



GOVERNMENT OF BANGLADESH  
MINISTRY OF ENVIRONMENT AND FORESTS

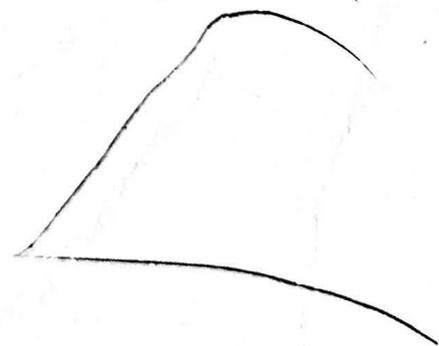
STATISTICAL REPORT  
FOREST PRODUCTS DEMAND PROJECTION

# FORESTRY MASTER PLAN

ASIAN DEVELOPMENT BANK (TA NO. 1355-BAN)

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**STATISTICAL REPORT**  
**FOREST PRODUCTS DEMAND PROJECTION**

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## **INTRODUCTION**

### **Background**

One of the important objectives of the consumption survey is to reassess the demand for forest products i.e. fuelwood, timber and bamboo in the rural areas. As most of the people in Bangladesh live in the rural areas, it is intended and believed that any objective assessment for rural Bangladesh can reflect a closer approximation for the nation as a whole with a greater degree of reliability.

The study of supply and demand of forest products in Bangladesh was done for the first time in 1981 by UNDP/FAO\* (1981). In the study Douglas (1981) estimated consumption per capita for different forest products in the country and estimated demand for various forest and wood based products by items. These are now out-dated. Up-dating the estimates will measure the changes in the consumption pattern due to various changes in socio-political and economic life.

The demand and supply information is very important for future planning and forecasting for a commodity and is essential for designing and formulating long term strategic plans.

### **Methodology**

The methodology followed is essentially the sample survey method on the basis of three - stage stratified sampling. Survey data was processed to get the per capita estimates for various forest products. The estimates obtained from the survey results are statistically readjusted and used for projection of national demand for forest products for the future period. Other methods are also followed to assess and estimate the demand for other forest based industrial products like newsprint, writing, printing and other industrial papers and panel products which were not included in the survey. Secondary sources of data are also explored extensively wherever possible.

For highly processed forest products, information and data are available both for production, final consumption, export, use of raw materials, prices, sales, etc. In such cases, searches were made to collect those from different sources and compiled to get the summary data. If any anomaly was noticed then interviews and discussion with relevant people were made which provided the framework to sorted out the anomalies. In many cases, the previous estimates of Douglas and Byron were accepted with appropriate adjustment.

Douglas did the pioneering work on estimating the household consumption demand of forest products. On the basis of his findings, Professor Byron in 1981 made the demand projection for forest products up to the year 2000. The scope of the Master Plan is much wider and the importance is more urgent than any previous study because of the the worldwide awareness of environmental deterioration and the need for conservation of the forests and nature.

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\* For this abbreviation and other terms and conversion factors, see Appendix 1.

## **Estimates and Results**

The consumption of sawn timber and round logs is difficult to assess because of their wider use as final and intermediate products. Rural consumption of sawn wood in different uses are estimated from the survey results. The nature of urban consumption of sawn timber varies from that of rural areas. An urban consumption survey was not done as acceptable prior data existed. Instead, old estimates were readjusted in the light of experiences of the rural survey.

The estimates for consumption of fuelwood in rural areas are straight forward and derived from the survey results. The same results are applied for the urban areas as well. In his study Douglas also used the same rural average as proxy for urban consumption of fuelwood because his survey of Dhaka Metropolitan areas and Metropolitan Fringes had shown a similar pattern of firewood consumption as in rural areas. The Bangladesh Energy Planning Project (BEPP,1981) study shows a different consumption per capita in the urban areas which is much higher than the rural consumption. If we consider the tendency to use more commercial energy in city dwellings in place of fuelwood, then the estimates of BEPP seems unrealistic for all city households. They could be true for some towns and cities where gas and LPG supply is not available.

The per capita consumption of bamboo, cane, thatch grass and other forest products are also estimated from the household survey. The consumption of round wood, which is mostly used for posts and poles in the rural areas, is also estimated from the survey results. The consumption of pulpwood, newsprint, writing-printing and industrial papers as well as the demand for industrial logs is also assessed.

Survey methods for inventory and supply results of forest products from village groves can be seen in the Village Forest Inventory (FMP 1992d). Survey methods for household consumption and sample units of households are also the same. The consumption survey is part of the total survey, Appendix 2 contains an example of the field questionnaire.

## **Objectives**

The purposes of this report are:

- a. To present the results of a household consumption survey by region and by income class for all major items of forest products. The results are presented in per capita terms.
- b. To present the national demand estimates for forest products in 1991 and make comparative statements with previous studies wherever necessary.
- c. To present the national demand projections under different scenarios for the future up to 2013.

## **Sequence of Presentation**

The presentation is made sequentially following the sequence of the questionnaire. It starts with the consumption and demand estimates for fuelwood and other traditional fuel energies in the rural areas. The results of the bamboo, cane and thatch grass survey are not presented in this report. These are presented in detail in the Bamboo (FMP 1992c) and Non Wood Product (FMP 1992b) Reports respectively.

For each item surveyed, the result is presented at the location, then national demand estimates for the item by regions and by income group. Finally, demand projections under different scenarios are presented. Appendices are provided wherever necessary.

# FUELWOOD CONSUMPTION

## General

The survey of fuel consumption was designed to measure the use of different biomass fuels like agriculture residue, cow-dung, bamboo, charcoal, oil energy and tree fuels. The survey gathered information regarding the quantity of fuel consumed yesterday, last week and last year by the households. The use of fuelwood in the monsoon is given special attention on the assumption that more fuelwood is used then than in the dry season due to lower availability of other bio-mass fuels in the rural areas.

Traditionally, the people of Bangladesh depend on fuelwood for domestic cooking. In the rural areas, trees are the major source of fuel energy and are more important in the absence of any cheap, convenient alternative. Tree fuel can be classified into three types:

- a. Fuelwood which comes from the stems and large branches, obtained once in the lifetime of the tree after its felling.
- b. Smaller branches and twigs which give fuel at regular intervals throughout the life cycle.
- c. Leaves that provide fuel energy regularly if not used for other purposes (humus, manure, etc).

In recent years, the shortage of fuelwood and its increased uses for commercial purposes compelled the rural households to use more agricultural residue and cow-dung as a cheap substitute. These were previously used as green manure to protect the fertility of agricultural land.

Fuelwood is also being used in different commercial and industrial activities like-brick burning, agro-processing, tobacco processing, lime processing, pottery and bakery manufacturings, in hotels, restaurants and other institutions. The commercial and industrial uses are outside the purview of the rural survey. Consumption requirements of these trades are estimated on the basis of information from secondary sources. Visits and interviews with relevant persons and groups were also made. The Energy Consumption Report gives the detailed break-down of the institutional and commercial consumption of firewood (Document No. 16).

## Survey Results

The survey results are presented by strata on a per capita basis and for the country as a whole. Table 1 shows the per capita annual consumption of different bio-mass and tree fuels for the whole country. The results are presented according to different income groups or land class.

The bottom lines of the table represent the over all average per capita/annum and weighted average per capita/annum. Weighted average is smaller than the total area average results. Weighted average is calculated after necessary statistical adjustment to represent all classes of households.

The results have revealed some interesting findings regarding fuel consumption in rural areas. The consumption of fuelwood proper has been reduced since Douglas' study with agricultural residue being substituted more and more for fuelwood. Fuelwood provides a small percentage of the total energy requirement per capita in the rural areas. Regional differences in the fuel consumption pattern are smaller than perceived earlier. The consumption shows the traditional patterns of fuel use with kerosene, natural gas, LPG, coal or electricity hardly used in the villages. People are not aware of the improved cooking stoves designed by the BCSIR.

The results for branches, tree waste, bamboo, agriculture residue, cow-dung and charcoal are presented in Table 1 in three estimates by land class. In all cases, daily estimates are the minimum.

Table 1 - Per Capita Fuelwood Consumption in Rural Bangladesh (Kg)

Land area (ha)	Fuelwood			Branches			Tree Waste			Bamboo			Agri Residue			Cow-dung			Charcoal		
	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A
0-0.2	25.13	26.63	31.47	82.60	82.38	79.50	147.33	141.45	125.75	27.50	23.25	23.03	194.28	183.73	177.62	81.53	83.35	80.95	2.60	2.78	2.15
0.2-1.0	37.37	39.30	51.43	69.50	70.47	77.53	127.32	124.27	105.92	19.45	19.15	23.15	215.72	203.58	194.50	80.63	82.53	86.00	2.80	2.37	1.42
1.0-3.0	41.82	47.70	69.22	77.78	79.07	86.85	129.47	122.07	117.97	22.02	22.63	26.83	204.00	192.17	176.72	81.37	79.77	81.87	3.22	2.43	1.32
3.0+	50.90	55.78	70.35	80.08	81.20	87.95	92.07	89.83	80.17	16.58	16.60	20.62	223.15	195.48	193.27	81.27	78.93	77.40	0.00	0.05	0.20
All area average	38.80	42.35	55.62	77.49	78.28	82.96	124.05	119.40	107.45	21.39	20.41	23.41	209.29	193.74	185.53	81.20	81.15	81.55	2.15	1.91	1.27
Weighted average	30.39	32.81	42.55	71.78	72.22	74.45	125.21	120.40	107.56	21.84	19.99	21.85	187.61	176.55	168.62	74.9	75.81	75.97	2.46	2.29	1.56
Weighted average in m <sup>3</sup>	0.0430	0.0465	0.0603	0.1017	0.1023	0.1055	0.1774	0.1705	0.1524	0.0309	0.0283	0.0309	0.2657	0.2501	0.2388	0.1061	0.1074	0.1076	0.0035	0.0032	0.0022
Kkilo calori (000)	93.87	101.35	131.44	221.73	223.09	229.98	377.51	363.01	324.29	65.85	60.27	65.88	565.64	532.30	508.39	209.05	211.59	212.03	19.90	18.53	12.62

Note:

D = Daily estimates  
W = Weekly estimates  
A = Annual estimates



In the bottom line of the table, the consumption of fuel energy in kilo calories term is presented for all items of traditional fuels. The estimates are made following the standard energy conversion factors used in Bangladesh Energy Studies as well as in FAO Studies by Douglas and others. The standard conversion factors can be seen in Appendix 1.

The fire wood consumption shows that the weighted per capita for all groups are 30.39 kg 32.81 kg and 42.55 kg per annum on the basis of daily, weekly and annual estimates respectively. The difference between two results of daily and weekly basis shows small difference but annual basis shows big difference of 31.36% and 29.68% higher than daily and weekly basis respectively. The results on daily basis is accepted for estimates for obvious reason. In cubic meter (m<sup>3</sup>) term the annual per capita averages are .043 m<sup>3</sup>, .046 m<sup>3</sup> and .06 m<sup>3</sup> respectively on three estimates. For estimation purpose these per capita could not be used because the disaggregated estimates are based on rich and poor household basis. Those are the adjusted weighted per capita for specific income groups.

Table 2 shows the <sup>annual</sup> daily estimates of fuel consumption.

(b)  
Table 2 - Traditional Fuel Consumption

Items	Kilogram	%	000 Kilo Calori	% of Total
Fuelwood	30.39	6%	93.87	6%
Branches	71.78	14%	221.73	14%
Tree Waste	125.21	24%	377.51	24.3%
Bamboo	21.84	4%	65.85	4%
Agri-Residue	187.61	36%	565.64	36%
Cow-dung	74.90	14%	209.05	13%
Charcoal	2.46	0.5%	19.90	1.5%
Total	514.19	100%	1553.55	100%

The present per capita use of all fuel energies in rural areas is 514.19 kg which in calorific value is 1.55 million kilo calori/ annum. Among the fuel items tree fuels provide 44%. Proper firewood provides only 6% of the energy in 1991. Agriculture residue including cow-dung provides 50% of the total energy.

The results can be compared with the findings of previous studies. The per capita consumption of fuelwood has decreased in all estimates of daily, weekly and annual basis. Douglas' results are presented in Table 3.

The consumption of fuel energy in kilo calories term has increased from some of the previous studies. According to Bangladesh Energy Study, 1976 the per capita consumption was only 0.71 million kilo calories while in the study of Islam, 1979, it was 1.00 million kilo calori. Briscoe, 1979, found the per capita consumption as 1.65 million kilo calori and Douglas, 1981, 1.06 million kilo calori. Briscoe has more consumption than the Master Plan estimate which is 1.55 million kilo calories.

Table 3 - Annual Fuel Consumption in Rural Bangladesh, 1981

Household Land Area Category (ha)	Estimate of Fuel Usage lbs/ Capita (bracketed figs. kgs/ Capita)													
	Firewood			Branches			Tree Waste		Bamboo		Agri Residue		Charcoal	
	D	W	A	D	W	A	D	A	D	A	D	A	D	A
0 - 0.4	33.1	32.8	33.5	42.6	43.1	43.1	151.2	129.8	16.2	24.7	246.1	177.9	3.1	
0.4 - 0.8	23.5	23.3	23.5	40.2	51.9	55.1	147.2	122.6	31.4	31.6	262.5	148.6	0.5	
0.8 - 1.2	39.2	34.3	34.3	47.1	49.1	45.2	141.8	102.2	25.3	33.8	270.9	149.2	3.6	
1.2 - 1.6	35.7	26.2	26.5	51.0	47.7	49.8	132.3	86.0	31.9	26.9	259.2	131.9	3.1	
1.6 - 2.0	41.6	37.1	38.3	54.9	44.3	44.2	137.7	85.1	26.7	24.4	271.8	125.2	1.4	
2.0 - 2.4	43.3	51.9	49.5	52.3	48.8	47.3	138.6	82.0	30.5	31.9	265.1	111.0	3.8	
2.4 - 2.8	34.5	39.2	39.2	42.0	34.9	45.1	113.0	62.7	27.1	32.7	230.3	125.6	4.1	
2.8+	56.6	52.7	53.5	60.5	60.8	63.0	116.5	59.5	29.9	22.7	270.0	74.9	2.8	
Weighted Average Consumption/ Capita	37.0	35.3	35.5	48.5	48.8	49.4	140.0	104.5	24.7	27.5	251.0	142.7	2.6	
Weighted Average Consumption Capita as measured by FMS	29.3	37.5	37.5	65.5	86.8	45.9	168.6	124.7	25.9	20.9	251.8	210.9	1.8	

Source: Consumption and supply of wood bamboo in Bangladesh, J.J. Douglas, BGD/78/010, 1981.

Note: D = Daily estimates  
W = Weekly estimates  
A = Annual estimates

## 1. Consumption

Table 4 shows the existing level of fuel wood consumption per capita/ annum in cubic metres. The results show that small landholders use less than large landholders.

Table 4 - Fuelwood Consumption by Land Class, m<sup>3</sup>/ A

Land Class (ha)	Household Consumption		
	Daily	Weekly	Annual
0 <0.2	.035	.037	.044
0.2 <1.0	.052	.055	.072
1.0 <3.0	.059	.067	.098
>3.0	.072	.079	.099

The daily estimates are minimum among the three estimates but comparable with the weekly estimates. For all cases, annual estimates show higher consumption than the daily and weekly estimates. Parenthesis presents the consumption per capita/ annum in cubic meters which shows both consistent increase from daily to annual estimates as well as from landless to a higher land class.

The results seem consistent between land class where the per capita for the lowest landclass is less than half of the highest land class in all three estimates. The variation of results between daily, weekly and annual estimates may be the outcome of the responses from the varying memories. Annual figures are mostly dependent on distant memory of last year's consumption. An upward bias is possible. The consumption of yesterday is more fresh in the memory of respondents which could be more accurate and reliable to accept. In daily cases, the enumerator could also help the respondent answer accurately showing the amount of quantity still left over in the backyard of the respondent.

The weighted average of consumption per capita on a daily basis is applied for all land classes for further estimates and for demand projections.

It is believed that the consumption of fuelwood for domestic purposes has been reduced since the last survey in 1981. In that survey, the per capita for the whole country was .059 m<sup>3</sup>/ annum which is the same as the highest land class representing only 3-4 of the population. One reason for this could be the higher price of fuelwood which is beyond the capacity of the poor to afford on a regular basis. There may also be less availability in many areas. Most of the richer people in the villages use the fuelwood free of cost as a product of their own groves. Usually they do not sell the firewood unless it is in big lots. Poor people normally sell trees along with large branches and use only the small branches and twigs.

In the case of questions regarding seasonal variation of firewood use, the responses showed bias in favour of the wet season although they could not give the exact amount used during the last wet season. It appears to be an obvious bias. Because of lack of quantitative data, the responses could not be processed further.

From the survey, the overall energy consumption is assessed, including fossil fuel and charcoal. The overall energy consumption is presented in Table 5 showing comparative fuel consumption between recent surveys and in different

Table 5 - Annual Consumption of Traditional Fuel in Bangladesh, Per Capita

Studies	Fuelwood	Other Tree Fuels	Agri-residue/ Others
Master Plan	30.30 kg (.043 m <sup>3</sup> )	197.43 kg (0.279 m <sup>3</sup> )	284.35 kg(0.4027 m <sup>3</sup> )
Douglas	3.52 ft <sup>3</sup> (0.1 m <sup>3</sup> )	189 kg (0.267 m <sup>3</sup> )	4.18 x 10 <sup>6</sup> BTU (1.06x10 <sup>6</sup> kcal)

Douglas estimated fuelwood consumption to be 0.1 m<sup>3</sup>/capita which is more than the estimates of the present survey. Later he adjusted his estimates and derived 0.59 m<sup>3</sup> to be an average, still higher than present overall estimates.

## 2. Branches

For branches, the survey shows that weighted averages are 71.78 kg, 72.22 kg and 74.45 kg respectively on daily, weekly and annual basis. The estimates are closer to each other and variations are negligible. In m<sup>3</sup> terms, per capita consumptions are .101 m<sup>3</sup>, .102 m<sup>3</sup>, and .105 m<sup>3</sup> respectively. Leaves and twigs also form important tree fuel for rural areas.

The important finding of the survey reveals that the village people use more tree waste than branches and more branches than fuelwood. Among the traditional fuels, agriculture wastes are used extensively.

There has been confusion in identifying fuelwood in the earlier studies of Douglas and Byron because large branches are included in fuelwood. It is difficult to determine the size of branch to be called "large". This may vary from respondent to respondent. To avoid confusion, the enumerators were instructed to include only small branches which do not require major chopping to be used as fuelwood in the branch category in the questionnaire. The results do not include any branch of proper fuelwood category. In the table branches mean small branches. During training, enumerators were instructed to clarify what the team meant by "large" branches to the respondent.

