Commercial Fuelwood Supply, Demand and Price in Bangladesh, 1985–2000*

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ABSTRACT

Fuelwood is one of the most important commercial energy forms in Bangladesh, but its stock is rapidly declining. This is due to extensive overcutting in response to increased demand. The study considers this problem for the fifteen-year period from 1985 to 2000 that is of concern to the Bangladesh Energy Planning Project (BEPP) funded by the Asian Development Bank/United Nations Development Program. Based on previous work on energy demand and on energy supply pricing, an attempt is made to present and analyze four scenarios that have bracketed the fuelwood problem within its likely policy boundaries. The study's basic conclusions are that without a vigorous village forestry (or comparable) program, beginning by 1986, current woodcutting practices to meet fuelwood demand will result in both a drastic short-term shortage of fuelwood and an accelerated reduction in the quantity of forest stock. The role of fuelwood as the primary commercially traded cooking fuel will thus be usurped by imported kerosene which would require large additional foreign exchange expenditures. While these funds may be available, their allocation to consumption rather than to productive investment would result in a reduced rate of economic development.

INTRODUCTION

This paper summarizes the results of a study undertaken in August 1984 for the Bangladesh Energy Planning Project (BEPP) funded by the Asian Development Bank/United Nations Development Program. Its objective was to develop an understanding of the commercial fuelwood supply, demand and price in Bangladesh over the period 1985 to 2000. Since fuelwood is an important energy form in many developing countries, the way in which it has been considered for energy planning in Bangladesh should be of considerable interest to many energy and forestry policy markers elsewhere.**

With very limited resources allocated for the study, the approach utilized was to consult available secondary data sources and to hold discussions with as many of the knowledgeable indivi-

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*Most references to FAO in the text concern a number of detailed discussions the author had during the course of his study with Dr. R. Neil Byron, Mr. Bill Welsh and Dr. John Davidson. They, along with Dr. James Douglas, are responsible for all the FAO studies and surveys conducted in Bangladesh since 1978.

**The views expressed in this article are strictly those of the author had do not necessarily represent those of either BEPP or the Government of Bangladesh.

duals in Bangladesh as was possible. Thus more than 40 papers were reviewed, and 15 of the most appropriate forestry sector people in Bangladesh were consulted, some several times. While the results of 7 major surveys were also reviewed, most proved to be more useful in confirming impressions of the current fuelwood situation than in forming opinions of its trends.

Wherever possible, figures used in or developed for other parts of BEPP were employed so that the analysis would be as compatible as possible with earlier work. Consequently, the study did not itself attempt to determine future fuelwood, coal and base kerosene demand, but instead accepted those of BEPP Working Paper 34, "Energy and Fuel Demand 1985 – 2000"[1]. It also took as given the key prices for kerosene and coal which were projected in BEPP Working Paper 36, "Data for Energy Supply Optimisation".[2] An attempt was made to be conservative in dealing with the extent of the country's developing fuelwood shortage, but also to present and analyze scenarios that have bracketed the problem within its likely bounds.

OVERVIEW OF THE BANGLADESH FUELWOOD SITUATION

At *present,* there does not appear to be an overall shortage of commercial fuelwood in Bangladesh. The same is also true of rural traditional energy – in that overall supplies can currently meet the total demand generated by the current low per-capita rate of usage. Although there are significant regional differences, the national scenario is that the poorer elements of the rural population generally use agricultural wastes, gathered twigs, leaves and cow dung as cooking fuel, while the richer peasantry and most urban dwellers use the bulk of fuelwood for cooking. Fuelwood is simply too valuable for the rural poor to consume. They prefer to sell it if they can produce it, and themselves utilize the lower value fuels that can be gathered. There are, however, accelerating pressures on the fuelwood supply. Increasing urbanization is requiring more of the commodity to be sold in the cities, while the growing proportion of HYV rice and wheat being planted produce less agricultural waste (and also generate less dung) than the crops they replace. Land planted in jute is also declining, so there are fewer jute sticks to be used as a cooking fuel in the countryside. This situation, then, is leading to imminent drastic changes in the national demand for fuelwood.

Farmers are responding by cutting into their stock of trees. Thus fruit trees are being felled instead of their branches being cut, and the wood is sold for town and city needs. The price is relatively high, so farmers act to increase their immediate gains. At first glance, the future supply seems threatened by these circumstances. Yet the long-term implications may not be as bad as they seem. The 1983 FAO/Planning Commission Survey of Villagers' Attitudes to Trees and Forests[3] clearly shows that village households in Bangladesh are actively and successfully replacing felled trees. Planting in 1983 was generally 3 to 5 times greater than in the five-year trend as a whole, and surviving seedlings were usually many times greater than the number of trees felled.

