance Division, Government of Pakistan, Islamabad. 207 pp.

4. FEDERAL BUREAU OF STATISTICS (1988). Household Income and Expenditure Survey 1985-86. Manager of Publications, Government of Pakistan. Karachi 573 pp.

5. FEDERAL BUREAU OF STATISTICS (1989). Pakistan Statistical Yearbook 1989. Manager of Publications, Government of Pakistan. Karachi. 727 pp.

6. JAN, A. (1990) Need for Social Forestry in Pakistan. Wood Producers-Users Seminar Souvenir. Office of Inspector General of Forests, Islamabad. p. 11-26.

7. KHATTAK, G.M. and M. AMJAD (1981). A Survey of Socio-Economic Conditions of Manpower Engaged in Forestry and Wood-Based Industries in Pakistan. Pakistan Forest Institute. Peshawar. 268 pp.

8. MATHTECH INC. (1988). Enerplan Project-Renewables Special Study. Report to USAID. Islamabad. 121 pp.

9. ROCK, C. and K. GEE (1987). An Appraisal of Agricultural Price Statistics in Pakistan. Pakistan Food Security Management Project. USAID. Islamabad. 38 pp.

10. SHEIKH, M. I. (1990). Background Paper. Wood Producers-Users Seminar Souvenir. Office of Inspector General of Forests. Islamabad p.3-10

11. SIDDIQUI, K. M. (1990). Farm Forestry Research in Pakistan. Pakistan Forest Institute. Peshawar. 17 pp.

12. WORLD RESOURCES INSTITUTE (1986). World Resources 1986. Basic Books: New York. 353 pp.