## 3. Other Tree Waste

Other tree waste includes twigs, leaves, barks, small chips and rotten roots after felling of trees. The results of these items are also consistent with the general belief and experiences. Tree waste is used more by the low income group than the higher income group. The lowest income group among the four landclasses uses the highest amount of tree wastes in relation to other tree fuels. On an average, they use 138 kg of tree waste per capita/annum while the highest group use only

87 kg. per capita/ annum. The average annual consumption for four land class are 138 kg, 119 kg, 123 kg and 87 kg respectively. In cubic meter terms, these are 0.195 m<sup>3</sup>, 0.168 m<sup>3</sup>, 0.174 m<sup>3</sup> and 0.123 m<sup>3</sup> respectively. Bamboo is also used as fuel but only as a second time use. A very small amount or none is being used for the first time. Only when the bamboo poles, fencing or implements get older and damaged, are they used as fuel energy.

#### 4. Agricultural Waste

Agricultural waste including cow dung forms one of the major bio-mass energy supplies in the villages. Most of the households are totally dependent on the agri-waste for their cooking, boiling and processing. From the survey it is revealed that per capita consumption of agri-waste is high for all land classes. For higher land holding groups it is more than the lower groups. This may happen because of lot of processings are necessary for agri-crops in richer farm families than poor families. Fuel requirement increases with the quantity of crops harvested by the farmers. In the case of cow-dung, the lower land holding group is using more than higher land holding groups. The results are closer for daily, weekly and annual estimates. The results can be seen in Table 1.

#### 5. Charcoal

Charcoal manufactured and processed by machine is not readily available and popular in all parts of Bangladesh. In Bangladesh, charcoal is not being used in households for cooking but is mostly used in blacksmith shops or in laundries.

In some parts of the country, low grade peat is found in the marshy lands and hoars. During the dry season, people collect this and dry it in the sun for use in the wet season. The use of charcoal shown in the result table, is mostly of low grade peat rather than charcoal proper. Its use is more in the lower part of greater Mymensingh and Sylhet districts.

#### Regional Fuel Consumption Variations

The fuel consumption and its nature varies from one region to another depending on the endowment of different fuel materials in the area. The survey was carried out on the basis of stratified regions. Regional variations in the use of fuel energy can be identified and assessed properly and measures recommended to augment the supply of fuelwood.

##### 1. Northwest

Stratum-I, the Northwest part of Bangladesh representing the Rajshahi Division forms Stratum-I.

This area is hard hit by drought every year. Moreover, the Farakka Barrage on the Ganges has far reaching adverse affects on the environment of the zone. The fertility of the soil is being reduced which may be the result less use of manure and green fertilizer. To many experts, the process of desertification has already been started in the region. A massive afforestation programme and supply of alternative fuel as a substitute for cow-dung and agricultural residue could be a solution.

In this region the use of fuelwood proper and branches is minimum, only 9.2 kg/capita/ annum for firewood and 33.3 kg/capita/ annum for branches. On the basis of daily and weekly averages in cubic meters, .013 m<sup>3</sup> capita/ annum and .047 m<sup>3</sup> respectively are used. Agriculture wastes occupy

the first position, being 367 kg/capita/annum followed by cow-dung, 146 kg and then tree waste of 134 kg. Firewood and branches provide 5% of the total bio-mass energy used by the rural households. Among the remaining 95%, 70% is supplied by the agri-residue and cow-dung. The remaining 15% is provided by tree waste and bamboo.

In this area, there are fewer trees/capita and average tree cover/square km is also minimal. The per capita standing volume is .50 cubic meter. The consumption of only 9 kg of firewood/capita/annum seems very low. However, most fuelwood available in this stratum probably goes to the brick fields and other commercial uses. The reliability of the estimate may be confirmed considering the total reality of the region.

Firewood use among landclasses shows that the landless or nearly landless group use only 2.5 kg of firewood/capita/annum or virtually none. The second and third category of household use is 13 kg and 11.2 kg per capita, respectively. It is shown that the higher land group uses less than group two and group three. They use higher amounts of agri-residue, 511 kg/capita/annum. The survey results for this stratum are presented in Table 5. Daily estimates are considered for analysis.

The use of charcoal and other fossil energy was not found during the survey. The change in the pattern of fuel consumption can be seen from Douglas, 1981. The stock of standing volume has reduced from .68 m<sup>3</sup> per capita/annum to .50 m<sup>3</sup> per capita/annum from 1981. Average energy consumption per capita is also less than other strata.

## 2. Northcentral

The regions of greater Dhaka and Mymensingh Districts form Stratum-II. The results of the survey for this stratum are presented in Table 4.

From the table it is clear that there are variations in the consumption of fuel energies on different basis of daily, weekly and yearly estimates. Average of daily and weekly are closer than the annual basis for fuelwood and all three are closer in case of branches. It is assumed that the average of which give the closer approximation to reality. In this case it is 43.74 kg of fuelwood per capita/annum which .062 m<sup>3</sup>. For annual basis it is 64.53 kg (e.i. .091 m<sup>3</sup>) per capita/annum. All three estimates for uses of branches show the closer figure. The use of agriculture residue and cow-dung is less in this region than Stratum-I. The use of fuelwood seems more than the national average. Kerosene use for cooking purposes is rarely found in this stratum but some charcoal is used by the middle land holding class.

The consumption by landclass also shows consistent variation. The small land holders consume 28.90 kg of firewood, 54.20 kg of branches and 116.50 kg of tree waste on a daily estimate basis, which are .04 m<sup>3</sup>, .076 m<sup>3</sup> and 0.165 m<sup>3</sup> respectively. The use of bamboo for fuel energy is less than Stratum-I.

**Table 6 - Annual Fuel Consumption in Stratum I, Kg/Capita**

Land area (ha)	Firewood			Branches			Tree Waste			Bamboo			Agri Residue			Cow-dung		
	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A
0 <0.2	2.00	3.50	13.90	31.00	43.60	49.70	182.10	176.60	164.60	67.20	45.70	45.30	272.20	255.50	265.80	94.20	118.20	133.30
0.2 <1.0	13.00	20.00	39.70	30.80	42.20	54.40	145.70	148.50	133.60	32.00	37.60	52.80	344.50	312.00	313.30	141.40	137.90	158.00
1.0 <3.0	11.20	19.80	48.50	33.60	51.30	58.10	119.00	105.50	102.10	26.30	29.80	38.40	335.70	319.70	301.20	163.40	167.30	189.10
> 3.0	4.60	48.90	71.40	38.40	44.90	61.40	103.30	96.40	89.80	25.80	25.20	41.80	511.50	386.70	419.90	164.90	161.80	167.20
All area average	7.70	23.05	43.38	33.45	45.50	55.90	137.53	131.75	122.53	37.83	34.58	44.58	365.98	318.48	325.05	140.98	146.30	161.90
Weighted average	6.46	12.27	28.05	29.29	41.27	49.03	143.92	139.51	129.46	43.79	36.35	42.33	290.77	267.07	269.95	114.41	124.68	140.72
Weighted average in m <sup>3</sup>	0.0092	0.0174	0.0397	0.0415	0.0585	0.0694	0.2039	0.1976	0.1834	0.0620	0.0515	0.0600	0.4119	0.3783	0.3824	0.1621	0.1766	0.1993
Thousand kilo calori	19.95	37.90	86.65	90.48	127.48	151.45	433.92	420.62	390.32	132.03	109.60	127.62	876.67	805.22	813.90	319.32	347.98	392.75

Note: D = daily estimates; W = Weekly estimates; A = Annual estimates.

**Table 7 - Annual Fuel Consumption in Stratum II, Kg/Capita**

Land area (ha)	Firewood			Branches			Tree Waste			Bamboo			Agri Residue			Cow-dung			Charcoal			
	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	
0 <0.2	28.90	44.00	53.60	41.10	47.50	116.50	62.20	115.80	16.20	15.90	14.70	111.10	95.30	78.00	35.20	43.80	35.00	0.00	0.00	0.00	0.00	0.00
0.2 <1.0	53.20	53.50	76.70	45.00	49.00	118.70	67.50	106.00	8.60	12.70	17.10	133.00	122.90	106.10	51.30	57.40	50.10	1.80	1.60	1.60	1.60	1.60
1.0 <3.0	69.10	71.30	106.00	39.70	46.40	123.90	75.30	123.70	11.80	13.20	18.50	146.60	135.80	123.00	25.20	24.90	25.20	4.20	3.60	3.60	3.60	3.60
> 3.0	63.40	58.00	104.80	42.70	48.20	81.90	52.20	84.70	11.20	11.30	17.20	144.50	135.30	123.70	48.90	44.60	45.00	0.00	0.00	0.00	0.00	0.00
All area average	53.65	56.70	85.28	42.13	47.78	110.25	64.30	107.55	11.95	13.28	16.88	133.80	122.33	107.70	40.15	42.68	38.83	1.50	1.30	1.30	1.30	1.30
Weighted average	40.04	47.41	64.53	38.62	43.85	107.92	60.32	107.07	11.98	13.20	14.78	114.06	102.04	87.10	35.56	41.18	35.07	1.13	0.99	0.99	0.99	0.99
Weighted average in m <sup>3</sup>	0.0567	0.0672	0.0914	0.0640	0.0547	0.1529	0.0854	0.1474	0.0170	0.0187	0.0209	0.1616	0.1445	0.1234	0.0504	0.0583	0.0497	0.0016	0.0014	0.0014	0.0014	0.0014
Thousand kilo calori	123.68	146.45	199.33	139.62	119.30	325.38	181.86	313.77	36.12	39.80	44.56	343.89	307.65	262.61	99.25	114.93	97.88	9.14	8.01	8.01	8.01	8.01

Note: D = Daily estimates; W = Weekly estimates; A = Annual estimates.

### 3. West

Stratum-III, the West includes the west and central west part of the country covering regions of greater Jessore, Kushtia, Faridpur and part of Khulna. The survey results of fuel consumptions are presented in Table 5.

In this stratum, the consumption of firewood is also compared to Stratum-I. Consumption is 12 kg per capita/annum both for daily and weekly basis and 18 kg for annual basis or .016 m<sup>3</sup> and .025 m<sup>3</sup> respectively, which is less than national averages. The overall consumption of tree fuel is similar to Stratum-II.

The consumption of branches is 62.08 kg (.087 m<sup>3</sup>) while consumption of tree waste is 142.41 kg (.201 m<sup>3</sup>) which is more than Stratum-II. This result is consistent considering the real characteristics of the areas. Due to less availability of tree fuel, the consumption of agri-residue is very high in this stratum. Among the different land holding classes, small holders use less firewood than other classes but have similar per capita use of branches and more of tree wastes. The use of cow-dung is the second highest among the strata.

According to the inventory survey, per capita standing volume for this strata is .58 m<sup>3</sup> which is less than the national average as well as that of the 1981 survey.

### 4. South

Stratum-IV includes the southern regions of Barisal, Patuakhali and forest fringe of greater Khulna districts are included in Stratum-IV. The survey results for the stratum are presented in Table 6. Result show that this stratum is endowed with more forest resources than other areas and the per capita consumption of tree fuel, including fuelwood is also more. The results for firewood consumption vary according to three basis of estimates. The daily basis is the lowest which is 55.5 kg/capita/annum (.078 m<sup>3</sup>) and annual basis is the highest with 72.91 kg/capita/annum (0.103 m<sup>3</sup>).

While tree fuel is used more in this strata, the use of agri-residue is less. From the inventory results this stratum is found to have the highest stock of .91 m<sup>3</sup>/capita/annum. The present stock is less than Hammermaster's study (1981) of 1.33 m<sup>3</sup>/capita. This reflects the wholesale reduction of reserves in the country in per capita terms.

The results for land holding class also confirms the general observation and experience that landless classes use less firewood than upper land holding classes. The results of daily, weekly and annual estimates show less variation and more consistency to each other, unlike the results of other strata.

### 5. Southeast

Stratum-V includes the southeastern areas of Chittagong Division except the Hill Tracts regions, Brahmanbaria and greater Sylhet district. The survey results of this stratum are presented in Table 7. All three estimates show the closer approximation of fuelwood consumption. On average, it is 27 kg (.038 m<sup>3</sup>) per capita/annum which is less than the national average. Use of branches and tree wastes is higher than in other strata except for stratum-VI. Use of cow-dung is minimum. Average use of branches and tree waste is 110 kg (.155 m<sup>3</sup>) and 120 kg (.169 m<sup>3</sup>) respectively. This region has the second highest per capita stock volume of .73 m<sup>3</sup> in the village groves. The maximum uses of branches and tree waste may be subscribed to their availability from the nearby reserve forests and village groves.



**Table 8 - Annual Fuel Consumption in Stratum III, Kg/Capita**

Land area (ha)	Firewood			Branches			Tree Waste			Bamboo			Agri Residue			Cow-dung		
	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A
0 < 2	6.80	5.80	11.50	65.30	75.90	77.70	170.20	165.40	157.50	39.50	34.50	34.30	275.20	264.40	279.40	96.30	96.30	92.70
0.2 < 1.0	17.70	17.90	22.00	65.80	62.90	65.70	135.70	134.00	124.40	19.10	15.90	19.60	238.40	227.20	232.00	110.60	112.50	111.50
1.0 < 3.0	19.40	21.00	30.90	71.10	74.50	75.50	151.90	142.40	126.20	17.90	19.10	22.80	229.00	219.00	212.90	104.70	96.10	82.60
> 3.0	18.40	23.90	27.20	69.80	77.20	84.70	114.80	110.30	98.00	16.80	19.10	23.50	261.00	247.20	243.30	110.00	100.00	95.00
All area average	15.58	17.15	22.90	68.00	72.63	75.90	143.15	138.03	126.53	23.33	22.15	25.05	250.90	239.45	241.90	105.40	101.23	95.45
Weighted average	12.35	12.53	18.12	62.08	66.57	68.59	142.41	137.90	128.25	25.72	23.11	24.98	235.27	225.18	231.27	95.6	94.01	89.36
Weighted average in m <sup>3</sup>	0.0175	0.0177	0.0257	0.0879	0.0943	0.0972	0.2017	0.1953	0.1817	0.0364	0.0327	0.0354	0.3332	0.3190	0.3276	0.1354	0.1332	0.1266
Thousand kilo calori	38.15	38.71	55.97	191.77	205.63	211.87	429.37	415.77	386.67	77.55	69.68	75.31	709.34	678.92	697.28	266.82	262.38	249.40

Note: D = Daily estimates; W = Weekly estimates; A = Annual estimates.

**Table 9 - Annual Fuel Consumption in Stratum IV, Kg/Capita**

Land area (ha)	Firewood			Branches			Tree Waste			Bamboo			Agri Residue			Cow-dung		
	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A
0 < 20	42.80	44.90	49.30	143.80	145.20	132.30	134.80	140.80	133.90	17.60	17.60	21.70	206.80	187.90	168.00	118.50	110.30	90.20
0.2 < 1.0	78.80	83.90	104.00	115.90	113.50	134.00	162.50	164.40	137.90	13.10	10.80	14.90	154.10	143.30	121.60	58.50	60.70	63.80
1.0 < 3.0	56.90	77.60	105.60	134.60	126.10	134.70	202.00	185.70	209.20	34.90	31.30	36.00	161.80	137.20	124.40	59.50	57.00	55.60
> 3.0	108.70	95.80	97.00	141.50	137.00	116.90	114.80	105.80	79.70	6.10	4.00	2.20	125.10	123.00	105.50	47.10	48.20	44.50
All area average	71.80	75.55	88.98	133.95	130.45	129.48	155.78	149.18	140.18	17.93	15.93	18.70	161.95	147.85	129.88	70.90	69.05	63.53
Weighted average	55.50	60.56	72.91	122.89	121.29	122.65	146.38	142.88	134.22	17.02	15.68	19.33	164.94	149.78	131.98	79.31	76.17	68.23
Weighted average in m <sup>3</sup>	0.0786	0.0858	0.1033	0.1741	0.1718	0.1737	0.2073	0.2024	0.1901	0.0241	0.0222	0.0274	0.2336	0.2122	0.1869	0.1123	0.1079	0.0966
Thousand kilo calori	171.44	187.07	225.22	379.61	374.66	378.87	441.34	430.78	404.67	51.32	47.28	58.28	497.29	451.59	397.92	221.35	212.59	190.43

Note: D = Daily estimates; W = Weekly estimates; A = Annual estimates.

## 6. Northeast

Stratum-VI represents the northeastern parts of the country, including greater Sylhet, lowlying areas of Mymensingh and Brahmanbaria districts. The survey results are presented in Table 11. This stratum shows moderate use of firewood and other tree fuels. The estimates are closer for all three basis. The use of agri-residue and cow-dung is also moderate. The average consumption of fuelwood is 36.66 kg/ per capita/ annum, the uses of other tree fuels are less than in other areas. Use of bamboo as fuel energy is also minimum. This area shows higher use of charcoal which is actually the use of lower grade peats available in the marshy areas of Sylhet and Mymensingh.

### Fuelwood Assessment

#### 1. Domestic

Shortage of firewood is a chronic problem in the country. Supply-demand scenarios describe the supply gap in most areas. Even with the best recommended supply scenario, there has been a wide gap between the demand and supply of fuelwood. Conservative estimates are taken for consideration, keeping in view the problem of shortage of supply all over the country except in Chittagong Hill Tracts region.

The estimation of current consumption of fuelwood for domestic purposes has been derived from the consumption of poor and rich households in urban and rural areas. Poor household are defined as those owning less than 1.0 ha of land. The rural rich are defined as owning more than a hectare of land. For urban areas, the top 20% of the total urban population is termed as rich and the remaining 80% is poor, following the distribution of Byron (1984).

The survey shows that the per capita annual consumption for rural rich is .065 m<sup>3</sup> and rural poor is .043 m<sup>3</sup>. This result is applied for the fuel wood consumption of urban areas also. The estimates are based on daily consumption figures of different land classes and averaging them in groups of poor and rich.

In the urban areas declining use of firewood is due to use of gas, oil and other commercial fuels. These are convenient, economic, and easier for maintaining cleanliness of the household and cooking utensils

Recently the distribution of LPG throughout the country also reduced the urban consumption of firewood. The expansion of the gas network to the other side of the Jamuna after the bridge is constructed will further reduce the use of firewood in the urban areas of northwestern Bangladesh.

The estimate, based on weighted average for all classes, shows the per capita consumption as .049 m<sup>3</sup> which is less than Douglas and Byron's estimate of .059 m<sup>3</sup>. The average per capita for all three estimates could not be used to avoid upward bias of the consumption. For better approximation, the uses of varying estimates for rich and poor is used.