Unfortunately, farmers are replacing the fruit trees that are cut down with similar, slow-growing trees rather than with fast-growing, multi-use varieties. Consequently a serious shortage of fuelwood may develop in the short term. Certainly, this is the case already in some areas of northwest and central Bangladesh. Since farmers are so knowledgeable about their trees, however, they would probably plant fast-growing varieties along with fruit trees if they were adequately informed and supported as they learned about the new species. The market price of fuelwood is, in fact, already high enough to generate a profit from the managed yields of such trees. One study has found an internal rate of return of 29% over 5 years for eucalyptus trial plots developed by FAO and the Forest Research Institute at Chittagong. If land costs were included, the internal rate of return would still be 19%.[4] However, since the individual trees take up very little space, almost no land planted in other crops would be taken out of production. These species have long narrow canopies and root systems, and can be planted in one meter square spaces. Thus the *higher* level of internal rate of return would actually be more likely.

FUELWOOD PRICE TRENDS

The price of fuelwood has been rising since 1971-1972 and, in the past few years, there has been quite a substantial price increase in parts of the country. In one area of the northwest, for instance, the price has doubled in the last three years. As Gerald Leach[5] has shown, however, the overall market price of fuelwood in Bangladesh has historically had, and continues to have, a close relationship to that of the next most expensive cooking fuel – kerosene. Using BEPP assumptions,[6] at 17.5% moisture content, a metric ton of fuelwood provides 15 GJ of energy, while a ton of kerosene provides 43.1 GJ. Since fuelwood, then, provides only 34.8% of the energy value of the same amount of kerosene, its price on an energy basis should be only 34.8% of that of kerosene. In fact, over the period 1972-1973 to 1981-1982, it has averaged 33.0% or 94.9% of its equivalent price in kerosene delivering the same amount of energy (see Fig. 1). This is quite a close relationship.

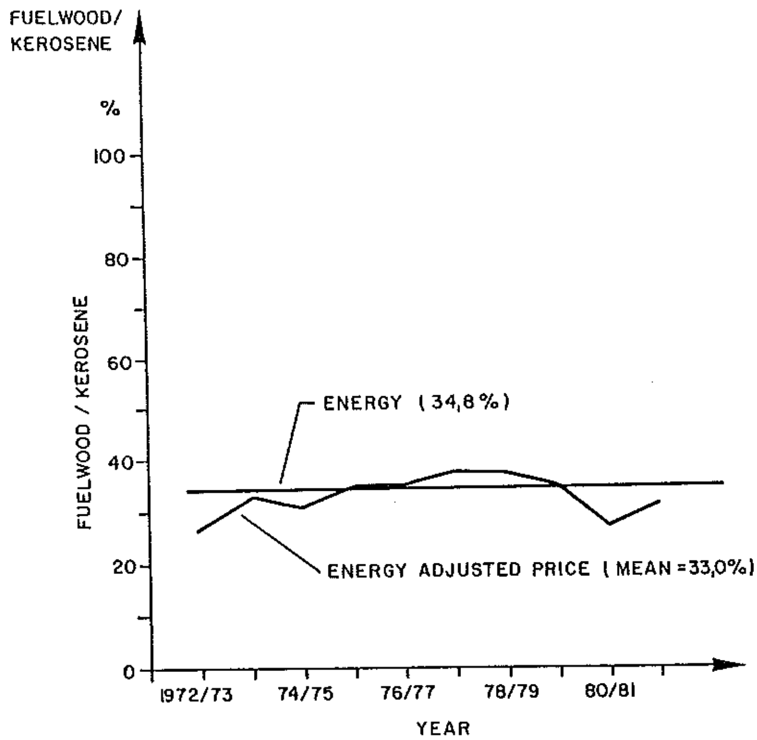

Fig. 1 Energy and price comparison of fuelwood and kerosene

The price difference is probably partially due to the lower average appliance efficiency of fuelwood stoves. The World Bank Energy Assessment Mission to Bangladesh in 1981[7] noted that kerosene stoves have an average appliance efficiency of 30%, while the appliance efficiency for fuelwood stoves is 12%. If these efficiencies are taken into account, the existing pricing structure might actually overvalue fuelwood relative to kerosene. This would be the case even if the additional use of fuelwood stoves to provide heat during the cold months is considered. Nevertheless, the Bangladesh domestic fuelwood consumer continues to prefer fuelwood to kerosene in spite of the latter's ready availability in urban markets. This indicates that actual appliance efficiencies in the case of Bangladesh may not be quite so far apart as the World Bank suggests, and/or simply that the Bangladeshi consumer does not take appliance efficiency into consideration in the fuel purchasing decision.