Table 10 - Annual Fuel Consumption in Stratum V, Kg/Capita

Land area (ha)	Firewood			Branches			Tree Waste			Bamboo			Agri-Residue			Cow-dung		
	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A
0 < 2	29.20	22.80	17.70	147.40	132.30	112.00	166.40	146.60	134.20	20.30	22.40	14.80	148.60	142.30	128.70	57.10	45.80	42.20
0.2 - < 1.0	33.00	33.60	38.00	97.40	98.20	97.20	123.30	112.30	101.80	22.20	18.60	15.40	198.50	192.90	179.30	58.30	61.10	60.90
1.0 < 3.0	43.30	45.90	54.10	140.80	134.50	158.70	108.30	102.50	123.70	17.80	16.90	20.10	133.10	119.20	115.40	41.70	40.00	46.00
> 3.0	46.60	49.00	64.40	125.60	126.70	163.00	83.10	85.20	108.20	11.10	16.40	13.90	203.70	185.70	181.40	35.40	33.60	35.70
All area average	38.03	37.83	43.55	127.80	122.93	132.73	120.28	111.65	116.98	17.85	18.58	16.05	170.98	160.03	151.20	48.13	45.13	46.20
Weighted average	29.56	27.04	27.09	116.93	109.59	102.29	131.53	117.92	110.58	18.97	18.67	14.26	152.96	146.63	135.12	51.21	46.73	45.54
Weighted average in m <sup>3</sup>	0.0419	0.0383	0.0384	0.1656	0.1552	0.1449	0.1863	0.1670	0.1566	0.0269	0.0264	0.0202	0.2167	0.2077	0.1914	0.0725	0.0662	0.0645
Thousand kilo calor	91.31	83.53	83.68	361.20	338.52	315.97	396.56	355.53	333.40	57.19	56.29	42.99	461.17	442.09	407.39	142.93	130.42	127.10

Note: D = Daily estimates; W = Weekly estimates; A = Annual estimates.

Table 11 - Annual Fuel Consumption in Stratum VI, Kg/Capita

Land areas (ha)	Firewood			Branches			Tree Waste			Bamboo			Agri-residue			Cow-dung			Charcoal		
	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A	D	W	A
0 < 2	41.10	38.80	42.80	53.90	56.20	57.80	103.50	102.10	102.10	4.20	3.40	7.40	151.80	157.00	145.80	87.90	85.70	92.30	15.60	13.30	9.30
0.2 - < 1.0	28.50	26.90	28.20	59.20	61.10	64.90	80.40	70.30	70.30	21.70	19.30	19.10	225.80	223.20	214.70	63.70	65.60	71.70	15.00	12.60	6.90
1.0 < 3.0	51.00	50.60	70.20	49.60	48.30	47.70	72.60	71.30	71.30	23.40	25.50	25.20	217.80	222.10	183.40	93.70	93.30	92.70	15.10	11.00	4.30
> 3.0	63.70	59.10	57.30	60.30	58.70	53.50	56.60	53.10	28.50	23.60	25.10	93.10	95.00	85.80	81.30	85.40	77.00	0.00	0.30	1.20	
All area average	46.08	43.85	49.63	55.75	56.08	55.98	77.30	74.20	74.20	19.45	17.95	19.20	172.13	174.33	157.43	81.65	82.50	83.43	11.43	9.30	5.43
Weighted average	36.66	35.00	40.38	50.77	52.05	53.59	82.22	78.36	78.36	12.95	12.11	13.78	171.11	173.39	159.22	74.95	74.60	78.87	13.68	11.30	6.80
Weighted average in m <sup>3</sup>	0.0519	0.0496	0.0572	0.0719	0.0737	0.0759	0.1165	0.1110	0.1110	0.0183	0.0172	0.0195	0.2424	0.2456	0.2255	0.1062	0.1057	0.1117	0.0194	0.0160	0.0096
Thousand kilo calor	113.24	108.12	124.73	156.83	160.78	165.54	247.11	236.26	236.26	39.04	41.55	41.55	515.90	522.77	480.05	209.19	208.21	220.13	110.67	91.42	55.01

Note: D = Daily estimates; W = Weekly estimates; A = Annual estimates.

## 2. Industrial/ Commercial

Among the commercial and industrial uses of fuelwood, the single major consumers are brick fields. Among the total commercial consumption, 75% or more goes for this purpose. All other uses are - road tarring, tea processing, tobacco curing, baking, pottery, lime processing, hotels and restaurants. The second highest use is in road construction which uses about 8% of the commercial requirements. The estimates for different commercial uses of fuelwood are derived from the secondary sources of information and data. The basis of the estimate has been accepted from the results of the BEPP study, 1986, and up-dated for the year 1991. Results are presented both in metric tons and cubic meters.

The consumption of fuelwood in 1991 including domestic cooking and commercial uses is presented in Table 12.

Table 12 - Industrial Consumption of Fuelwood, 1991

Domestic Cooking	Industrial/ Commercial								Total
	Brick burning	Road tarring	Tea processing	Tobacco curing	Baking	Soap	Pottery	Others	
(in million ton)									
3.600	1.520	0.163	0.079	0.066	0.081	0.009	0.034	0.060	2.012
(in million m <sup>3</sup> )									
5.119	2.158	0.231	0.112	0.094	0.115	0.013	0.048	0.085	2.856
Grand Total	(Domestic Cooking + Industrial Commercial) = 7.975 million m <sup>3</sup>								

## 3. National Demand

The national demand estimate of fuelwood is based on the population of the country as well as the per capita results of the survey. Regional distribution is made on the basis of regional population and its distribution of rural, urban, rich and poor. Industrial and commercial consumption is also distributed according to regional population. The fuelwood demand for 1991 is presented in Table 13.

Table 13 - 1991 National Fuelwood Demand, (000 m<sup>3</sup>)

Users Sector	North-West	N-Central	West	South	South-East	N-East	Ctg Hill Tracts	Total
	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII	
Urban Rich	27.05	79.94	24.82	13.43	47.71	18.34	2.03	213.33
Urban Poor	71.59	211.53	65.68	35.55	126.24	48.54	5.37	564.49
Rural Rich	131.67	227.52	165.97	136.50	184.22	151.81	10.89	1190.58
Rural Poor	830.03	602.05	439.18	361.21	487.47	401.72	28.81	3150.29
Domestic total	1242.35	1121.03	695.65	546.70	845.64	620.41	47.09	5118.69
Industrial	690.40	625.70	426.20	271.10	472.00	346.20	22.20	2856.80
Grand Total	1935.75	1746.73	1121.85	817.80	1317.64	966.61	69.29	7975.49

Note:

- Results are derived on the basis of actual population of 1991.
- Rich and poor in urban and rural areas are assumed to be 1:4 in ratio.
- Industrial consumption includes commercial and institutional demand.
- Same level of consumption per capita applied for Chittagong Hill Tracts region.

## **PROJECTION OF FUELWOOD DEMAND**

Fuelwood is a significant forest product in Bangladesh with very limited alternatives for use, particularly in the rural areas. It is expected that the use of firewood in the urban areas will be reduced with affluence and increased income. On the other hand, it could increase in the rural areas with rising income and wealth. Three alternative scenarios have been projected for fuelwood consumption for the next 20 years, status quo scenario, low consumption scenario and high consumption scenario.

### **General**

#### **1. Consumption Standard**

Consumption standard is a dynamic concept for a nation and varies with the stages of development. The consumption of fuelwood for domestic purposes is an outmoded way of living in most developed societies. Today there are various convenient and superior alternative energies available in those countries. The situation in Bangladesh is different. The lack of a superior substitute or expansion programme of gas supply compels the use of fuelwood particularly in the rural areas. The present consumption per capita is lower than it was 10 years ago. With the increase in per capita GDP the consumption per capita has gone down not because of shifting to superior and convenient substitutes of wood but due to shortage of local supplies. It is assumed that supply has been reduced even more for household consumption. The present pattern of consumption per capita may change with the change in the economic growth, availability of cheap and superior substitutes as well as the availability of supplies of fuelwood in abundance. If the supply grows, then the consumption will also grow.

The projection for status quo and low consumption scenarios has been made on the basis of current consumption standards for different classes of people which remain constant throughout the planning period. It is customary to project future demand on the basis of economic growth and it is generally agreed that, when the income grows the consumption will also grow. For fuelwood consumption in rural Bangladesh, this has not been the case. The survey confirms that the current consumption of firewood is less than what it was in 1980 though income has grown at a rate of 3.5% per annum over the period. Moreover, fuelwood became expensive in relation to natural gas and LPG which inspired urban consumers to change.

#### **2. Regional Variation**

It is assumed that all households, rural and urban in Stratum I, III and IV will continue to use fuelwood for domestic purposes during the plan period. There is little possibility of connecting gas supplies to the other side of the Padma and the Jamuna in this century. With the implementation of the Jamuna Bridge Project there will be a chance to connect the gas pipeline to the north-west of the country. This does not help the domestic consumption much because the government has no plan to supply the gas to all the rural consumers. When connected, 8% of the urban people of Stratum I may get benefits from the pipelines. There has been a wide expectation that industrial enterprises will be booming on the other side of the Jamuna with the introduction of gas after the bridge is built. Coal mining is an immediate possibility in the northwest if the financing arrangements are negotiated.

#### **3. Urban and Rural Consumption**

Survey results show consumption of urban rich and urban poor is the same as the rural rich and rural poor. It is assumed that only 20% of the urban people are considered to be rich although their income may be higher than the same class living in rural areas. The remaining 80% are treated as poor.

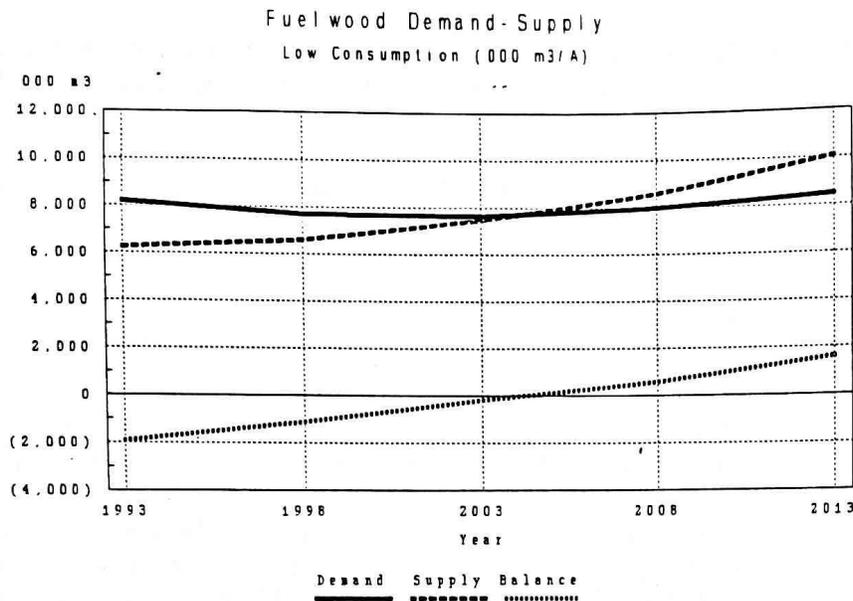


Figure 1 - Scenario 1 Fuelwood Development and Low Consumption

the regions of Stratum II, IV and VI even 50% of the urban houses could not be covered till now. However, as a matter of fact, the pressure on firewood will continue to grow with the growth of rural population even the gas network expands.

#### 4. Alternative Energy Sources

Use of coal, solar energy and popularisation of improved stoves will require time for implementation and were not considered to be effective until the beginning of the new century. This is a disappointing assumption and negative outlook but is close to the reality of Bangladesh. In the new century, it is expected that this programme will yield results if implemented properly, but in terms of a huge increased demand, this will not seriously affect the demand for fuelwood for domestic consumption.

The constant current consumption over the planning period will be seen as unrealistic to many readers. It is assumed that with gas connections to the major cities and increased coal availability to urban as well as industrial users, the demand for fuelwood will be reduced. The consumption of fuelwood will probably change from commercial use to more domestic use. However, people in rural areas will demand more fuelwood because of higher incomes and cheap availability.

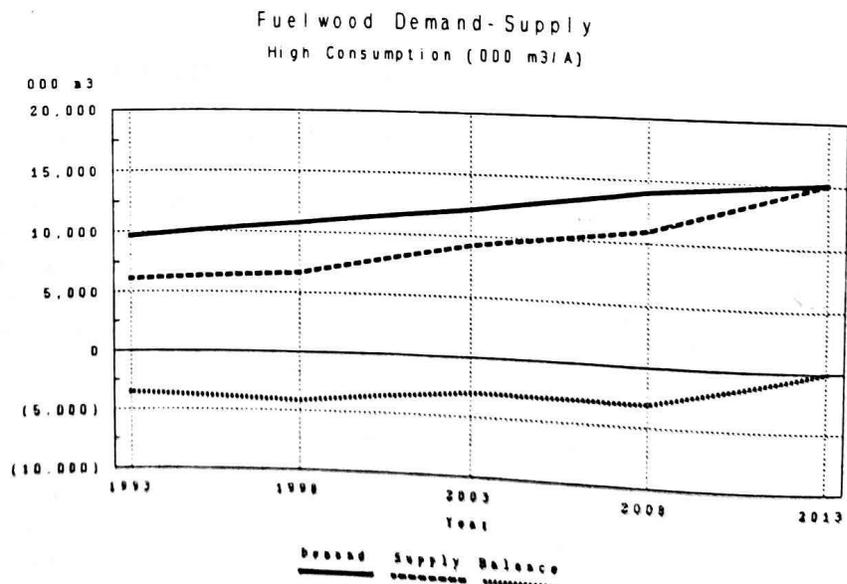


Figure 2 - Scenario 2 Fuelwood Development and High Consumption

It is generally believed that the urban consumption of fuelwood per household will be more than rural one because of more income and purchasing power. The team observed that those may be true for fuelwood consuming households only, when we consider to include all urban households in the per capita term the national average rightly holds true for them. In 1993 there will be 18 million people in the urban areas of which 30-35% will be under the gas supply network, the remaining 65-70% will be outside the coverage. In spite of the expansion of gas supply network during the past in

## 5. Population Growth Projection

Population is distributed by regions following the population census of 1991. The urban-rural, rich-poor and literate-illiterate are also distributed with the projected growth rate of population, literacy and urbanisation. Based on past data, Population growth looks to decline from 2.1 to 1.3% during the terminal years of the plan. The rate of urbanisation and literacy is assumed to increase to 35 and 36% respectively in 2013. Population distribution and projection can be seen in the Appendix 3. The same projections were used for the village inventory survey as well as for the household consumption survey and demand projections. During the prior two census Bangladesh's population grew at rates of 2.9% and 2.5% simple interest. This report continues this declining trend and uses an average rate of 1.86% during the plan.

### Demand Projection

#### 1. Status Quo

Status quo demand for fuelwood is projected on the basis of the following assumption and presented in Table 14 and Figure 1.

- a. Consumption demand has increased with growth in the population and households. The per capita present consumption remains throughout the planning period. Actual consumption per capita as derived from the survey is used throughout.
- b. There is no new invention and exploration of cheaper alternatives. No qualitative change in life style occurs. In the case of domestic consumption, the traditional fuel will dominate with higher uses of agricultural residue and cow-dung.
- c. Industrial and commercial consumption continues at the present level without any restriction.
- d. The investment in the forestry sector will remain the same with no major change in the management practice.
- e. Gas supply will be limited to big cities only and most of the rural areas will be outside the gas network.
- f. Large amounts of excess unsatisfied demand for fuelwood is observed throughout due to shortage of supply in most of the geographical regions.
- g. Excess supply in one area may not help meet the unsatisfied demand in another area because of transportation cost and low value of the produce.

#### 2. Scenario 1

This more likely scenario is projected on the basis of the following assumptions and presented in the Table 15 and Figure 2.

- a. Domestic consumption will be the same as the status quo scenario. No consumption growth is assumed because of GDP growth due to availability of substitutes and efficient use of fuelwood.
- b. The opening of coal mine in the north-west part of Bangladesh is assumed. The extracted coal will be used mostly for industrial and commercial purposes. Domestic use will be negligible because of price.

- c. Use of fuelwood for commercial purposes would gradually be replaced by commercial fuels like coal and gas. Imported coal will be replaced by local coal after the year 2000.
- d. With the enforcement of laws restricting fuelwood use in brick burning, the commercial use of fuelwood may be reduced up to 80% in the final year of the plan.
- e. Gas supply will be possible in the north because of the Jamuna Bridge. Major urban centres will come under the gas supply network and part of the excess demand could be met by gas and other efficient fuels.
- f. Moderate investment in the forestry sector is assumed and the supply will be the same as the status quo supply.
- g. Gradual reduction of gaps to the minimum to balance the demand and supply.

Table 14 - Fuelwood Supply-Demand Projection, Status Quo, (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
<b>1. Fuelwood</b>								
<b>Demand:</b>								
a. Domestic	1288.61	1162.78	721.56	567.05	877.13	643.51	48.85	5309.49
b. Industrial	719.06	648.85	441.97	281.13	489.46	359.01	23.02	2962.50
<b>Total</b>	<b>2007.67</b>	<b>1811.63</b>	<b>1163.53</b>	<b>848.18</b>	<b>1366.59</b>	<b>1002.52</b>	<b>71.87</b>	<b>8271.80</b>
<b>Supply</b>	<b>882.00</b>	<b>763.00</b>	<b>546.00</b>	<b>860.00</b>	<b>857.00</b>	<b>391.00</b>	<b>1880.00</b>	<b>6179.00</b>
<b>Balance</b>	<b>-1125.67</b>	<b>-1048.63</b>	<b>-617.53</b>	<b>-12.82</b>	<b>-509.59</b>	<b>-611.52</b>	<b>-1808.13</b>	<b>-2092.80</b>
1998								
a. Domestic	1404.27	1267.14	786.32	617.95	955.85	701.27	53.23	5786.03
b. Industrial	790.96	713.74	486.17	309.24	538.41	394.91	25.32	3258.75
<b>Total</b>	<b>2195.23</b>	<b>1980.88</b>	<b>1272.49</b>	<b>927.19</b>	<b>1494.26</b>	<b>1096.18</b>	<b>78.56</b>	<b>9044.79</b>
<b>Supply</b>	<b>969.00</b>	<b>843.00</b>	<b>597.00</b>	<b>931.00</b>	<b>932.00</b>	<b>434.00</b>	<b>1788.00</b>	<b>6494.00</b>
<b>Balance</b>	<b>-1226.23</b>	<b>-1137.88</b>	<b>-675.49</b>	<b>-4.19</b>	<b>-562.26</b>	<b>-662.18</b>	<b>-1709.44</b>	<b>-2550.79</b>
2003								
a. Domestic	1519.93	1371.51	851.09	668.85	1034.58	758.95	57.62	6262.52
b. Industrial	870.06	785.11	534.78	340.17	592.25	434.40	27.86	3584.63
<b>Total</b>	<b>2389.99</b>	<b>2156.62</b>	<b>1385.87</b>	<b>1009.01</b>	<b>1626.83</b>	<b>1193.35</b>	<b>85.47</b>	<b>9847.15</b>
<b>Supply</b>	<b>1062.00</b>	<b>927.00</b>	<b>656.00</b>	<b>1001.00</b>	<b>1027.00</b>	<b>478.00</b>	<b>1678.00</b>	<b>6829.00</b>
<b>Balance</b>	<b>-1327.99</b>	<b>-1229.62</b>	<b>-729.87</b>	<b>-8.01</b>	<b>-599.83</b>	<b>-715.35</b>	<b>+1592.53</b>	<b>-3018.15</b>
2008								
a. Domestic	1635.59	1475.87	915.85	719.74	1113.31	816.78	62.00	6739.14
b. Industrial	957.06	863.62	588.26	374.18	651.48	477.84	30.64	3943.09
<b>Total</b>	<b>2592.65</b>	<b>2339.49</b>	<b>1504.11</b>	<b>1093.93</b>	<b>1764.78</b>	<b>1294.63</b>	<b>92.64</b>	<b>10682.24</b>
<b>Supply</b>	<b>1174.00</b>	<b>1033.00</b>	<b>727.00</b>	<b>1146.00</b>	<b>1334.00</b>	<b>531.00</b>	<b>1577.00</b>	<b>7212.00</b>
<b>Balance</b>	<b>-1418.65</b>	<b>-1306.49</b>	<b>-777.11</b>	<b>+53.07</b>	<b>-430.78</b>	<b>-763.63</b>	<b>+1484.36</b>	<b>-3470.24</b>
2013								
a. Domestic	1751.25	1580.24	980.61	770.64	1192.03	874.54	66.38	7215.69
b. Industrial	1052.77	949.98	647.09	411.60	716.62	525.63	33.71	4337.40
<b>Total</b>	<b>2804.02</b>	<b>2530.22</b>	<b>1627.70</b>	<b>1182.24</b>	<b>1908.66</b>	<b>1400.17</b>	<b>100.09</b>	<b>11553.10</b>
<b>Supply</b>	<b>1300.00</b>	<b>1155.00</b>	<b>813.00</b>	<b>1346.00</b>	<b>1518.00</b>	<b>590.00</b>	<b>1486.00</b>	<b>8208.00</b>
<b>Balance</b>	<b>-1504.02</b>	<b>-1375.22</b>	<b>-814.70</b>	<b>+164.76</b>	<b>-390.66</b>	<b>-810.17</b>	<b>+1385.91</b>	<b>-3345.10</b>

### 3. Scenario 2

The high consumption demand is projected and presented in Table 16 and Figure 3. The results are based on the following assumptions.



- a. Replacement by all other traditional fuels as alternatives to fuelwood or even by tree fuel is not possible. Replacement of a part of the cow-dung use which is important for increasing fertility of the soil, is assumed.
- b. The higher income higher per capita consumption is assumed for domestic consumption.
- c. Industrial and commercial uses remained at the same level as Status Quo situation because of newer uses in other commercial fields.
- d. High investment supply is assumed.
- e. Excess demand is observed throughout with high investment supply. (7)

Table 15 - Fuelwood Supply-Demand Projection, Low Consumption (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
<b>1. Fuelwood</b>								
<b>Demand:</b>								
a. Domestic	1288.61	1162.78	721.56	567.05	877.13	643.51	48.85	5309.49
b. Industrial	693.40	625.70	426.20	271.10	472.00	346.20	22.20	2856.80
<b>Total</b>	1982.01	1788.48	1147.76	838.15	1349.13	989.71	71.05	8166.29
<b>Supply</b>	895.00	776.00	575.00	847.00	870.00	399.00	1880.00	6242.00
<b>Balance</b>	-1087.01	-1012.48	-572.76	+9.15	-479.13	-590.71	+1808.05	-1924.29
1998								
a. Domestic	1404.27	1267.14	786.32	617.95	955.85	701.27	53.23	5786.03
b. Industrial	243.39	730.48	218.18	131.45	415.19	143.20	31.15	1913.04
<b>Total</b>	1647.66	1997.62	1004.50	749.40	1369.04	844.47	84.38	7699.07
<b>Supply</b>	983.00	857.00	628.00	917.00	969.00	443.00	1788.00	6585.00
<b>Balance</b>	-664.66	-1140.62	-376.50	-168.60	-400.04	-401.47	+1703.62	-1114.07
2003								
a. Domestic	1519.93	1371.51	851.09	668.85	1034.58	758.95	57.62	6262.52
b. Industrial	403.00	188.39	256.68	163.27	142.13	208.50	13.37	1375.34
<b>Total</b>	1922.93	1559.90	1107.77	832.12	1176.71	967.45	70.99	7637.87
<b>Supply</b>	1202.00	1121.00	652.00	1075.00	1185.00	536.00	1678.00	7449.00
<b>Balance</b>	-720.93	-438.90	-455.77	+243.88	+9.71	-432.45	+1607.01	-188.87
2008								
a. Domestic	1635.59	1475.87	915.85	719.74	1113.31	816.78	62.00	6739.14
b. Industrial	298.48	269.33	167.17	130.85	203.17	149.05	11.31	1229.36
<b>Total</b>	1934.07	1745.20	1083.02	850.59	1361.48	965.83	73.31	7968.50
<b>Supply</b>	1380.00	1309.00	870.00	1236.00	1563.00	619.00	1577.00	8554.00
<b>Balance</b>	-554.07	-436.20	-213.02	+867.41	+202.52	-346.83	+1503.69	+586.50
2013								
a. Domestic	1751.25	1580.24	980.61	770.64	1192.03	874.54	66.38	7215.69
b. Industrial	298.48	269.33	167.13	130.85	203.17	149.05	11.31	1229.32
<b>Total</b>	2049.73	1849.57	1147.74	901.49	1395.2	1023.59	77.69	8445.01
<b>Supply</b>	1700.00	1662.00	1095.00	1355.00	1986.00	770.00	1486.00	10054.00
<b>Balance</b>	-349.73	-187.57	-52.74	+454.51	+591.80	-253.59	+1408.31	+1609.99

Table 16 - Fuelwood Supply-Demand, High Consumption (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
<b>1. Fuelwood</b>								
<b>Demand:</b>								
a. Domestic	1617.03	1459.11	866.12	746.86	1100.66	807.59	65.53	6662.91
b. Industrial	719.06	648.85	441.97	281.13	489.46	359.01	23.02	2962.50
<b>Total</b>	<b>2336.09</b>	<b>2107.96</b>	<b>1308.09</b>	<b>1027.99</b>	<b>1590.12</b>	<b>1166.60</b>	<b>88.55</b>	<b>9625.41</b>
<b>Supply</b>	<b>910.00</b>	<b>756.00</b>	<b>551.00</b>	<b>857.00</b>	<b>826.00</b>	<b>382.00</b>	<b>1840.00</b>	<b>6122.00</b>
<b>Balance</b>	<b>-1426.09</b>	<b>-1351.96</b>	<b>-757.09</b>	<b>-170.99</b>	<b>-764.12</b>	<b>-784.60</b>	<b>+1831.45</b>	<b>-3503.41</b>
1998								
a. Domestic	1829.76	1651.06	981.30	844.00	1245.45	913.83	74.02	7539.42
b. Industrial	790.96	713.74	486.17	309.24	538.41	394.91	25.32	3258.75
<b>Total</b>	<b>2620.72</b>	<b>2364.80</b>	<b>1467.47</b>	<b>1153.24</b>	<b>1783.86</b>	<b>1308.74</b>	<b>99.34</b>	<b>10798.17</b>
<b>Supply</b>	<b>1002.00</b>	<b>933.00</b>	<b>605.00</b>	<b>927.00</b>	<b>932.00</b>	<b>432.00</b>	<b>1865.00</b>	<b>6696.00</b>
<b>Balance</b>	<b>-1618.72</b>	<b>-1431.80</b>	<b>-862.47</b>	<b>-226.24</b>	<b>-851.86</b>	<b>-876.74</b>	<b>-1765.66</b>	<b>-4102.17</b>
2003								
a. Domestic	2091.56	1887.31	1123.58	963.09	1423.65	1044.58	84.41	8618.18
b. Industrial	870.06	785.11	534.78	340.17	592.25	434.40	27.86	3584.63
<b>Total</b>	<b>2961.62</b>	<b>2672.42</b>	<b>1658.36</b>	<b>1303.26</b>	<b>2015.90</b>	<b>1478.98</b>	<b>112.27</b>	<b>12202.81</b>
<b>Supply</b>	<b>1558.00</b>	<b>1737.00</b>	<b>853.00</b>	<b>1242.00</b>	<b>1325.00</b>	<b>691.00</b>	<b>1825.00</b>	<b>9231.00</b>
<b>Balance</b>	<b>-1403.62</b>	<b>-935.42</b>	<b>-805.36</b>	<b>-61.26</b>	<b>-690.90</b>	<b>-887.98</b>	<b>+1712.73</b>	<b>-2971.81</b>
2008								
a. Domestic	2449.39	2210.18	1319.18	1124.83	1667.21	1223.28	98.49	10092.54
b. Industrial	957.06	863.62	588.26	374.18	651.48	477.84	30.64	3943.09
<b>Total</b>	<b>3406.45</b>	<b>3073.80</b>	<b>1907.44</b>	<b>1499.01</b>	<b>2318.69</b>	<b>1701.12</b>	<b>129.13</b>	<b>14035.63</b>
<b>Supply</b>	<b>1826.00</b>	<b>2179.00</b>	<b>1209.00</b>	<b>1462.00</b>	<b>1708.00</b>	<b>850.00</b>	<b>1724.00</b>	<b>10958.00</b>
<b>Balance</b>	<b>-1580.45</b>	<b>-894.80</b>	<b>-698.44</b>	<b>-37.01</b>	<b>-610.69</b>	<b>-851.12</b>	<b>-1594.87</b>	<b>-3077.63</b>
2013								
a. Domestic	2617.84	2362.19	1408.27	1203.65	1781.87	1307.40	105.43	10786.65
b. Industrial	1052.77	949.98	647.09	411.60	716.62	525.63	33.71	4337.40
<b>Total</b>	<b>3670.61</b>	<b>3312.17</b>	<b>2055.36</b>	<b>1615.25</b>	<b>2498.49</b>	<b>1833.03</b>	<b>139.14</b>	<b>15124.05</b>
<b>Supply</b>	<b>2623.00</b>	<b>3562.00</b>	<b>1800.00</b>	<b>1853.00</b>	<b>2402.00</b>	<b>1292.00</b>	<b>1540.00</b>	<b>15072.00</b>
<b>Balance</b>	<b>-1047.61</b>	<b>+250.17</b>	<b>-255.36</b>	<b>+238.75</b>	<b>-96.49</b>	<b>-541.03</b>	<b>+1400.86</b>	<b>-52.05</b>

### Fuelwood Supply

From the survey results it is clear that use of firewood for domestic purposes is declining.

The supply estimate for the projected period is shown in Table 16. This indicates that there has been shortage of supply all over the period. To augment the shortage of fuelwood in the country, the Master Plan has recommended different projects, so that at the terminal year there could be adequate supply of firewood to met the incremental demand in all regions.

### CONSUMPTION OF SAWN AND ROUND TIMBER

The consumption of sawn wood and round timber in the rural areas was surveyed with the questionnaire. The major items of consumption included in the questionnaire are:

- Building Materials
- Furniture and Fixture
- Transport Equipments
- Agriculture Implements
- Round Wood

The consumption of round wood normally used as poles in the village houses was surveyed as a separate item. During the survey, the enumerators counted and measured all items of timber used in the household. In the case of construction materials, all measurements were taken physically on the spot and recorded. For other items like furniture, transport and agriculture implements, the volume of sawnwood consumed was calculated on the basis of a conversion list supplied to all field staff. Consumption estimates thus made are weighted by land class to get the accurate estimates for the national level consumption as far as possible. The survey was an inventory of the wooden items used in the rural households irrespective of their age.

The survey was carried out by household units but the results are processed on a per capita consumption basis for each separate item.

Initially, all results were calculated item by item then adjusted statistically to get the weighted per capita for the item. The per capita consumption of all items made of sawn timbers were place together to get the over all per capita sawnwood consumption. The round wood consumption is treated as the consumption of poles so the results show the consumption of poles and posts separately. The results are presented sequentially by items.

## Survey Results

### 1. House Construction and Building Materials

For construction of buildings and houses both sawn wood and round timber as well as bamboo is used. Rural houses in different parts of the country vary in construction style and use of materials depending on the availability of the materials. Northwest regions and some parts of west and central north regions use mud for construction of walls. In other areas where mud is not suitable for use, more wood and bamboo is used for walls and roofs. In some areas, floors are also made of wood. Table 17 represents the survey results of consumption of wood in building materials by regions and by land class.

Table 17 - Consumption of Sawn Timber in Building Materials (in m<sup>3</sup>)

Household Land Class, ha	Per Capita Consumption, Regions						Weighted Average
	N-West	N-Central	West	South	S-East	N-East	
0 <0.2	.031	.116	.082	.219	.140	.071	.101
0.2 <1.0	.181	.233	.122	.380	.275	.177	.217
1.0 <3.0	.194	.302	.218	.623	.285	.252	.284
>3.0	.336	.402	.258	.691	.423	.288	.367
Weighted Average	.111	.182	.127	.348	.203	.139	.1719

From the table it is clear that some regions use more timber than others. The highest uses are in the south and the lowest in the north-west regions. The regions of south and southeast are using more timber for house construction because of higher availability of timber. This is due to two reasons, (i) higher density of village forests and (ii) being on the fringe of the large reserved forests of the Sundarbans, Chittagong and Chittagong Hill Tracts.

The adjusted weighted average is .1719 m<sup>3</sup> per capita for life of the building. Assuming economic life of the house to be 25 years then the consumption per capita/annum is .0068 m<sup>3</sup> for building construction. The results show consistent trends from lower to upper land class. Smaller land

holders use .101 m<sup>3</sup> of wood which is only 27% of the consumption of the higher land class who use .367 m<sup>3</sup>/capita.

## 2. Furniture and Fixtures

Numerous items are included in the furniture and fixture categories. All of these items were surveyed in the field and the consumption of sawn wood in those are calculated using the standard conversion table for each of the items. Generally the rural households use less standard furniture than urban households and use simpler furniture and fixtures.

The consumption of sawn wood in furniture is present in Table 18.

Table 18 - Consumption of Sawn Timber in Furniture (m<sup>3</sup>)

Household Land Class, ha	Per Capita Consumption in Furniture, Regions						Weighted Average
	N-West	N-Central	West	South	S-East	N-East	
0 <.20	.052	.052	.043	.054	.065	.048	.045
0.2 <1.0	.088	.079	.051	.078	.096	.069	.079
1.0 <3.0	.108	.101	.081	.113	.112	.090	.101
3.0	.159	.115	.106	.153	.147	.112	.131
Weighted Average	.0757	.0681	.0553	.0742	.0809	.0631	.0664

The results show the region and land class weighted averages. From the results it is clear that all areas are using furniture more or less uniformly with small variation in per capita consumption.

The adjusted weighted average is .0664 m<sup>3</sup> per capita for the life of the furniture. Assuming 25 years of economic life, the per capita consumption is .0026 m<sup>3</sup>/annum. The weighted averages for each land class have also been shown in the table. Smaller land holders use less than the larger land holders.

## 3. Transport Equipment

Only the rural transport equipment is included in the survey - bullock cart, boat, rickshaw van, hackney carriage, palki, duli, etc. Modern mechanized transport like bus, minibus, truck, launch and cargo ships are outside the purview of the survey and are dealt with separately under industrial consumption of sawlogs. Table 19 represents the results of the survey for sawn wood consumption in transport equipment.

Table 19 - Consumption of Sawnwood in Transport Equipments (m<sup>3</sup>)

Household Land Class, ha	Per Capita Consumption in Transports, Regions						Weighted Average
	N-West	N-Central	West	South	S-East	N-East	
0 <.20	.005	.007	.009	.000	.000	.006	.002
0.2 <1.0	.009	.013	.007	.010	.018	.008	.011
1.0 <3.0	.034	.009	.015	.002	.012	.006	.016
>3.0	.024	.015	.017	.004	.000	.014	.014
Weighted Average	.0120	.0091	.0099	.0035	.0073	.0068	.0072

The adjusted weighted average is .00721 m<sup>3</sup> per capita. Considering the economic life of the transport equipment to be 20 years, the annual per capita consumption is .00036 m<sup>3</sup>. The lesser economic life of 20 years is assumed because of its exposure to the elements. The weighted average by land class is also estimated and presented in the table. The smaller land holders use only 14% of the larger landholders in terms of transport equipment. These results are consistent and reflect the practical situation of the country. The poor class rarely has transport equipment of their own unless used for occupational reasons.

From the results, regional variations can also be observed. For the northwest, the per capita use is highest for rich people amongst all regions due to the prevalence of bullock carts in the area. Well-to-do farmers have their own bullock carts for private purpose use. In other regions, the small land holder category has the most consumption for transport. This may be because of the prevalence of rickshaw vans and country boats in those areas which are used mainly for occupational purposes by the small farmers.

#### 4. Agriculture Implements

Agriculture implements include various equipment and tools used by the farming households in the rural areas. All major items of agriculture equipment are included in the questionnaire and standard wood consumption for each item is also given in the conversion table. The results of the survey are presented in Table 20.

Table 20 - Consumption of Sawnwood in Agriculture Implements  
(in m<sup>3</sup>)

Household Land Class, ha	Per Capita Consumption in Agri-Implements, Regions						Weighted Average
	N-West	N-Central	West	South	S-East	N-East	
0 <.20	.029	.019	.021	.023	.022	.031	.020
0.2 <1.0	.044	.036	.025	.029	.026	.039	.034
1.0 <3.0	.048	.041	.033	.031	.024	.050	.039
>3.0	.054	.051	.035	.038	.028	.056	.045
Weighted Average	.0373	.0277	.025	.0266	.0236	.0373	.0276

The above table shows the per capita consumption of sawn wood for agri-implements by land class and by regions. The consumption is highest in the northwest and northeast regions. The results probably reflect the more agrarian economy of the regions compared to other regions.

The adjusted weighted average by land class is .0276 m<sup>3</sup>. Assuming the economic life of agri-implements is 20 years, the per capita consumption is .0014 m<sup>3</sup>/annum. A 20 year life is assumed because of exposure to nature and the use of low quality timber in many cases. The results seem compatible. The inter class and intra class variation is not very high because farmers having 0.2 ha of land or 2.0 ha of land will have the same number of principal implements. It is obvious that big farmers will have more implements and tools and the results confirm that consistency.

#### Sawn Timber Demand Assessment

The rural consumption of sawnwood has been estimated applying equal depreciation during the life cycle of articles made of wood and by taking weighted average of all land classes. The estimated consumption is .0111 m<sup>3</sup> per capita/annum for all uses. This result is an average of rich and poor in the rural areas. The single average for rural areas is estimated for convenience.

Rural poor have little or no use of sawn timber per capita/annum. The rural rich have some use but the society does not have a wood based culture. Therefore, the single average has been calculated. These results are also consistent with Douglas'. It is interesting to note that unlike fuelwood, the consumption of sawn timber in the rural areas did not reduce but remained the same as it was 10 years before or only slightly improved. A survey of urban consumption was not done and was approximated from the village survey consumption.