Further evidence for this point is provided by the finding that most Bangladeshi consumers consistently purchased fuelwood rather than kerosene for cooking between 1972 and 1982. This was despite the fact that in at least part of three of those ten years, when coal imports were much lower than normal, the price of fuelwood was higher than that of kerosene on an energy basis (although never higher than 9.2%). This suggests that experience indicated to consumers that the fuelwood price would soon fall (as it indeed did). Thus, most people appear to have been unwilling (and some were unable) to invest in a kerosene stove (at an approximate cost of 45-50 Tk. or US$2 at 1984 prices for the simplest one-burner model) necessary for conversion to a less familiar cooking fuel. Fuelwood, then, appears to be very much the preferred domestic fuel.

DEMAND ISSUES

The continued use of fuelwood will be determined by the rate of interfuel substitution with its next cheapest alternative. At present, the largest quantities of fuelwood are used in households for cooking. The most significant industrial quantities are consumed in brick-making, and these are projected by BEPP to become much larger by the year 2000. Since coal and natural gas are the preferred fuels for brick-making, it is important from a policy standpoint to encourage their use in order to free this quantity of fuelwood for domestic consumption.

Conversion to gas is already occurring where it is available, and this will continue since gas is by far the cheapest fuel. Its growth for brick-making, as well as for other industrial consumers, however, is constrained by the size and accessibility of the pipeline network. For the purpose of this paper, gas use is assumed to be extended to the west zone where it is presently absent through the construction of an east-west gas interconnector or the discovery of western gas fields. Wherever pipelines exist in the east, or are likely to exist in the east and west zones in the future, it is assumed that brickyards will have converted to gas use. The trade-offs between fuelwood and coal that are analyzed below concern only the remaining brickyards for which gas is not likely to be an option. The assumed brickyard fuel use for four points in time are:

1985 – 22% for gas and 39% each for coal and fuelwood;
1990 – 36% for gas and 31% each for coal and fuelwood;
1995 – 49% for gas, 26% for coal and 25% for fuelwood; and
2000 – 51% for gas, 33% for coal and 14% for fuelwood.

In view of these assumptions, 49% of brickyards will still not be able to use gas in the year 2000. Consequently, close attention should be paid to possibilities for the use of coal for the remainder. Since the infrastructure for its distribution to brickyards exists and no major investments are needed at the kilns for fuel conversion, it can be assumed that the price at which coal will be substituted for fuelwood will be the point at which its cost per unit of energy delivered is lower than that of fuelwood. The difference in transportation costs for the two fuels should theoretically also be included in the price determination. That is, such decisions are based on individual location criteria, and transport is likely to be an important factor in the relative cost of these fuels. However, with more than 2000 brickyards in the country, it is impossible to evaluate the relative costs of shipping coal or fuelwood to each of them. On a macroeconomic basis, the energy equilibrium price is sufficient for energy supply scenario purposes.

While the world market price of coal (currently about 80% of that of fuelwood on an energy basis) has been favorable for conversion to take place in Bangladesh brickyards for some time, the import of coal was until recently under the supervision of the government's Coal Controller. Various management difficulties in that office resulted in the government import of low-quality coal which, while adequate for transport purposes, did not penetrate the industrial sector. This prompted the GOB to abolish this office in late August 1984, and allow direct private sector imports. The brick industry has reacted immediately and favorably to this move, and coal conversion should now occur rapidly.

The price at which kerosene will be substituted for wood for household use in cooking is analogous to that of coal for fuelwood in brickmaking. Again, natural gas is the cheapest fuel, but its limited availability in towns curtails its substitution for fuelwood. For the purpose of this study, the gas supply to urban areas is forecasted on the basis of known and possible load areas. These are divided into three categories by BEPP's demand analysis:

- those which have an existing gas supply or for which there is a committed supply plan;
- those in the east zone for which, supply may be installed in the late 1980s; and
- those in the west zone whose supply depends on the construction of the east-west gas interconnector or the discovery of gas in the west. The earliest possible date of connection for these consumers is the beginning of the 1990s.

Assuming all categories receive gas by the year 2000, 42% of the urban population will still be excluded from gas distribution. This is in contrast to the 55% that currently reside outside the gas network area. The analysis that follows, then, is concerned only with those domestic consumers who will have no access to gas in the future and who must continue to choose between fuelwood and kerosene for cooking.