The average for rural consumption is applied for the urban poor. For urban rich the estimate has been made considering the results of Byron and present availability and usage of substitutes of sawnwood. In Byron's estimate the per capita consumption for urban rich in 1981 was .135 m<sup>3</sup>/annum. It is accepted that urban rich use more wood and firewood than urban poor and rural classes but the degree has been reduced in recent years. The Forestry Master Plan considers the per capita present consumption of urban rich to be 0.11 m<sup>3</sup>/annum. This is less than the estimate of Byron. To many people, the per capita will be higher for urban rich than the estimate accepted for demand projection. This will have little impact on total demand because of the low number of urban rich in relation to the total. It is generally believed that the consumption of sawn timber has gone up tremendously in urban areas in recent years which is evident from the increasing number of saw mills and furniture shops.

In spite of domestic demand, the sawnwood is used for commercial and industrial purposes and in the government sector. In the present study, the commercial and government use has been taken as 15% of the urban consumption but may be more. The demand for industrial logs for panel products and other consumer industries has been derived separately.

The demand assessment is made for 1991. The demand for urban, rural and commercial use is estimated by regions. The demand for industrial logs/round equivalent is estimated separately. Table 20 represents the demand for sawn wood and industrial sawlogs. The sawlog equivalent for all consumption is also presented in the table at a conversion rate of 37.50%.

It is found that at the present level of efficiency of saw milling the recovery is only 37.50% on average, considering all species. If sawing technology is improved and labour efficiency is increased, then the recovery rate may improve up to 55%. (For details see the Industrial Report)

Table 21 - 1991 Demand for Sawnwood and Round Wood Equivalent, (000 m<sup>3</sup>)

Users Sector	North-West	N-Central	West	South	South-West	North-West	Ctg Hill Tracts	Total
Urban Rich	45.13	135.28	42.01	22.74	80.74	31.04	3.43	361.13
Urban Poor	18.48	54.60	16.96	9.18	32.59	12.53	1.39	145.76
Rural Rich	64.26	189.88	58.96	31.91	113.32	43.57	4.82	506.89
Rural Poor	267.83	194.26	141.71	116.55	157.29	129.62	9.30	1016.52
Govt.+Comm	9.64	28.48	8.84	4.79	17.00	6.54	0.72	76.03
Total Sawnwood	341.73	412.63	209.52	153.25	287.62	179.73	14.84	1599.44
Total RWE	911.29	1100.35	558.72	408.67	766.97	479.28	39.56	4265.18
Industrial Consumption of RWE	5.34	57.81	66.47	-	39.38	25.06	10.13	204.19

## **Demand Projection**

Sawlogs are the major products of the forests. Producers always try to maximise the output of sawlogs at a minimum cost and shorten the rotation period. Demand for sawnwood and primarily the sawlog is most important for forestry as a whole. If there is no demand for sawn timber then commercial forestry is not required and the question of investment in forest development does not arise. Today's situation is reversed and the natural forest can no longer meet the demand. Timber is used for wide range of industrial and commercial purposes. Many large industries are developed on based forest supplies. In many countries, timber becomes the major item of foreign trade. Bangladesh also imports sawnwood, logs, poles, and various forest based finished products in huge quantities. This has increased manifold in recent years.

## **Sawlog Scenarios**

Three alternative scenarios can be projected considering the overall conditions of forestry in this country. Though the history of scientific management of forestry is a century old, the achievement in terms of output development, innovation, research and development, silvicultural practices, industrialisation and modernization of the sector has been very small. In the past, many projects were undertaken and implemented but no major improvements were created in the sector. The following three scenarios can be projected for consideration. The figures in the projection are presented in terms of sawlog volume. Assumptions of projection scenarios are presented sequentially.

### **1. Status Quo**

The status quo scenario is the steady state situation with little expectation for change in demand and supply conditions. In this scenario, the forest department invests just to protect the deteriorating situation from further aggravation. Supply will grow steadily because of growing stocks in plantations. No moratorium on felling and tribal insurgency in the CHT is assumed. Demand has increased steadily because of population growth. This does not involve the implementation of Master Plan recommendations.

### **2. Scenario 1**

As a result of the FMP study, there can be two possible options for the government to implement the recommendations. It can either go for high investment in the sector with a drastic change in the management practices in forestry or go for moderate investment with minor changes. The second category will enhance some output to partially augment the supply shortage. Demand will increase because of income growth in GNP terms as well as population growth. The supply of forest based products also increases but this may not be able to meet the increased demand. The import of forest based products will continue in order to meet the local demand.

### **3. Scenario 2**

For the high consumption scenario forestry has been looked into as a tremendous potential sector for economic development and for commercial and industrial activities. A massive change is assumed in all aspects of forestry management, industrial development and investment strategy. Because of high investment, high yield and output from the sector will be received and high consumption demand is expected. All requirements are tried to be met from the output and resources. Demand for domestic consumption is assumed to be similar to the high wood consuming neighbouring countries. The surpluses could be treated as export items in the foreign trade.

## Status Quo

The status quo supply and demand is presented in Table 22 and Figure 3. Status quo assumption are:

- Consumption per capita assessed and found from the household survey remains for the entire projection period.
- Commercial consumption includes the consumption of industrial logs for production of panel products and other consumer goods and various industrial spares.
- Projections are made on the basis of incremental population in urban and rural, areas.
- Regional distribution varies on the basis of urban and rural population distribution.
- Supply figures are status quo supply from all sources without any moratorium on the felling of trees.
- Log conversion rate is assumed to be 37.5% which remains throughout the planning period.

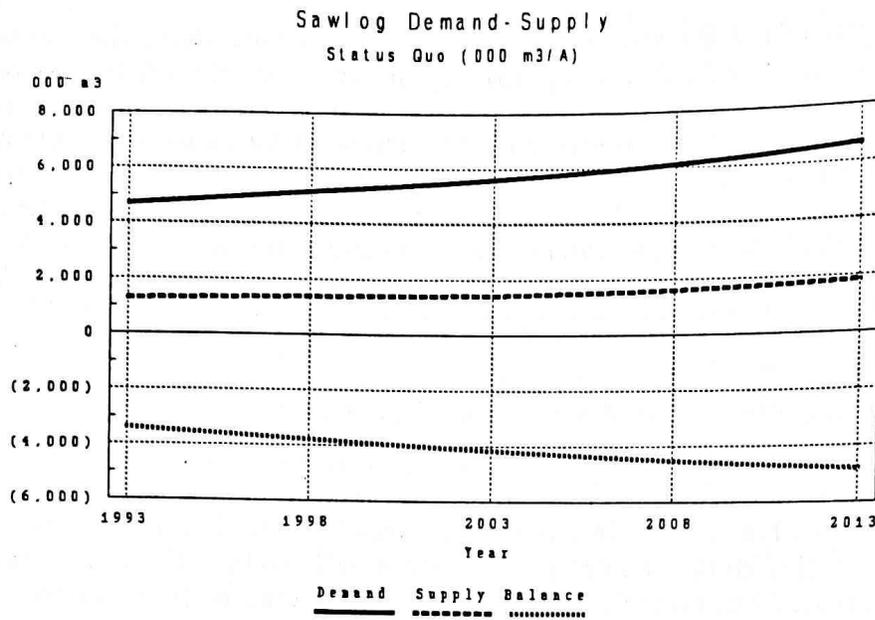


Figure 3 - Sawlog Status Quo Demand-Supply

The results are very clear. In the projection years the supply are less than the expected demand and the demand-supply gap is widening with the passage of time. Except in the Chittagong Hill Tracts all regions are deficit in sawlogs.

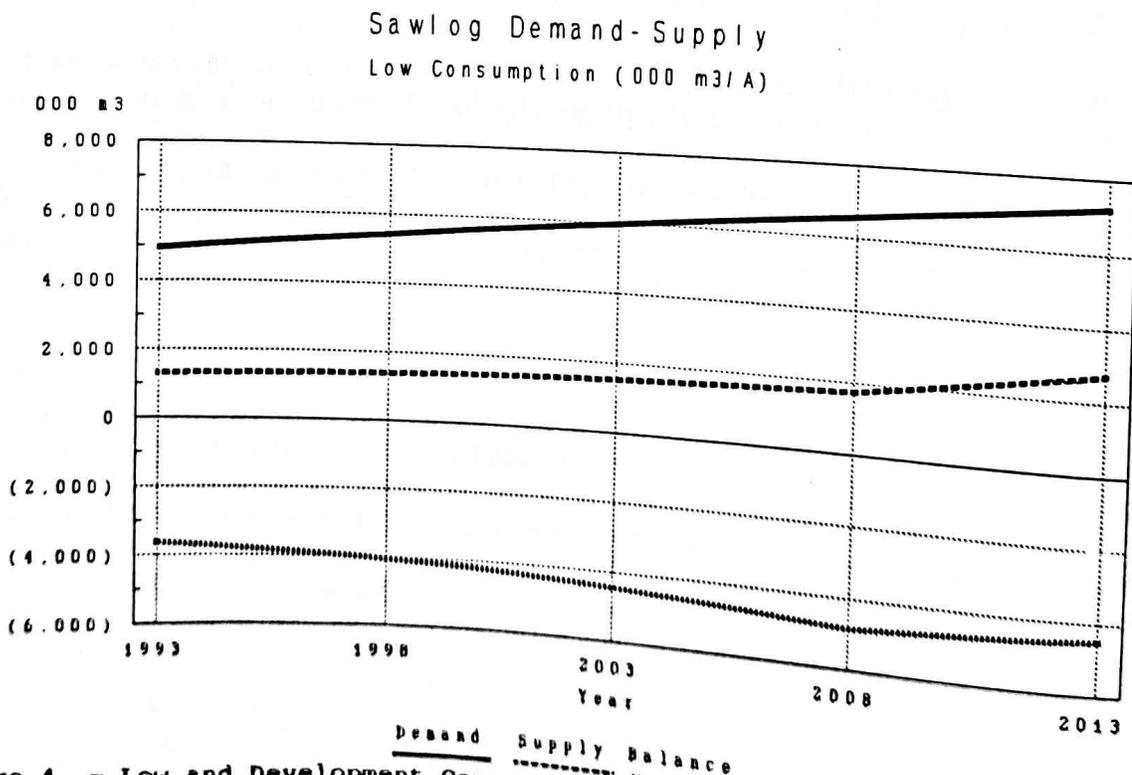


Figure 4 - Low and Development Consumption Sawlog Demand-Supply



Table 22 - Sawlog Supply-Demand, Status Quo (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
<b>Sawlog:</b>								
a. Domestic Urban	196.56	542.18	173.62	96.54	326.25	129.91	14.04	1479.53
b. Domestic Rural	734.05	531.23	388.19	319.41	430.47	355.16	25.46	2783.80
c. Commercial <sup>a</sup>	56.20	155.04	49.65	27.61	93.29	37.15	4.01	423.07
<b>Total</b>	<b>986.81</b>	<b>1228.45</b>	<b>611.46</b>	<b>443.56</b>	<b>850.01</b>	<b>522.22</b>	<b>43.51</b>	<b>4686.40</b>
Supply	178.00	154.00	112.00	330.00	192.00	103.00	216.00	1285.00
Balance	-808.81	-1074.45	-499.46	-113.56	-658.01	-419.22	+171.49	-3401.40
1998								
a. Domestic Urban	232.98	607.80	199.72	113.47	368.32	150.95	16.01	1689.73
b. Domestic Rural	793.18	572.82	419.25	345.10	464.51	383.95	27.49	3005.84
c. Commercial	62.41	162.80	53.50	30.39	98.66	40.43	4.29	452.60
<b>Total</b>	<b>1088.57</b>	<b>1343.42</b>	<b>672.47</b>	<b>488.96</b>	<b>931.49</b>	<b>575.04</b>	<b>47.79</b>	<b>5148.17</b>
Supply	199.00	175.00	123.00	347.00	205.00	109.00	206.00	1364.00
Balance	-889.57	-1168.42	-549.47	-141.96	-726.49	-466.04	+158.21	-3784.17
2003								
a. Domestic Urban	269.33	673.35	225.78	130.37	410.33	171.95	17.99	1899.62
b. Domestic Rural	852.34	614.43	450.32	370.81	498.57	412.14	29.51	3227.99
c. Commercial	68.77	171.94	57.65	33.29	104.78	43.91	4.59	485.06
<b>Total</b>	<b>1190.41</b>	<b>1459.72</b>	<b>733.75</b>	<b>534.47</b>	<b>1013.68</b>	<b>628.00</b>	<b>52.09</b>	<b>5612.67</b>
Supply	219.00	194.00	135.00	365.00	237.00	99.00	183.00	1432.00
Balance	-971.41	-1265.72	-598.75	-169.47	-776.68	-529.00	+130.91	-4180.67
2008								
a. Domestic Urban	305.74	738.94	251.87	147.30	452.39	192.98	19.95	2109.73
b. Domestic Rural	911.48	656.03	481.39	396.51	532.62	440.69	31.55	3450.06
c. Commercial	79.61	192.72	65.59	38.36	117.80	50.25	5.19	549.37
<b>Total</b>	<b>1296.83</b>	<b>1587.39</b>	<b>798.85</b>	<b>582.17</b>	<b>1102.81</b>	<b>683.92</b>	<b>56.69</b>	<b>6109.16</b>
Supply	242.00	217.00	150.00	389.00	284.00	107.00	200.00	1589.00
Balance	-1054.83	-1370.39	-648.85	-193.17	-818.18	-576.92	+143.31	-4520.16
2013								
a. Domestic Urban	341.97	804.37	277.86	164.14	494.32	213.92	21.91	2319.09
b. Domestic Rural	970.69	697.68	512.49	422.24	566.71	469.23	33.58	3672.40
c. Commercial	95.48	224.58	77.58	45.83	138.01	59.73	6.12	647.49
<b>Total</b>	<b>1408.14</b>	<b>1726.63</b>	<b>867.93</b>	<b>632.21</b>	<b>1199.04</b>	<b>742.88</b>	<b>61.61</b>	<b>6638.98</b>
Supply	2661.00	243.00	165.00	425.00	334.00	132.00	263.00	1828.00
Balance	-1142.14	-1483.63	-702.93	-207.21	-865.04	-610.88	+201.39	-4820.98

<sup>a</sup> Includes government, commercial and other industrial users

### Scenario 1

This scenario expresses the following assumptions:

- a. Per capita GDP grows at 5% annually and reaches \$400 in the year 2013 however lower per capita consumption growth is assumed. The estimate begins with the present consumption as a basis and increases consumption if two to three percent in the planning period. This compares to a wood scarce economy - for example, India, Sri Lanka, or Bangladesh today.
- b. The consumption per capita varies from year to year on the basis of incremental growth in income.

- c. Commercial demand includes the demand for industrial sawlog.
- d. The supply is projected with moderate investment in the forestry sector and without major change in forest management practice.
- e. The log conversion rate is assumed to be 37.5% which remains the same throughout the planning horizon.

The projection of demand and supply is presented in Table 23 and Figure 4.

Table 23 - Projected Sawlog Supply-Demand, Scenario 1 Development (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
<b>Sawlog:</b>								
a. Domestic Urban	229.62	633.40	202.82	112.78	381.13	151.76	16.40	1728
b. Domestic Rural	734.05	531.23	388.19	319.41	430.47	355.16	25.46	2784
c. Other *	56.20	155.04	49.15	27.61	93.29	37.15	4.01	422
<b>Total</b>	<b>1019.87</b>	<b>1319.67</b>	<b>640.16</b>	<b>459.80</b>	<b>904.89</b>	<b>544.07</b>	<b>45.87</b>	<b>4934</b>
Supply	183.00	154.00	112.00	330.00	219.00	86.00	234.00	1318
Balance	-836.87	-1165.67	-528.16	-129.80	-685.89	-458.07	+188.13	-3618
1998								
a. Domestic Urban	270.18	708.05	233.32	132.56	428.28	176.34	18.70	1968
b. Domestic Rural	793.18	572.82	419.25	345.10	464.51	383.66	27.47	3006
c. Other	62.41	162.80	53.50	30.39	98.82	40.43	4.29	453
<b>Total</b>	<b>1125.00</b>	<b>1443.67</b>	<b>706.07</b>	<b>508.05</b>	<b>991.61</b>	<b>600.43</b>	<b>50.46</b>	<b>5427</b>
Supply	200.00	174.00	124.00	346.00	233.00	92.00	224.00	1393
Balance	-925.00	-1269.67	-582.07	-162.05	-758.61	-508.43	+173.54	-4034
2003								
a. Domestic Urban	319.88	799.71	268.75	154.84	487.34	204.22	21.36	2257
b. Domestic Rural	852.34	614.43	450.32	370.81	498.57	412.14	29.51	3228
c. Other	68.77	171.94	57.65	33.29	104.78	43.91	4.59	485
<b>Total</b>	<b>1240.99</b>	<b>1586.08</b>	<b>776.72</b>	<b>558.44</b>	<b>1090.69</b>	<b>660.27</b>	<b>55.46</b>	<b>5970</b>
Supply	220.00	194.00	136.00	365.00	246.00	99.00	283.00	1544
Balance	-1020.99	-1392.08	-640.72	-193.44	-844.69	-561.27	+227.54	-4426
2008								
a. Domestic Urban	372.03	899.15	306.47	179.23	550.47	234.82	24.27	2567
b. Domestic Rural	911.48	656.03	481.39	396.51	532.62	440.69	31.55	3450
c. Other	79.61	192.42	65.59	38.36	117.80	50.25	5.19	550
<b>Total</b>	<b>1363.12</b>	<b>1747.60</b>	<b>853.45</b>	<b>614.10</b>	<b>1200.89</b>	<b>725.76</b>	<b>61.01</b>	<b>6567</b>
Supply	265.00	237.00	165.00	405.00	279.00	115.00	273.00	1739
Balance	-1098.12	-1510.60	-688.45	-209.10	-921.89	-610.76	+211.99	-4828
2013								
a. Domestic Urban	428.15	1007.10	347.88	205.50	618.90	267.83	27.43	2903
b. Domestic Rural	970.69	697.68	512.49	422.24	566.71	469.23	33.58	3672
c. Other	95.58	224.58	77.58	45.83	138.01	59.73	6.12	648
<b>Total</b>	<b>1494.42</b>	<b>1929.30</b>	<b>937.95</b>	<b>673.57</b>	<b>1323.62</b>	<b>796.79</b>	<b>67.13</b>	<b>7223</b>
Supply	292.00	265.00	180.00	442.00	483.00	160.00	916.00	2739
Balance	-1202.42	-1664.30	-757.95	-231.57	-840.62	-636.79	+848.87	-4484

\* Includes government, commercial and other industrial users

The results of the low investment scenario are not too different from the status quo scenario. In this scenario, the gap between supply and demand is reduced due to investment. It is expected that this gap will be further reduced after the plan period is over.

## Scenario 2

High consumption demand for sawlog is presented in Table 24 and Figure 5. The assumptions behind this scenario are:

- Two or more consumption patterns can exist even at the same GDP. In the terminal year of the project in 2013, Bangladesh will achieve a GDP per capita equivalent to U \$400. At this level, there have been different rates of consumption of sawlogs in different countries. This scenario assumes a high consumption rate of 0.1 m<sup>3</sup> per capita of sawlogs similar to a wood rich economy like Indonesia or Malaysia.
- The rate of consumption varies from year to year as income increases.
- High investment supply is assumed because of high input and output assumption.
- Log conversion remains the same at 37.50% as before.

Table 24 - Projection of Supply-Demand of Sawlogs, Scenario 2 Consumption (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
<b>Sawlog:</b>								
a. Domestic Urban	239.71	659.73	211.26	117.47	396.98	158.07	17.08	1801
b. Domestic Rural	752.85	547.18	401.30	330.20	444.01	367.16	26.32	2882
c. Other *	61.47	169.55	54.29	30.19	102.02	40.62	4.39	463
<b>Total</b>	<b>1054.03</b>	<b>1376.46</b>	<b>666.85</b>	<b>477.86</b>	<b>943.00</b>	<b>565.85</b>	<b>47.79</b>	<b>5146</b>
Supply	183.00	164.00	125.00	330.00	215.00	132.00	272.00	1421
Balance	-871.03	-1212.46	-541.85	-147.86	-728.01	-433.85	+224.21	-3725
1998								
a. Domestic Urban	422.69	1102.72	362.34	205.87	668.23	273.86	29.04	3066
b. Domestic Rural	1010.24	729.57	533.97	439.54	591.62	488.65	35.01	3833
c. Other	105.67	275.88	90.59	51.47	167.06	68.46	7.26	767
<b>Total</b>	<b>1538.60</b>	<b>2108.17</b>	<b>986.90</b>	<b>696.88</b>	<b>1426.91</b>	<b>830.97</b>	<b>71.31</b>	<b>7666</b>
Supply	201.00	183.00	146.00	346.00	253.00	89.00	310.00	1528
Balance	-1337.60	-1898.17	-840.90	-350.88	-1173.91	-741.97	+238.69	-6138
2003								
a. Domestic Urban	649.90	1624.76	544.79	314.59	990.12	414.91	43.40	4583
b. Domestic Rural	1209.40	871.83	638.97	526.15	707.43	584.79	41.88	4583
c. Other	144.28	360.70	120.94	69.84	219.81	92.11	9.64	1018
<b>Total</b>	<b>2003.58</b>	<b>2857.29</b>	<b>1304.70</b>	<b>910.58</b>	<b>1917.36</b>	<b>1091.81</b>	<b>94.92</b>	<b>10185</b>
Supply	230.00	217.00	145.00	367.00	213.00	104.00	399.00	1675
Balance	-1773.58	-2640.29	-1159.70	-543.58	-1704.36	-987.81	+304.08	-8510
2008								
a. Domestic Urban	920.19	2225.04	758.54	443.60	1362.44	581.19	60.08	6352
b. Domestic Rural	1342.59	966.31	709.07	584.05	784.53	649.13	46.47	5082
c. Other	184.16	445.09	151.71	88.72	272.49	116.24	12.02	1270
<b>Total</b>	<b>2446.94</b>	<b>3636.44</b>	<b>1619.32</b>	<b>1116.37</b>	<b>2419.46</b>	<b>1346.56</b>	<b>118.57</b>	<b>12704</b>
Supply	276.00	295.00	161.00	423.00	346.00	124.00	393.00	2018
Balance	-2170.94	-3341.44	-1458.32	-693.37	-2073.46	-1222.56	+274.43	-10686
2013								
a. Domestic Urban	1234.61	2904.07	1003.16	592.59	1784.67	772.33	79.11	8373
b. Domestic Rural	1408.35	1012.21	743.46	612.54	822.11	680.71	48.71	5328
c. Other	224.70	528.54	182.57	107.85	324.81	140.56	14.40	1522
<b>Total</b>	<b>2867.66</b>	<b>4444.82</b>	<b>1929.19</b>	<b>1312.98</b>	<b>2931.59</b>	<b>1593.60</b>	<b>142.22</b>	<b>15223</b>
Supply	558.00	552.00	350.00	604.00	1123.00	357.00	2340.00	5884
Balance	-2309.66	-3892.82	-1579.19	-708.98	-1808.59	-1236.60	+2197.78	-9339

\* Includes government, commercial and other industrial users.

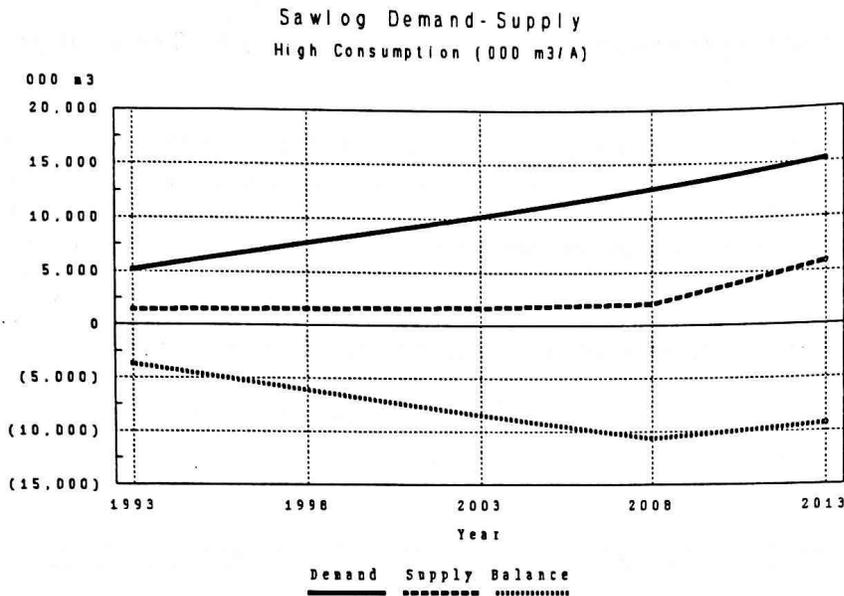


Figure 5 - High Consumption and Scenario 2 Sawlog Demand-Supply

consumption per capita is .0019 m<sup>3</sup>/annum in rural areas. Though many of the urban dwellings use posts and poles for house construction, this is not included because of lack of information. It is suspected that the urban consumption of poles for domestic usage is declining because of replacement of wooden and kuchca house by pucca construction. This present estimate is slightly higher than Douglas' which was .0017 m<sup>3</sup>/per capita/annum. Community structures were not included in the survey so their usage is also excluded in the estimate.

The result of the poles consumption in the survey is presented in Table 25.

Table 25 - Consumption of Poles and Posts in Rural Areas (m<sup>3</sup>)

Household Land Class, ha	Regions						Weighted Average Per capita
	N-West	N-Central	West	South	S-East	N-East	
0 <.20	.004	.056	.009	.014	.038	.015	.027
0.2 <1.0	.003	.068	.005	.020	.038	.034	.031
1.0 <3.0	.019	.077	.005	.034	.074	.043	.040
>3.0	.013	.170	.016	.032	.074	.030	.057
Weighted Average	.0068	.0647	.0073	.0195	.0195	.0257	.0311

Poles used in the villages are of both hard and soft wood species. The soft species get damaged earlier because of exposure to the earth and water. The economic life of poles used in the rural area is assumed to be 16 years. The total demand for poles for household consumption was 174 thousand m<sup>3</sup> in 1991.

In the high consumption and investment scenario it is expected that the output of the high investment would induce the further consumption and then production. However, it is seen that shortages are more than in the previous scenarios.

## CONSUMPTION OF POLES AND POSTS

### Survey Results

#### 1. Domestic Consumption

During field work the consumption of round wood was surveyed meaning domestic use of poles and posts. The average

## 2. Industrial Consumption

The major industrial users of poles and posts are the Rural Electrification Board (REB), Power Development Board (PDB), Bangladesh Railway, Port Authorities, Department of Food and construction firms. The demand for REB and PDB is estimated on the basis of their present consumption and projected future demand for different sizes of poles and logs. The quantity demand by REB and PDB was 52.15 thousand cubic meters in 1991-92. All other demand has been estimated to be 36 thousand cubic meters on the basis of interviews with different users. This estimates is accepted for 1993. All other estimates are based on the actual projection of REB and PDB.

### Assessment of Demand for Poles/ Posts

The assessment of demand for poles and posts for 1991 was based on the rural population of the country as well as the demand for industrial uses. The demand is presented in Table 26.

Table 26 - Consumption of Poles and Posts, 1991

Items	N-West	N-Central	West	South	S-East	N-East	CHT	Total
Domestic	45.84	33.25	24.26	19.95	26.92	22.19	1.59	174.00
Industrial	21.18	19.11	11.86	9.28	14.41	10.57	1.74	88.15
Total	67.02	52.36	36.12	29.23	41.33	32.76	3.33	262.15

### Projection of Demand for Poles/ Posts

Projections of demand for poles and posts are made on the basis of the same three scenarios as previously mentioned.

#### 1. Status Quo

- The demand for poles and posts remains the same for both status quo and moderate investment. In the case of status quo, the supply gap will be more than in moderate investment.
- Domestic consumption per capita remains the same throughout the plan period. Total consumption has been increased because of population growth.
- Industrial consumption grows very slowly because of limited numbers of bonafide users.

Status Quo demand and supply projection is presented in Table 27 and Figure 6.

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Table 27 - Supply-Demand for Poles and Posts, Status Quo (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
Demand:							1.63	178.69
a. Domestic	47.12	34.10	24.92	20.50	27.63	22.80	1.74	88.15
b. Industrial	21.18	19.11	11.86	9.28	14.41	10.57	3.34	266.84
Total	68.30	53.21	36.78	29.78	42.04	33.37	29.00	154.00
Supply	1.00	2.00	0.00	22.00	64.00	36.00	+25.66	-112.84
Balance	-67.30	-51.21	-36.78	-7.22	+8.04	-3.37		
1998								
Demand:							1.76	192.94
a. Domestic	50.91	36.77	26.91	22.15	29.82	24.63	0.85	91.98
b. Industrial	22.32	20.14	12.50	9.78	15.19	11.20	2.61	284.92
Total	73.23	56.91	39.41	31.93	45.01	35.83	28.00	153.00
Supply	1.00	2.00	0.00	22.00	51.00	49.00	+25.39	-131.92
Balance	-72.23	-54.91	-39.41	-9.93	+6.01	+14.83		
2003								
Demand:							1.89	207.20
a. Domestic	54.71	39.44	28.91	23.80	32.00	26.45	0.85	91.98
b. Industrial	22.32	20.14	12.50	9.78	15.19	11.20	2.74	299.18
Total	77.03	59.58	41.41	33.58	47.19	37.65	23.00	149.00
Supply	1.00	2.00	0.00	22.00	55.00	46.00	+20.26	-150.18
Balance	-76.03	-57.58	-41.41	-11.58	+8.19	+9.65		
2008								
Demand:							2.20	221.46
a. Domestic	58.51	42.11	30.90	25.45	34.19	28.29	0.85	91.98
b. Industrial	22.31	20.14	12.50	9.78	15.19	11.20	2.87	313.44
Total	80.83	62.25	43.40	35.23	49.38	39.49	31.00	215.00
Supply	54.00	25.00	13.00	27.00	41.00	24.00	+28.13	-98.44
Balance	-26.83	-37.25	-30.40	-8.77	-8.38	-15.49		
2013								
Demand:							2.16	235.73
a. Domestic	62.31	44.78	32.90	27.10	36.38	30.12	0.85	91.98
b. Industrial	22.32	20.14	12.50	9.78	15.19	11.20	3.01	327.71
Total	84.63	64.92	45.40	36.88	51.57	41.32	54.00	296.0
Supply	63.00	38.00	24.00	32.00	53.00	32.00	+50.99	-31.71
Balance	-21.63	-26.92	-21.40	-4.88	+2.43	-9.32		

**Scenario 1**

While the demand for poles and posts remains the same for both status quo and moderate investment scenarios the supply in the two scenarios is different. In the moderate investment scenario the supply is greater than the status quo situation. The demand is presented in Table 28 and Figure 7.

**3. Scenario 2**

Projections are based on population growth as well as consumption growth per capita over the plan period. Modest growth of industrial

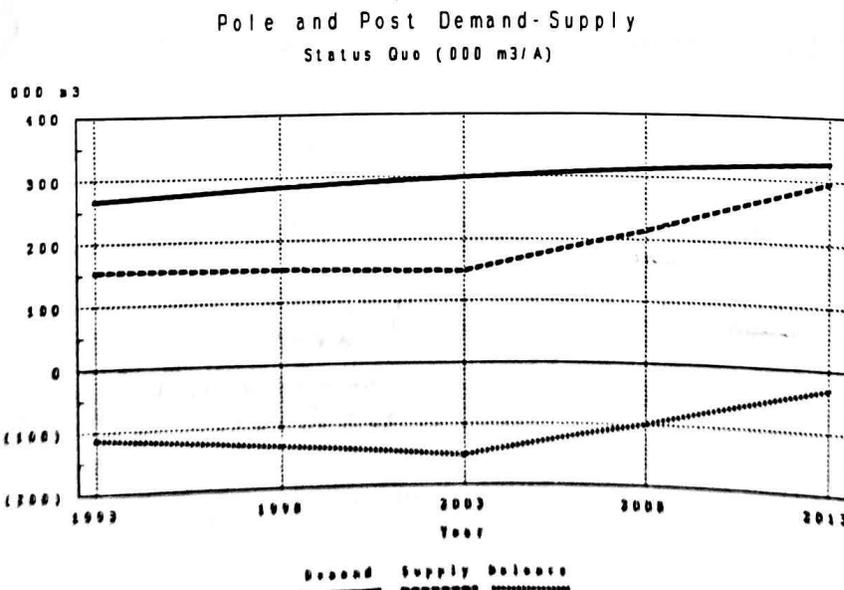


Figure 6 - Status Quo Pole and Post Demand-Supply

Table 28 - Supply-Demand for Poles and Posts, Scenario 1 (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
Demand:								
a. Domestic	47.12	34.10	24.92	20.50	27.63	22.80	1.63	178.69
b. Industrial	21.18	19.11	11.86	9.28	14.41	10.57	1.174	88.15
Total	68.30	53.21	36.78	29.78	42.04	33.37	3.34	266.84
Supply	1.00	2.00	0.00	31.00	75.00	39.00	31.00	179.00
Balance	-67.30	-51.21	-36.78	+1.22	+33.04	+5.63	+27.66	-87.84
1998								
Demand:								
a. Domestic	50.91	36.77	26.91	22.15	29.82	24.63	1.76	192.94
b. Industrial	22.32	20.14	12.50	9.78	15.19	11.20	0.85	91.98
Total	73.23	56.91	39.41	31.93	45.01	35.83	2.61	284.92
Supply	1.00	2.00	0.00	31.00	63.00	52.00	30.00	179.00
Balance	-72.23	-54.91	-39.41	-0.93	+17.99	+16.17	+27.39	-105.92
2003								
Demand:								
a. Domestic	54.71	39.44	28.91	23.80	32.00	26.45	1.89	207.20
b. Industrial	22.32	20.14	12.50	9.78	15.19	11.20	0.85	91.98
Total	77.03	59.58	41.41	33.58	47.19	37.65	2.74	299.18
Supply	1.00	2.00	24.00	28.00	79.00	57.00	25.00	216.00
Balance	-76.03	-57.58	-17.41	-5.58	+31.81	-19.55	+22.26	-83.18
2008								
Demand:								
a. Domestic	58.51	42.11	30.90	25.45	34.19	28.29	2.20	221.46
b. Industrial	22.31	20.14	12.50	9.78	15.19	11.20	0.85	91.98
Total	80.83	62.25	43.40	35.23	49.38	39.49	2.87	313.44
Supply	104.00	43.00	29.00	64.00	163.00	46.00	34.00	483.00
Balance	+23.17	-19.25	-14.40	+28.77	+113.62	+6.51	+31.13	+169.56
2013								
Demand:								
a. Domestic	62.31	44.78	32.90	27.10	36.38	30.12	2.16	235.73
b. Industrial	22.32	20.14	12.50	9.78	15.19	11.20	0.85	91.98
Total	84.63	64.92	45.40	36.88	51.57	41.32	3.01	327.71
Supply	174.00	90.00	78.00	132.00	219.00	80.00	57.00	830.00
Balance	+89.37	+25.08	+32.60	+95.12	+167.43	+38.68	+53.99	+502.29

consumption is assumed. High investment supplies are projected. The demand projection are presented in Table 29 and Figure 8.

From the table, it is clear that the country is running short of a supply of poles. Most of the poles being used are imported from abroad. The shortage will continue until 2003. With recommended afforestation programmes, the shortage can be offset by 2008, when there will be a small improvement.