This choice is assumed to occur at the point at which the kerosene cost per unit of energy delivered is less than that of fuelwood. However, there is another cost that must theoretically be considered in relation to the cost of kerosene. This is the investment cost of the kerosene stove that is required to make the fuel conversion. Furthermore, there will be a lag of perhaps a year in such a purchase and hence in conversion, while the consumer saves to buy the stove and becomes confident that the new relative prices will be stable and justify his expenditure. This should also be incorporated into the calculation. Even though at 45-50 Tk. a stove, the capital cost of conversion is really only slightly more than the cost of one maund (37.326 kg) of fuelwood in Dhaka (and perhaps as much as 2 maunds elsewhere), and while for many households that may be considered a trivial expense, it does represent several days' pay for the average Bangladeshi wage earner. For the purposes of this paper, however, a microeconomic decision on the purchase of an end-use appliance such as a stove for kerosene can be excluded, just as it is in the consideration of all other fuels by the BEPP.

SUPPLY ISSUES

The theoretical interfuel substitution prices for fuelwood, both in households and in the brickmaking industry, have now been identified. It remains to be determined, however, when these price levels will be high enough relative to production costs and alternative crop decisions to stimulate, on a scale large enough to satisfy demand, the managed village production of firewood. It is perhaps surprising to some, but the consensus of opinion among foresters in Bangladesh is that, in theory, the average wholesale market price of firewood is *already* sufficient for small farmers to raise fast-growing species on their homesteads and in their fields at a good profit. The essential problem is that most farmers simply do not know about the fast-growing species which are available.

FAO believes that without the onset of a large-scale information and demonstration program throughout Bangladesh within the next year or two, the supply of fuelwood will collapse by 1990. Stock will simply be cut too quickly for the slow-growing fruit trees planted as replacements to mature quickly enough to meet demand. FAO further believes that a base supply will remain. About 20% of projected fuelwood demand would continue to be satisfied because farmers will not cut all their trees. They must be retained for their other uses and will, therefore, still yield some fuelwood. Most commercial users would switch to the next-best alternative – kerosene – the demand for which would require substantial additional imports and the expenditure of huge amounts of foreign exchange. If this money were actually made available, its allocation to fuelwood purchases, that is to consumption, would mean that it would not be spent for productive purposes such as extending rural electrification or developing a village forestry program for fast-growing trees.

If, on the other hand, this money were *not* made available, the poor would suffer the most. This situation could manifest itself in a number of ways, some due to the manner in which the more prosperous and urban Bangladeshis adapt. For example, if urban dwellers had neither enough kerosene nor fuelwood at their disposal for cooking, they would move down the energy chain and use other, less desirable forms of biomass normally used by the very poor. Cow dung, for instance, would become virtually unavailable to the landless, as those more well off (i.e., those that own cattle) could be expected to have easier access to this fuel. In the most extreme circumstances, the lives of the very poor could even be threatened by the lack of fuel.

It is more likely, however, that other measures will mitigate the most severe impacts of a fuelwood shortage. More and more people will cook only one hot meal a day, or perhaps only one every two days, thereby lowering demand. Furthermore, some additional foreign funds are almost certain to be made available, and farmers will begin to plant fast-growing trees as knowledge about them spreads. Without action soon, however, the incidence of fuelwood shortages will increase as regional and then national gaps between the supply and demand for cooking fuel develop. While these shortages may only last a few years, the readjustment to a new supply and demand balance could be terribly painful. It need not be so.

EVALUATION OF COMMERCIAL FUELWOOD BALANCE PROJECTIONS

Given the situation described above, a number of scenarios were designed for incorporation into the BEPP supply analysis. Their basic premise is that the primary commercial cooking fuel for those households without gas connections and with purchasing power will soon be kerosene unless action is taken to increase fuelwood supply in the next two years. Four scenarios are presented to establish realistic bounds on the range of fuelwood supply at its traditional price relationship to kerosene. The first is the continuation of present practices under circumstances of high fuelwood demand. This represents the extreme or worst case that could develop. The second scenario represents an attempt to ameliorate the situation through a far-reaching government forestry program, establishing large plantations of fast-growing trees under conditions of more moderate fuelwood demand. The third attempts to remedy the situation by the widespread dissemination of fast-growing species to small farmers for village or homestead forestry purposes, while the final scenario presents a modest and balanced program that draws on the elements of the previous two. Both of these also assume circumstances of more moderate fuel demand.