Pole and Post Demand-Supply  
Scenario 1 (000 m<sup>3</sup>/A)

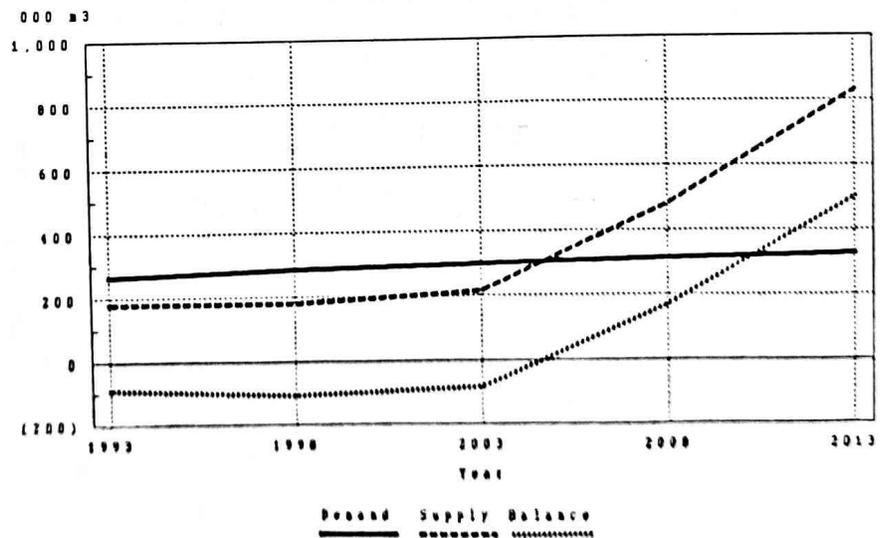


Figure 7 - Scenario 1 Pole and Post Demand-Supply

Table 29 - Supply-Demand for Poles and Posts, Scenario 2 (000 m<sup>3</sup>)

Commodity	N-West	N-Central	West	South	S-East	N-East	CHT	Total
1993								
Demand:								
a. Domestic	47.12	34.10	24.92	20.50	27.63	22.80	1.63	178.69
b. Industrial	21.18	19.11	11.86	9.28	14.41	10.57	1.174	88.15
Total	68.30	53.21	36.78	29.78	42.04	33.37	3.34	266.84
Supply	1.00	2.00	0.00	31.00	70.00	38.00	26.00	168.00
Balance	-67.30	-51.21	-36.78	+1.22	+27.96	+4.63	+22.66	-98.84
1998								
Demand:								
a. Domestic	50.91	36.77	26.91	22.15	29.82	24.63	1.76	192.94
b. Industrial	22.32	20.14	12.50	9.78	15.19	11.20	0.85	91.98
Total	73.23	56.91	39.41	31.93	45.01	35.83	2.61	284.92
Supply	1.00	2.00	0.00	31.00	58.00	54.00	29.00	175.00
Balance	-72.23	-54.91	-39.41	-0.93	+12.99	+18.17	+26.39	-109.92
2003								
Demand:								
a. Domestic	60.18	43.38	31.80	26.18	35.20	29.09	2.08	225.83
b. Industrial	24.55	22.15	13.75	10.75	16.70	12.32	0.85	103.15
Total	84.73	65.53	45.55	36.93	51.90	41.41	2.93	328.98
Supply	1.00	2.00	144.00	28.00	179.00	316.00	37.00	907.00
Balance	-83.73	-63.53	+98.45	-8.93	+127.10	+274.59	+34.07	+578.02
2008								
Demand:								
a. Domestic	64.36	46.32	33.99	27.99	37.61	31.12	2.42	243.81
b. Industrial	24.54	22.15	13.75	10.75	16.70	12.32	0.95	101.16
Total	88.90	68.47	47.74	38.74	54.31	43.44	3.37	344.97
Supply	705.00	242.00	245.00	140.00	391.00	292.00	38.00	2053.00
Balance	+616.10	+173.53	+197.26	+101.26	+336.69	+248.56	+34.63	+1708.03
2013								
Demand:								
a. Domestic	70.79	50.95	37.39	30.78	41.37	34.23	2.66	268.17
b. Industrial	27.00	24.36	15.12	11.82	18.37	13.55	1.05	111.27
Total	97.79	75.31	52.51	42.60	59.74	47.78	3.71	379.44
Supply	985.00	465.00	439.00	303.00	434.00	371.00	57.00	3054.00
Balance	+887.21	+389.69	+406.49	+260.40	+374.26	+323.22	+53.29	+2674.56

## PULPWOOD

Pole and Post Demand-Supply  
Scenario 2 (000 m<sup>3</sup>/A)

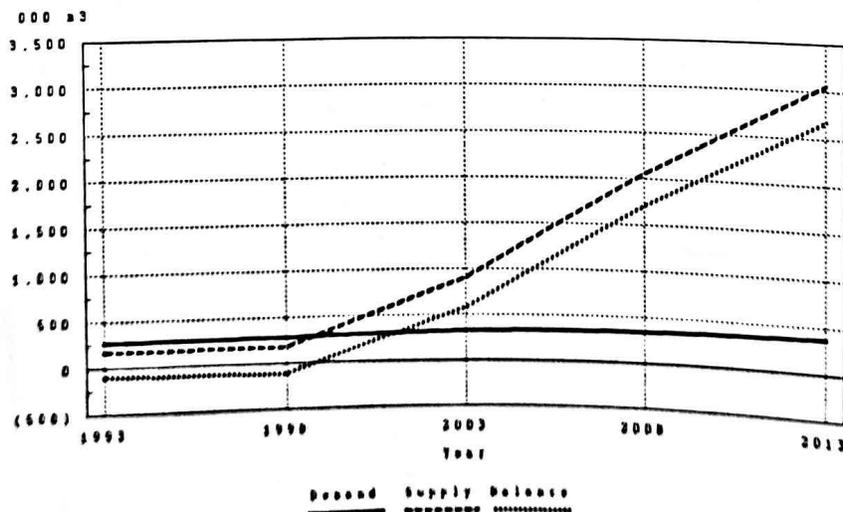


Figure 8 - Scenario 2 pole and Post Demand-Supply

(Proj. 372001/11-2)

## Consumption and Demand Projection

Among the forest based industries, newsprint and paper manufacturing occupies a dominant position. In Bangladesh there is only one newsprint mill in Khulna and for writing and printing paper there are three mills of which two of them, the Karnaphully Paper Mills (KPM) and North Bengal Paper Mills (NBPM) are under the Bangladesh Chemical Industries Corporation (BCIC) and one, M/s Sonali Paper and Boar Mills Ltd is under the private



sector. Sylhet Pulp and Paper Mills (SPPM) is also under BCIC. Karnafuli Paper Mill Ltd, Sonali Paper and Board Mills and Hossain Paper and Pulp Mills manufacture industrial grade papers and paper boards. Except NBPM, all mills consume wood and/or bamboo pulp for their production while NBPM uses sugarcane baggasse plus purchased pulp.

Demand for pulpwood is a derived demand from the demand for newspapers, writing-printing, cultural grade paper and other industrial papers. The demands for paper and paper items depends mostly on the rate of literacy and education in the country as well as the level of economic development. The more educated the society, the more the demand for papers. Industrialisation and export of finished goods also has an impact on the demand for industrial papers, paper boards and packaging items.

The demand for pulpwood for 1993 has been estimated on the basis of present consumption of the mills under BCIC. The private sector mills depends on SPPM and imports for pulp supplies. The per capita consumption of newsprint, writing and printing paper has been estimated from the time series data for consumption of those and on the basis of regression analysis. The projection is based both on population growth and literacy growth. The per capita consumption was .4375 kg and .5602 kg for newsprint and other papers respectively in 1991.

At present, KPM and SPPM use different ratios of pulpwood (firewood) and bamboo, preferring higher use of bamboo. Of the total demand for fibrous raw materials (FRM) the one-third usage of bamboo is assumed for white paper manufacturing after 2000 year. This is reasonable because of the flowering cycle of the muli bamboos and gradual loss of bamboo areas in the reserved forest. (For details see the Bamboo Report).

The demand for pulpwood is not shown stratawise because the major concentrations are in Khulna, Chittagong Hill Tracts and in Sylhet regions. The projected future demand can not be met with the existing capacities in the mills. New mills are required to meet the increased demand or else face a greater reliance on imports. The consumption of paper items as well as the requirement of pulp wood FRM in the future under different scenarios is presented separately in Table 30 and Figure 9. The discussions on different grades of paper are presented separately by items in the following pages. The pulpwood demand estimate assumes all pulp production is from wood not bamboo as raw material.

Table 30 - Supply-Demand Balance of Pulpwood under Different Scenarios (000 m<sup>3</sup>)

Source	1993	1998	2003	2008	2013
<b>Demand</b>					
- Population	256.9	320.9	377.4	441.3	505.2
- Population/Literacy	279.5	408.2	508.0	614.9	722.5
- Mass Literacy & High Export	515.34	844.7	1226.1	1499.9	1829.8
U\$ 400 GDP Economy	462.2	688.2	929.2	1178.4	1448.7
<b>Supply</b>					
- Status Quo	284	344	478	500	518
- Scenario 1	293.0	393.0	628.0	648.0	655.0
- Scenario 2	293.0	403.0	1122.0	1370.0	1640.0
<b>Balance</b>					
- Population	27.1	23.1	100.6	58.7	12.8
- Population/Literacy (Scenario 1)	13.5	(15.2)	(120.0)	(330.1)	(67.5)
- Mass Literacy & High Export Economy (Scenario 1)	(222.3)	(451.7)	(598.1)	(851.9)	(1174.8)
- Mass Literacy & High Export Economy (Scenario 2)	(222.3)	(441.7)	(104.1)	(129.9)	(189.8)
- U\$ 400 GDP	(169.2)	(285.2)	+192.8	+191.6	+191.3

Because of a shortage of wood pulp and particularly quality pulps in the country, all the paper mills have to depend on imported pulps to mix with local pulps. The import figure shows an enormous increase in recent years. The import figures are shown in Table 31. It is now a set policy of BCIC that its paper mills will use only 10% imported pulp to maintain the quality of the products. From the import figures it can be estimated that an additional 75-100 thousand cubic meter of pulpwood would be required to produce the same amount of pulp.

Table 31 - Import of Wood Pulp and Fibrous Materials

Year	Import (MT)	Value Tk Million
1980	7972	65.97
1981	7371	77.42
1982	7649	82.35
1983	3536	50.79
1984	25659	314.30
1985	41157	478.13
1986	26278	346.77
1987	33970	541.31
1988	17325	292.21
1989	17546	384.00
1990	21186	472.57

Source: Foreign Trade Statistics of Bangladesh, 1979-80 to 1989-90, BBS.

The demand for papers and pulpwood will have increased growth in future if the mass education programme is implemented. Even the high investment supplies can not cope with the ever increasing demand for paper. At home, BFRI has been trying to convince the government to finance a pilot project of pulp production from low quality jutes and jute cuttings. If the experiment shows successful results, then the problems of new materials may be reduced in the future.

### Newsprint

The sale of newsprint in the country has shown a fluctuating tendency in the 70's and from then on a steady upward trend. The consumption was 15,120 MT in 1976-77 and 13,280 MT in 1979-80.

Demand for newsprint depends both on the rate of literacy as well as the press and publication laws of the country. During the Martial Law periods when strict censor measures are observed, the newsprint consumption declines.

Traditionally, Bangladesh is an exporter of newsprint but from this year, 1991-92, the local consumption has grown to such an extent that there will be hardly any surplus to export. During the next financial year, 1992-93, it may require imports of newsprint if the current consumption is to be maintained. There has been no import of newsprint since

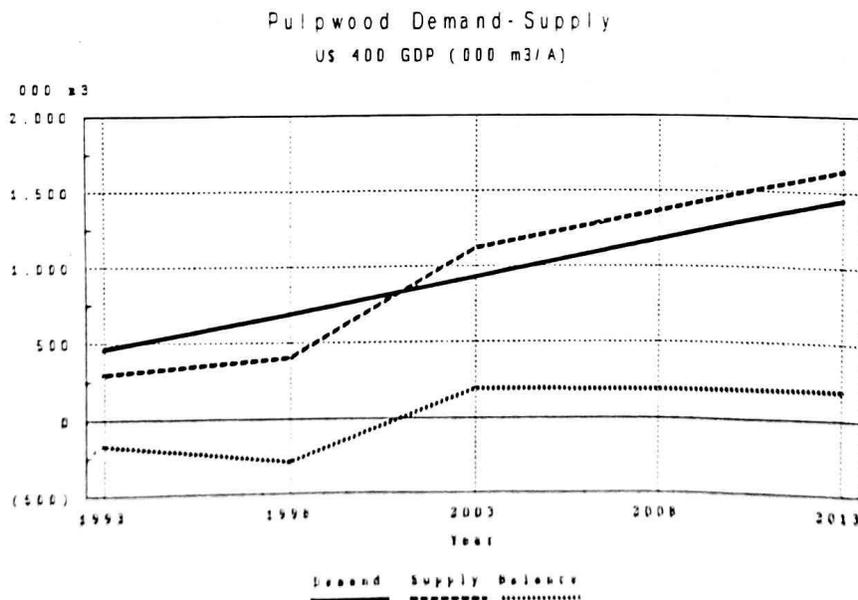


Figure 9 - US400 GDP Pulpwood Demand and Scenario 2 Supply

the establishment of KNM in 1955. The production, consumption and export of newsprint is presented in the Table 32.

**Table 32 - Consumption and Export of Newsprint, MT**

Year	Production	Export	Consumption
1976	20,060	4,940	15,120
1977	14,590	7,570	7,202
1978	27,490	29,330	6,160
1979	33,610	20,330	13,280
1980	38,070	21,410	16,660
1981	30,902	16,458	14,444
1982	44,004	10,542	25,309
1983	31,202	9,163	21,804
1984	37,764	13,984	31,988
1985	50,852	18,084	31,416
1986	55,100	16,022	37,963
1987	50,396	18,600	34,280
1988	49,859	13,899	35,136
1989	47,762	7,799	39,015
1990	50,465	4,674	46,456
1991	49,510	3,500	46,010

Source: MIS Department, BCIC.

Newsprint is mostly used in printing newspapers, magazines and periodicals but recently some of the economy books are also published in newsprint. The average per capita consumption has been increased from .1920 kg in 1980-81 to .4375 kg in 1991-92. The per capita consumption is expected to grow with the improvement of the literacy rates. Newsprint thus become one of the items with a fast growing demand.

Phasing out of the expected growth rates are also shown in the table. The projection of demand for newsprint under different scenarios in presented in Table 33.

**Table 33 - Projection of Demand for Newsprint Under Different Scenarios (000 MT)**

Year	Population		U\$ 400 GDP	Growth Rates	
	Only	Literacy		Popul- ation	Literacy
1991	49.51	-	-	-	25.32%
1993	53.47	55.70	120.2	1.86%	26.07%
1998	69.28	87.62	149.2	1.79	29.84%
2003	85.14	114.22	178.2	1.64	32.12%
2008	100.99	140.72	206.9	1.52	34.07%
2013	116.85	167.41	235.6	1.41	35.80%

### Writing, Printing and Cultural Grade Papers

The consumption of writing and printing paper in the country also shows a fluctuating tendency. It is believed that annual consumption is about 60,000 MT or more, of which about 20% is met from imports and the remaining supplies coming from local production. There has been no export of writing and printing paper from the country.

Production and consumption are presented in Table 34. The import of white paper shows an increasing trend from 1985. The major user of the writing and printing papers are publication industries and education institutions. The demand for paper is directly related to the education system and literacy rate of a country and not on population numbers.

Table 34 - Production and Consumption of White Paper including Cultural Papers

Year	Production (M. Ton)	Import (M. Ton)	Consumption (M. Ton)
1976	41,940	4,300	46,240
1977	45,410	4,652	50,062
1978	30,510	6,730	37,240
1979	37,390	10,725	48,115
1980	35,095	5,000	40,905
1981	41,098	5,500	53,598
1982	49,996	5,600	55,596
1983	76,798	6,540	83,338
1984	71,236	3,000	74,236
1985	53,148	2,000	55,148
1986	57,900	7,000	64,900
1987	63,604	7,000	70,604
1988	48,141	10,000	58,141
1989	48,238	10,000	58,238
1990	50,367	10,836	61,203
1991	48,500	12,000	60,500

Source: MIS Department of BCIC and Statistical Year Books of Bangladesh, BBS.

### Paper Demand Projection

Three different demand situation have been presented for the future demand of white paper on the following basis:

- a. Population Growth
- b. Literacy Rate Growth
- c. Mass Literacy Programme

Population growth is one of the important determinants for consumption of paper items. When population grows at a faster rate, the demand for paper increases at the same rate. This assumption assumes that quality of life i.e. literacy rate, income and standards, remains static. When this is not so, the demand may change in any direction depending on the goods.

The Status Quo scenario is presented here to show the future demand when there is no change in the quality of life. There has been confusion regarding the growth of literacy in the past. According to the 1979 population census, the literacy rate was 22%; the 1981 census shows that it has reduced to 20%; the 1991 census shows that it has improved to 25%. From these paradoxical figures it is difficult to determine the trend of literacy growth in the country for the last 20 years.

The second demand since considers a modest growth of literacy. During the plan period the literacy rate will grow to 36% if the normal emphasis of the government remains as it is.

The average per capita consumption has increased from .44 kg in 1988 to .56 kg in 1991. If the present consumption rate is maintained then the consumption demand will be 85,000 MT in 1993. The demand projection for writing and printing paper under the first two situations is presented in Table 35, compared to an US\$400 GDP economy.

**Table 35 - Writing and Printing Paper (000 MT)**

Year	Population		US\$ 400 GDP
	Only	Literacy	
1991	67.68	-	-
1993	70.84	71.99	264.0
1998	78.76	87.94	332.6
2003	86.68	101.22	401.3
2008	94.60	114.46	469.9
2013	102.51	127.80	538.6

The third demand situation is projected on the basis of a recent declaration by the government to initiate mass literacy programmes and to achieve 80% literacy by the end of the century. It is obvious that if the objective of this programme is achieved, the demand for newsprint and writing and printing paper will increase many fold. The same per capita consumption as now is assumed for the higher literacy rate, as well. The cent percent literacy rate is assumed to be achieved in 2008.

The effect of fulfilling 100% literacy achievement will have far reaching impact on the demand for paper items. Initially, the demand for writing and printing paper will go up immediately with starting the preparatory stage of the programme, followed by increasing demand for newspaper and other cultural grade paper. It is difficult to isolate the consequent demand for different grades of paper because of the literacy programme. There has been no example of a country where 100% literacy was achieved through a mass literacy programme before achieving per capita GDP of US \$400. As a result, the incremental demand for paper and pulpwood is shown on aggregate. After the achievement of cent percent literacy, the demand for paper and paper products will increase further for diversified uses.

Phasing out the achievement of literacy programmes along with the demand for paper pulp can be assigned as in Table 36.

**Table 36 - Pulpwood Requirement at 100% Literacy Rate**

Item	1991	1993	1998	2003	2008	2013
Literacy Rate Proposed %	26%	40%	60%	85%	100%	100%
Printing, Writing and Newsprint Paper, 000MT	117.19	192.00	314	481	609	652
Pulp Wood * Demand, 000m3	279	430	646	915	1076	1292

\* The demand for pulp wood excludes the use of bamboo for pulping. It is suspected that there can be supply of bamboo other than the present level. For increased demand for FRM, all pulpwood is considered.

### Other Papers

#### 1. Wrapping and Packaging

The consumption of industrial grade paper and duplex paper board is difficult to ascertain because of lack of data. Paper board and packaging materials are presently manufactured by small private

sector enterprises and the information is not collected regularly. With the recent expansion of export oriented industries like garments, shoes, shrimps and frozen food etc., the demand for high quality board and packaging paper has been increased tremendously. Most of the existing demand for export oriented industries is met through imported boards and papers. The local demand for boards is met from local sources. Small plants use recycled paper and wastes for low quality boards. Demand for other papers based on BCIC estimates and a U\$ 400 GDP economy appear in Table 37.

Table 37 - Demand for Other Papers (000 m<sup>3</sup>/A)

Year	Wrapping/Packaging		Specialities U\$400 GDP
	BCIC	U\$400 GDP	
1993	18.0	18.0	3.3
1998	75.3	42.6	20.0
2003	132.7	67.2	45.0
2008	190.0	91.8	75.0
2013	247.3	116.3	116.3

## OTHER INDUSTRIAL WOOD

### Consumption of Industrial Sawlog

The definition of industrial consumption of sawlog is those round logs which are used in the production of relatively large and modern processing units requiring some degree of capital intensity. Modern sawmilling industries producing sawn timber, furniture factories and cabinet manufacturing are excluded from the definition as their products are used as final consumption by households and are considered in the household consumption survey. Users of industrial logs can be classified as wood-based panel manufacturing and other miscellaneous wood products industries.