Scenario 1: Worst Case

The projections produced here (see Table 1) accept the BEPP assumptions for a high urbanization rate (8% per year), a high manufacturing growth rate (7.59% per year) and high kerosene import prices. They also assume a continuation of current forestry practices, the continued absence of a major plantation or village forestry program and a long-term ban of fuelwood to coal conversion in brick-making. Under these conditions, with the energy equilibrium price of wholesale fuelwood considered to be 34.8% of that of imported kerosene (CIF Chittagong), an additional 3317 thousand metric tons (Th MT) of imported kerosene worth US$895.72 million (con-

Table 1. Scenario 1: Worst Case*

	1985	1990	1995	2000
Demand (Th MT)				
Urban cooking	7,324	11,133	15,828	22,006
Brick industry	445	625	838	804
Other industries	128	158	152	146
Total	7,897	11,916	16,818	22,956
Supply (Th MT)				
Fuelwood	7,897	2,383	3,364	4,591
Other tree fuels	23,691	7,149	10,092	13,773
Energy equilibrium prices ($ per MT)				
Kerosene	260	270	306	403
Fuelwood	90.48	(93.96)	(106.49)	(140.24)
Additional kerosene imports necessary to meet demand				
Th MT	–	3,317	4,682	6,391
Million US$	–	895.72	1,432.69	2,575.57

*High urbanization, high growth rate of gas in the West, high manufacturing sector growth rate, current forestry practices, no major forestry program, high kerosene import prices, no coal substitution in industry.

Note to Tables 1-5 and Fig. 2. The following assumptions have been made for these calculations:

- All prices in constant 1983 US$.
- All urban biomass for cooking is fuelwood; all rural biomass for cooking includes other tree fuels (twigs, leaves, etc.), dung and agricultural residues, but not fuelwood.
- With current wood-cutting practices, only 20% of the fuelwood demand will be satisfied in 1990. This, however, will be a floor below which wood supply will not fall.
- 1 MT fuelwood at 17.5% moisture = 15 GJ.
- 1 MT kerosene = 43.1 GJ.
- 1 plantation acre of fast-growing trees will yield 2000 ft^3 of clear-cut fuelwood in 5 years. At 50 ft^3 = 1 MT, this is 40 MT of firewood annually if 1 acre is planted each year. For village forests, 1 acre is assumed to yield 1500 ft^3 or 30 MT of firewood annually.
- Other tree fuels are assumed to be produced at the ratio of 3 MT per MT of fuelwood for traditional trees (source: Bangladesh Bureau of Statistics). For fast-growing exotic trees, the FAO field plot assumption for eucalyptus is utilized. This is 0.4 MT per MT of fuelwood produced (see Annex 1). These are *not* considered as commercial fuelwood, but are included to indicate the impacts of various fuelwood policies for rural noncommercial biomass supply.
- Demands are taken from BEPP Working Paper 34 *(Energy and Fuel Demand, 19852000).*
- Kerosene prices are taken from BEPP Working Paper 36 *(Data Base for Energy Supply Optimisation).*
- Forestry assumptions are from discussions with the FAO/Dhaka.
- All economic and population growth-rate assumptions are from BEPP Working Paper 34.

stant 1983 dollars) will be required in 1990, and an additional 6391 thousand tons, worth US$2.6 *billion,* will be required by the year 2000 to support the urban household cooking needs of Bangladesh under the BEPP population and economic growth assumptions. With total crude oil and petroleum product imports worth only US$354.66 million in 1981-1982, Bangladesh would face an awesome task in raising this additional sum of money.

Scenario 2: Traditional Forestry Solution

The approach underlying these projections is to mobilize the capabilities of the Forestry Department to the greatest extent possible and plant as much land as is available and under its control with high-yielding, fast-growing fuelwood trees. According to the FAO, the limit is 20 000 acres per year annually from 1985. Also assumed are BEPP figures for a low rate of urbanization (6% per year), a low growth rate of gas use in the West under a low manufacturing sector growth rate (6.02% per year), and full substitution of coal and/or natural gas for all industrial fuelwood needs identified by the BEPP. The scenario is developed for both high and low kerosene import price assumptions. The calculations show that under the most favorable conditions, 2038 thousand metric tons of additional kerosene must be imported in 1990, and 2514 thousand metric tons in the year 2000. At the lowest possible prices, these will cost US$470.78 million in 1990 and US$822.08 million in the year 2000.

These costs are certainly heavy, but they are not inconceivable. Bangladesh's total petroleum and petroleum product imports in 1981-1982 (US$354.66 million) were 9.3 times greater than those of 1972-1973 (US$38.32 million), and kerosene imports were ten times greater. In contrast, the Scenario 2 projections would require a 9.3-fold increase of kerosene import costs between 1981-1982 and 1990, but one of only 1.8 times between 1990 and 2000. Naturally these

Table 2. Scenario 2: Traditional forestry solution*

	1985	1990	1995	2000
Demand (Th MT)				
Urban cooking	6,655	9,039	11,517	14,216
Brick industry	417	0	0	0
Other industries	120	0	0	0
Total	7,192	9,039	11,517	14,216
Supply (Th MT)				
Fuelwood base supply (20% of high demand Scenario 1)	n/a	2,383	3,364	4,591
Govt. fuelwood planting program (20,000 acres each year, yielding in year 5 at 40 MT/acre	–	800	1,600	2,400
Total supply	7,192	3,183	5,064	6,991
Other tree fuels	21,576	7,469	10,772	14,733
Energy equilibrium prices ($/MT)				
Kerosene H	260	270	306	403
L	228	231	260	327
Fuelwood H	90.48	(93.96)	(106.49)	(140.24)
L	79.34	(80.39)	(90.48)	(113.80)
Additional kerosene imports necessary to meet demand				
Th MT	–	2,038	2,246	2,514
Million $ H	–	550.26	687.28	1,013.14
L	–	470.78	583.96	822.08

*Low urbanization, low growth rate of gas in the West, low manufacturing growth rate, planting of 20 000 acres of high-yield, fast-growing tees annually from 1985, high and low kerosene import prices, full substitution of coal and/or gas for all industry.

additional import costs must be considered along with all the other consumption and capital goods imports the country will require in 1990 to determine if they are truly possible; but they do not appear out of the question in comparison to past import adjustments that have been made in the energy sector. However, the key point is that a government forestry program of this scale is unlikely by 1985, and is perhaps too ambitious to be operating at full capacity even by 1990. In addition, the FAO estimates a program costing US$6.8 million annually for such an effort. An initial investment of US$5 million to expand and upgrade the forestry service field staff is also necessary. While these sums are quite low in relation to benefits, they nonetheless represent a substantial commitment of financial resources for the Forestry Department.

Scenario 3: Village Forestry Solutions

This case uses all the assumptions of the second scenario but substitutes a village forestry program for the government-operated plantation program. Assuming the BEPP low urbanization population projections and an average household size of 5.8 people, there would be 13.9 million rural households in Bangladesh in 1985, 19.5 million in 1990, and 14.7 million in 1995. Assuming further that only half of these households plant one tenth of an acre of high-yield, fast-growing trees starting in 1985 (at a clear-cut yield of 1500 ft^3 per acre), a total of 735 000 acres will have been planted by the year 2000 at an annual rate of 49 000 acres. This is more than twice the land that the Forestry Department would be able to plant for only about 20 to 30% more money, although with a 25% lower yield.

Table 3. Scenario 3: Village forestry solution*

	1985	1990	1995	2000
Demand (Th MT)				
Urban cooking	6,655	9,039	11,517	14,216
Brick industry	417	0	0	0
Other industries	120	0	0	0
Total	7,192	9,039	11,517	14,216
Supply (Th MT)				
Fuelwood base supply (20% of high demand Scenario 1)	n/a	2,383	3,364	4,591
Village fuelwood planting program (yielding from year 5 at 30 MT/acre)	–	1,470	2,940	4,410
Total supply	7,192	3,853	6,304	9,001
Other tree fuels	21,576	7,737	11,268	15,537
Energy equilibrium prices ($/MT)				
Kerosene H	260	270	306	403
L	228	231	260	327
Fuelwood H	90.48	(93.96)	(106.49)	(140.24)
L	79.34	(80.39)	(90.48)	(113.80)
Additional kerosene imports necessary to meet demand				
Th MT	–	1,805	1,814	1,815
Million $ H	–	487.35	555.08	731.45
L	–	416.96	471.64	593.51

*Low urbanization, low growth rate of gas in the West, low manufacturing sector growth rate, village forestry program, high and low kerosene import prices, full substitution of coal and/or gas for all industry.

As a result of this program, 1805 thousand metric tons of additional kerosene imports would be required in 1990 (at a minimum cost of US$416.96 million). This level then remains almost constant with 1814 thousand tons required in 1995, and 1815 thousand tons in the year 2000. The minimum foreign exchange burden of the import requirement in the year 2000 would be US$593.51 million, or almost US$300 million less than that necessary with the traditional plantation program. This is a level of importation that Bangladesh can reasonably expect to meet. The FAO estimates this program would cost US$10 million to establish the necessary infrastructure and then US$8.4 million annually. Again the benefits are substantial in relation to costs, but the government may have difficulties mobilizing the necessary resources. Consequently, a lower level of effort incorporating both a limited government plantation program and a limited village forestry program is suggested in the final scenario.

Scenario 4: A Modest Effort

This section demonstrates the outcome of a much more modest effort at coping with declining fuelwood supply. The results show that anything less than a major program will not have significant impact. Assumed here would be a high rate of urbanization, a low growth rate of gas use in the West, a low manufacturing sector growth rate, the substitution of coal for fuelwood in brickyards but not in other industries, a modest government fuelwood plantation program (2000 acres planted each year from 1985-1989, 4000 acres each year from 1990-1994, and 8000 acres each year thereafter) and a village forestry program assuming one quarter of rural households plant one-twentieth of an acre per year at a yield of only 1000 ft^3 per acre. Projections were again calculated at both high and low import prices of kerosene. The FAO has estimated the average annual cost of this plantation program as US$1.6 million and that of the village forestry program as US$1.4 million. In addition, the plantation program would necessitate a 5 million dollar investment in field staff expansion, while upgrading the village forestry program would require a 10 million dollar investment to establish the necessary human and physical infrastructure. In contrast to these costs, the results indicate 2978 thousand metric tons of additional kerosene would be required in 1990 and 5642 in the year 2000. The costs are similarly high – a minimum of US$-687.92 million in 1990 (vs. US$804.06 million at high world market prices for kerosene) and one of US$1.84 billion (vs. US$2.27 billion) in the year 2000.

Table 4. Scenario 4: Modest effort

	1985	1990	1995	2000
Demand (Th MT)				
Urban cooking	7,324	11,133	15,828	22,006
Brick industry	417	0	0	0
Other industries	120	130	113	93
Total	7,861	11,263	15,941	22,099

*High urbanization, low growth rate of gas in the West, low manufacturing sector growth, modest government plantation program, reduced village forestry effort, high and low kerosene import prices, substitution of coal for fuelwood in brickyards only.

Table 4 (Cont'd)

	1985	1990	1995	2000
Supply (Th MT)				
Fuelwood base supply (20% of high demand Scenario 1)	n/a	2,383	3,364	4,591
Fuelwood from government (yielding from year 5 at 40 MT/acre	–	80	240	560
Fuelwood from village planting program (yielding from year 5 at 20 MT/acre)	–	245	490	735
Total supply	7,861	2,708	4,094	5,886
Other tree fuels	23,585	7,279	10,384	14,162
Energy Supply prices ($/MT)				
Kerosene H	260	270	306	403
L	228	231	260	327
Fuelwood H	90.48	(93.96)	(106.49)	(140.24)
L	79.34	(80.39)	(90.48)	(113.80)
Additional Kerosene imports necessary to meet demand				
Th MT	–	2,978	4,123	5,642
Million $ H	–	804.06	1,261.64	2,273.73
L	–	687.92	1,071.98	1,844.93

Figure 2 summarizes Section 6 and compares the additional kerosene import requirements of all four scenarios.

CONCLUSIONS AND RECOMMENDATIONS

This study of fuelwood supply, demand and prices in Bangladesh has accepted throughout the fuelwood demands specified by the BEPP demand analysis. Consequently, the scenarios of Section 6 that attempt to close the rapidly emerging fuelwood gap in the nation, discussed previously in Sections 3, 4 and 5, consist only of supply-side adjustments. This does not mean that demand-side actions cannot be taken, but only that they are outside the scope of this study. For example, it is well known that fuelwood stove efficiency can be significantly improved in Bangladesh, and a study of the cost effectiveness of a program to disseminate improved stoves to urban households versus one to disseminate fast-growing trees to farmers would be well worth

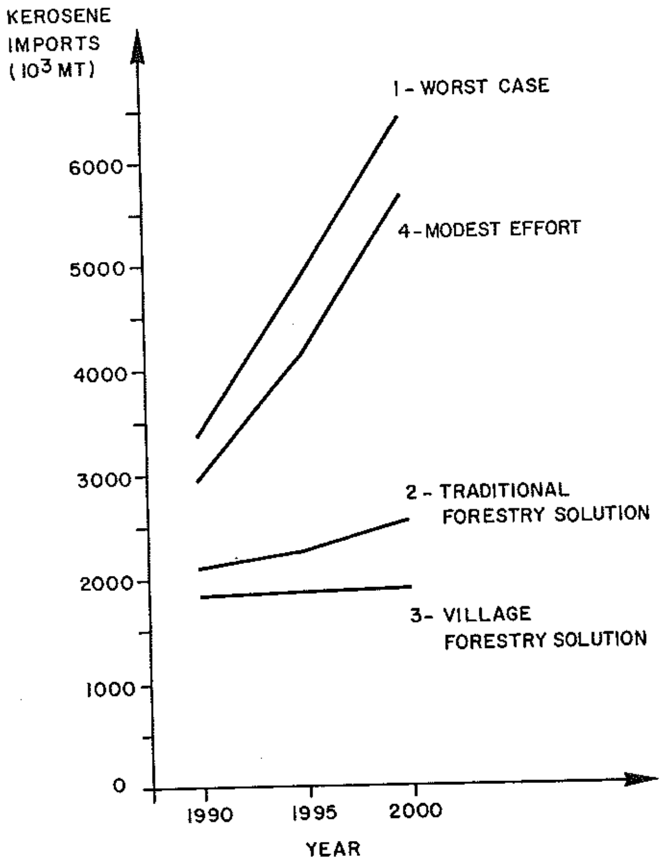

Fig. 2 Additional kerosene imports under various scenarios

conducting. Fuelwood, then, should basically not be considered differently than any other commercial fuel, in that a combination of supply and demand actions will have to be taken to optimize its use.

In view of the foregoing analysis, a number of important conclusions can be made and recommendations suggested. These include:

(1) Unless immediate, comprehensive and effective action in the village forestry area is taken by the government, the stock of trees in Bangladesh could be reduced to a bare minimum by 1990, and a nearly complete conversion to kerosene as the urban cooking fuel for the more than 50% of households that will remain without access to gas could occur.

(2) This would require massive additional kerosene imports at high foreign exchange costs.

(3) Most urban dwellers currently using purchased cooking fuel would probably be able to adjust. However, poorer people would not, and would therefore substitute even lower energy value biomass. Thus the brunt of the adjustment would be borne by the poorest rural people, especially the landless, who would find the prices for and availability of twigs, leaves, dung, etc. to be increasingly problematic.

(4) The funds necessary for additional kerosene purchases must come, at least in part, from additional external funds. Their cost would be reduced development investment and hence a lower future living standard.

(5) The most effective way to deal with these problems is for the government to accept that they exist, and to recognize village forestry as an energy as well as a forestry problem. Any effective actions will require the close cooperation of both forestry and energy sector interests within the government.

(6) Forestry sector funds should be directed away from unproductive investments in traditional, slow-growing hardwood forests and made available to individual small farmers. An expanded and upgraded extension service must be developed and financed to disseminate the information so crucial to accelerate the planting of the high-yield, fast-growing species from which farmers can *already* make a profit at current fuelwood production costs and selling prices.

(7) Finally, fuelwood should be recognized not only for the high return cash crop that it is, but also for its value as a renewable, indigenous energy resource that can reduce the oil product import bill. If cultivated in a managed way, it can provide a reliable, easily accessible cooking fuel for the majority of Bangladesh's citizens until the end of the century.

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Annex 1: Other Tree Fuel Calculations

Eucalyptus

1. FAO's field trial plots showed 1 ha would yield 184 m^3 of green stemwood + 37.37 MT branches, leaves and twigs after 5 years.
2. Thus, if one established 1/5 ha each year for 5 years, then perpetuated that cycle by replanting, etc., the annual yield from clear felling 1/5 ha would be 36.8 m^3 stemwood + 7.5 MT minor fuel + annual leaf/branch shed from the other 4/5 ha (25% of the canopy).
3. Therefore each 1/5 ha would have 7.5 MT of minor fuel when it is 5 years old.
4. By interpolation, 4 X 1/5 ha (average age 2) would have a canopy of 3 MT each, of which 25% is shed annually; therefore the annual minor fuel shed = 3 MT.
5. So the total annual sustainable production = 36.8 m^3 stemwood + 10.5 minor fuels from 1 ha.
6. From the FAO/UNDP consumption survey[8]:
   Annual domestic fuel consumption per capita:
   - small twigs, leaves, etc. =152 – 189 kg
   - fuelwood = .05 – .10 m^3
   - posts, poles, implements = .009 – .013 m^3
7. Consequently, based on these assumptions, 1 ha would supply:
   - small twigs and leaves for 55 – 69 people, and
   - fuelwood + posts, poles and implements for 325-624 people
8. 1 MT fuelwood = 50 CFT
   1 m^3 = 35.3147 CFT
   Annual sustainable yield = 36.8 m^3 wood = 1299.6 CFT = 26 MT
   Other tree fuels = 10.5 MT

   Thus 10.5 MT of other tree fuels with 26 MT of fuelwood, and therefore for 1 MT of fuelwood from eucalyptus, 0.4 MT of other tree fuels are produced.