Table 38 - Demand for Industrial Sawlogs by Panel Manufacturing Units

Industries	Units	Capacity	Average Production	Average Requirement of RWE (000 m <sup>3</sup> )
Plywood and plywood products	000 m <sup>2</sup>	27,871+1 Mill Tea Chest	1,500+1 Mill Tea Chest	42
Hard board	000 m <sup>2</sup>	3,122	1,600	30
Board Products	000 m <sup>2</sup>	3542	2300	25
Total	000 m <sup>2</sup>	9,451+ 1 Mill Tea Chest	5,400+1 Mill Tea Chest	97

### Wood-based Panel Manufacturing

Wood-based panels includes the manufacturing of a wide variety of semi-finished and intermediate products like, hard board, particle board, plain wood text, veneer board, plywood, tea chests, flash doors, etc. Production of many of these items are declining and many factories have stopped production in recent years because of shortage of raw materials. The consumption estimates for the future are difficult to derive from the present production. Both the private and public sector enterprises are engaged in the production of panel products. Information on the public sector enterprises are available but not for the private sector. The lack of complete information

regarding those products poses a serious constraint for the estimator. From a rough estimate, it is shown that the annual average requirement of sawlog in these units is about 97 thousand m<sup>3</sup>

The demand for plywood and plywood products is presented in Table 38.

The consumption of panel products is obviously higher in the urban areas than in the rural areas. However, there is no evidence for such an assumption. To avoid assigning arbitrary per capita consumption figures by urban and rural areas, the study assigns the consumption of round wood equivalent according to the regions of the establishments and enterprises.

### Future of Plywood Factories

Plywood and hardboard manufacturing are concentrated in Khulna, Chittagong, CHT and in Sylhet. All large plywood factories are closed or nearly closed for a number of reasons - the shortage of raw materials, high production and administration costs and mismanagement. On the other hand, many new and small plywood factories have recently set-up to produce tea chests. If the forest department does not agree to supply sufficient quantity of sawlogs to BFIDC, then the closed factories may not reopen soon, resulting in further shrinkage of demand and consumption.

The tea board, who is the major consumer for tea chests, is also thinking seriously about the future supply of civit to the chest manufacturers. They are searching for suitable alternatives and have already undertaken programmes to convince the overseas buyers to accept alternative tea packing. If this is realised then the demand for tea chests will also be reduced.

### Other Miscellaneous Wood Products

Among the other miscellaneous wood products, match manufacturing occupies a prominent place. Other major log consumers are - pencil and toy manufacturers, body manufactures of transport vehicles, launch manufacturers, producers of textile and jute mill spares and accessories and other items.

The concentration of the producing units is near the cities and consumption of urban and rural can not be made because of the nature of the services. The average annual consumption of the round wood equivalent by those manufacturing units is presented in Table 39.

Table 39 - Demand for Industrial Sawlogs by Miscellaneous Manufacturing Units (000 m<sup>3</sup>)

Industries	Unit	Capacity	Average Annual	Roundwood Equivalent (000 m <sup>3</sup> )
Match Factories	1,000 Gross Boxes	20,000	14,000	55
Transport Sector	Vehicle body	-	7,500 bodies	12
Pencil & Accessories	1,000 Gross	194+		40
Total				107

The consumption of RWE in this case is also distributed according to the manufacturing capacity of the regions. For Stratum IV, no consumption was shown because of the absence of producing units in that region.

The total requirement for industrial log is assessed to be 204,000 m<sup>3</sup> in 1991. This demand has been kept constant for 1993 for obvious reasons. After 1998, the demand has been shown increasing at a very nominal rate.

## Demand - Supply Summary

The potential supply of primary wood products is derived from regions and sources. The supply projections are made considering three alternative investment scenarios - Status Quo, Scenario 1 and Scenario 2. Among the major sources identified for supply are natural forest, plantation forest, strip plantation, Unclassed State Forests and village forests. Long rotation, medium rotation and short rotation plantations and harvests are considered during the assessment of the supply.

The supply of each commodity is assessed separately by sources and by regions. The commodities assessed are - Fuelwood, Sawlog, Poles and Posts and Pulpwood.

The projection of demand is then compared with supply for each scenario and item by projection years. The methodology of demand projection is described in this reports earlier. At first demand and consumption of final products are assessed than the demand for primary products like sawlog is derived. In case of paper products and pulpwood demand the same procedure was followed. The summary data of the demand and supply projections are presented in Table 40 and 41, respectively.

Table 40 - Demand Schedule of Forest Products (000 m<sup>3</sup>)

Details/ Alternatives	Y e a r				
	1993	1998	2003	2008	2013
<u>Status Quo</u>					
Sawlogs	4686	5148	5612	6109	6639
Pulpwood	257	321	377	441	505
Poles	266	285	299	313	327
Fuelwood	8271	9044	9847	10682	11553
Total	13480	14792	16135	17545	19024
<u>Scenario 1</u>					
Sawlogs	4934	5427	5970	6567	7223
Pulpwood	279	408	508	614	722
Poles	266	285	299	313	327
Fuelwood	8166	7699	7637	8554	8445
Total	13645	13819	14414	16048	16717
<u>Scenario 2 U\$ 400 GDP</u>					
Sawlogs	5147	7666	10185	12704	15223
Pulpwood	462	688	929	1178	1449
Poles	266	285	329	345	380
Fuelwood	9625	10798	12202	14037	15124
Total	15500	19437	23645	28264	32176

Comparing the table it makes clear that the gap between demand and supply is wide in all cases. Among the primary forest products sawlogs are more important as they have a wide variety of uses and many industries are dependent on them. The demand/supply gap is highest in the case of sawlogs. Sawlogs are also important as there is no substitute available in the country. For fuelwood, people use agricultural waste or more efficient fuels of commercial nature if the supply of fuelwood is not adequate to meet the demand. In the case of sawlogs, the demand remains unsatisfied.

It is to be noted here that forestry is a process of production which requires a long gestation period of 50-60 years. Therefore, plantation during the plan period does not yield output except for a few short rotation fuelwood species.



It is expected that in the high investment scenario the demand for forest products could be met satisfactorily after the plan period and the yields received are harvested.

Table 41 - Supply Schedule for Forest Products (000 m<sup>3</sup>)

11

Details/ Alternatives	Y e a r				
	1993	1998	2003	2008	2013
<u>Status Quo</u>					
Sawlogs	1,285	1,364	1,432	1,589	1,828
Pulpwood	284	344	478	500	518
Poles	154	153	149	215	296
Fuelwood	6,179	6,494	6,829	7,212	8,208
Total	7,902	8,355	8,888	9,516	10,850
<u>Scenario 1</u>					
Sawlogs	1,318	1,393	1,544	1,739	2,739
Pulpwood	293	393	628	648	655
Poles	179	179	216	483	830
Fuelwood	6,242	6,585	7,449	8,554	10,054
Total	8,032	8,550	9,837	11,242	14,278
<u>Scenario 2</u>					
Sawlogs	1,421	1,528	1,675	2,018	5,884
Pulpwood	293	403	1,122	1,370	1,640
Poles	168	175	907	2,053	3,054
Fuelwood	6,122	6,696	9,231	10,958	15,072
Total	8,004	8,802	12,935	16,399	25,650

**APPENDIX 1**  
**ABBREVIATIONS, TERMS AND CONVERSION FACTORS**

**STATISTICAL REPORT**  
**FOREST PRODUCTS DEMAND PROJECTION**

**APPENDIX 1**

**ABBREVIATIONS, TERMS AND CONVERSION FACTORS**

BCAL	=	Bangladesh Census of Agriculture and Livestock, 1983-84
BSS	=	Bangladesh Bureau of Statistics
BGD	=	Bangladesh Government
BEPP	=	Bangladesh Energy Planning Project
BCSIR	=	Bangladesh Council for Scientific and Industrial Research
BFIDC	=	Bangladesh Forest Industries Development
BCIC	=	Bangladesh Chemical Industries Corporation
BFRI	=	Bangladesh Forest Research Institute
CHT	=	Chittagong Hill Tracts
DBH	=	Diameter at breast height
DBHOB	=	Diameter at breast height over bark
DBHUB	=	Diameter at breast height under bark
DOS	=	Disk Operating System
FAO	=	Food & Agriculture Organization of the United Nations
FD	=	Forest Department
FMPP	=	Forestry Master Plan Project, 1991
FRM	=	Fibrous Raw Materials
GOB	=	Government of Bangladesh
GDP	=	Gross Domestic Products
GNP	=	Gross National Products
HSC	=	Higher Secondary Certificate
IBM	=	International Business Machine
KNM	=	Khulna News Print Mills
KPM	=	Karnafuli Paper Mills Ltd
LC	=	Land holding Class
LPG	=	Liquified Petroleum Gas
MOP	=	Ministry of Planning
MOEF	=	Ministry of Environment and Forest
NBPM	=	North Bengal Paper Mills Ltd
PC	=	Planning Commission
PDB	=	Power Development Board
QCS	=	Quality Control Supervisors
RWE	=	Round Wood Equivalent
SPPM	=	Sylhet Paper and Pulp Mills Ltd
SSC	=	Secondary School Certificate
SV	=	Standing Volume
TOR	=	Terms of Reference
UNDP	=	United Nations Development Programme
USF	=	Unclassed State Forest

**APPENDIX 2**  
**CONSUMPTION QUESTIONNAIRE**

**STATISTICAL REPORT**  
**FOREST PRODUCTS DEMAND PROJECTION**

**APPENDIX 2**  
**CONSUMPTION QUESTIONNAIRE**

District \_\_\_\_\_  
 Upazila \_\_\_\_\_  
 Village \_\_\_\_\_  
 Population of Village \_\_\_\_\_  
 Name of Household owner \_\_\_\_\_  
 \_\_\_\_\_  
 Income(monthly) \_\_\_\_\_

**FORESTRY MASTER PLAN 1991-1992**  
**SURVEY OF WOOD & BAMBOO IN VILLAGE FORESTS**  
 A) AVAILABILITY  
 B) CONSUMPTION  
 C) PUBLIC ATTITUDES

Group \_\_\_\_\_  
 Enumerator \_\_\_\_\_  
 Supervisor \_\_\_\_\_  
 Date \_\_\_\_\_

Sample No 

--	--	--	--	--	--	--	--

1. General  
 Number of family Member: Total \_\_\_\_\_ (Male \_\_\_\_\_ Female \_\_\_\_\_ Minors \_\_\_\_\_)  
 Main Occupation: 1) Farming 2) Fishing 3) Dairy/Poultry 4) Crafts  
 5) Labourer 6) Small trade 7) Service 8) Other.....   
 Land Ownership (acres): 1) Less than .50 2) .50 to <2.50  
 3) 2.50 to <7.5 4) 7.5 & above.....   
 2. Livestock (number): a) Cattle \_\_\_\_\_ b) Buffalo \_\_\_\_\_  
 c) Goat \_\_\_\_\_ d) Sheep \_\_\_\_\_ e) Others \_\_\_\_\_

**CONSUMPTION QUESTIONNAIRE**

**PART II**

1. Fuel Consumption  
 a) Quantity:

Item	Unit	Qty consumed				Total Annual	How obtained (1-5)*
		yester-day	Last 7 days	Dry season weekly	Wet season weekly		
Firewood Proper	seer						
Branches	seer						
Tree Waste**	seer						
Bamboo	seer						
Agri.Residue***	seer						
Cow dung	seer						
Charcoal	seer						
Oil,Gas,Electric	liter						

\* 1) Own production 2) Purchased 3) Collected from elsewhere  
 4) Part own, part purchased or collected 5) Don't know  
 \*\* Leaves, Twigs, Roots  
 \*\*\* Rice husk hay, jute sticks

- b) If collected who collects material? 1) Owner 2) Family members  
 3) Paid servants 4) Others(specify) \_\_\_\_\_

- c) How many days in each week is spent in collection?  
 1) One day per week 2) Every day 3) More than 1 but less than 3   
 4) 3 to 5 days 5) Don't know .....
- d) How far one has to go to collect fuel?   
 1) Less than a mile 2) 1 to 3 miles 3) More than 3 miles .....
- e) How long it takes to collect a week's fuel? \_\_\_\_\_
- f) How would you rank availability of fuel in your area?   
 1) Scanty 2) Ample 3) Abundant 4) Don't know.....
- g) How has availability changed during last 5 years?   
 1) Decreased greatly 2) Decreased slightly 3) Same  
 4) Increased slightly 5) Increased greatly 6) Don't know.....
- h) If any cowdung is burnt, would the farmer like to divert part burnt as manure? if so, how much?   
 1) All 2) Half 3) Less than half 4) Don't know.....
- i) how the data were collected \_\_\_\_\_
2. Fodder
- a) Do you grow or collect any fodder? 1) Yes 2) No.....
- b) If yes, mention what kind?   
 1) Agricultural waste 2) Fodder Crop 3) Tree.....
- c) Do you at times divert part of the fodder to fuel use? 1) Yes 2) No....
- d) If yes, at what season? 1) Winter 2) Summer 3) Rains.....
- e) If yes, at what proportion?   
 1) Less than quarter 2) Half 3) Three quarter or more.....
- f) How far one has to go to collect fodder?   
 1) Less than a mile 2) 1 to 3 miles 3) More than 3 miles .....
- g) How long it takes to collect a weeks fodder? \_\_\_\_\_
- h) How has availability changed during last 5 years?   
 1) Decreased greatly 2) Decreased slightly 3) Same  
 4) Increased slightly 5) Increased greatly 6) Don't know.....
- i) How would you rank availability of fodder in your area?   
 1) Scanty 2) Ample 3) Abundant 4) Don't know.....

3. Building Materials

- i) Main Buildings  
 a) Roofs, Ceilings & walls:

Member	External/ Cladding material	Quantity in Structural members			Replacement within last 12 months		
		Wood vol (cft)		Bamboo	Others	material	qty/no
		sawn	round	number	name & qty		
Roofs							
Ceilings							
Walls							

- b) Doors, Pillars, Windows:

Member	Wood vol. (cft)		Bamboo number	Others Name & quantity	Replacement in 12 months	
	sawn	round			Material	Qty/number
Doors						
Pillars						
Windows						

ii) Other Buildings

	Wood vol.(cft)		Bamboo number	Others Name & quantity	Constructed in the last 12 months (number)
	sawn	round			
Kitchens					
Latrines					
Others					

Use the following relationship for calculating volume of timber/wood, number of whole bamboo, weight of jute stick/thatch under each category (i.e.Pillar, Window, Door, Wall, Roof etc.) as follows:

1 whole bamboo	= 25 rft	1 pillar of bamboo	= 10 ft
1 muli bamboo gives tarja	= 5 sft	1 standard pillar(wood)	= 3 cft
1 bundle of jute stick	= 2 seer	1 window (solid wood)	= 1 cft
1 bundle of Sun Grass	= 5 seer	1 wooden door (solid)	= 2 cft

iii) Fencing:

Type - Jute stick, Bamboo matting, others	Length	Material quantity used			
		Wood volume(cft)		Bamboo number	Others
		sawn	round		

4. Furniture

i) Wooden furniture

Item	Volume /unit (cft)	Total Number	No.obtained in the last 12 months	Remarks about special items
Bed cot (standard)	4.5			
Bed cot (decorated)	6.0			
Table with drawer(4'x3')	3.0			
Table - normal(3'x2')	2.0			
Chair(all wood)- armless	0.8			
Chair(all wood)-with arm	1.3			
Chair (cane seat)	0.8			
Almirah - no glass	5.0			
Almirah	4.0			
Bench - high	2.0			
Bench - seat	1.5			
Bench - arm & back	2.5			
Shelf	2.5			
Pira	0.5			
Box	5.0			
Alna	1.5			
Bed-stead(Chowki)	3.0			
Bed-stead(Chowki)-single	2.5			
Desk - standard	3.0			
Stool	0.5			

ii) Cane furniture

Item	Cane type	cane length /piece(rft)	Bamboo rft per piece	Total number	Number obtained in the last 12 month
Lawn Chair- single	Golla	75			
Lawn Chair- double	Golla	110			
Table - central	Golla	35			
Table - side	Golla	30			
Mura - round	Jali	80			
Mura - chair	Jali	250			
Suitcase	Jali	100			
Cradle	Golla	70			

5. Agricultural Implements

Item	Volume of wood per piece (cft)	Bamboo length per piece (rft)	Total number owned	Number obtained in the last 12 months
Plough	5			
Ladder	3			
Dheki	2.5			
Rice Pounder	5			
Spade/Axe handle	0.05			
Polo				
Topa				
Jhaka/Tukri/Jhuri				
Kholui/Mathal				
Grain Storage bin				

6. Transportation

Items	Wood volume per piece(cft)	Bamboo length per piece(rft)	Total number owned	Number purchased in the last 12 months
Boat-Below 15'				
Boat-15' to 30'				
Boat-Above 30'				
Cart				
Rickshaw				
Dulee				
Palki				
Others				

7. Sales and Purchase

a) Actual:  
If the householder bought or sold any wood or bamboo within the last 12 months, fill out this table.

	Qty sold (cft)	Sale price/unit	Sold to*	Qty purchased(cft)	Purchase price/unit	Purchased from*
Timber round						
Timber sawn						
Fuelwood						
Bamboo						

\* 1 - Person from same village  
2 - Outsider from another village  
3 - Outsider from town/Market  
4 - Don't know



b) Harvest:

If the householder harvested within last 12 months any tree over 24" girth BHOB, record if possible with species.

Species	Girth	Number

**CONVERSION TABLE OF WOOD AND BAMBOO FOR BUILDINGS AND FURNITURE**

The following relationships are used for calculating volume of timber/wood, number of whole bamboo, weight of jute stick/thatch sun grass and cane under each category of building materials (i.e. pillar, window, door, wall, roof etc), wooden furniture and implements and cane furniture as follows:

Items	Standard Volume	Item	Standard Volume	Items	Standard Volume
1 Whole bamboo	25 rft	Bed cot (standard)	4.5 cft	Pira	0.5 cft
1 muli bamboo gives tarja	5 sft	Bet cot (decorated)	6.0 cft	Box	5.0 cft
1 bundle of jute stick	2 seer	Table with drawer (4' x 3')	3.0 cft	Alna	1.5 cft
1 bundle of sun grass	5 seer	Table - normal (3'x 2')	2.0 cft	Bed-stead (Chowki)	3.0 cft
1 pillar of bamboo	10 ft	Chair (all wood) armless	0.8 cft	Bed-stead (Chowki)-single	2.5 cft
1 standard pillar (wood)	3 cft	Chair (all wood)-with arm	1.3 cft	Lawn Chair-single (Golla)	75 rft
1 window (solid wood)	1 cft	Chair (cane seat)	0.8 cft	Lawn Chair-double (Golla)	110 rft
1 wooden door (solid)	2 cft	Almirah - no glass	5.0 cft	Table-central (Golla)	35 rft
Plough	5 cft	Almirah	4.0 cft	Table-side (Golla)	30 rft
Ladder	3 cft	Bench - high	2.0 cft	Mura-round (Jali)	80 rft
Dheki	2.5 cft	Bench - seat	1.5 cft	Mura-chair (Jali)	250 rft
Rice Pounder	5 cft	Bench - arm & back	2.5 cft	Suitcase (Jali)	100 rft
Spade/Axe handle	0.05 cft	Shelf	2.5 cft	Cradle (Golla)	70 rft
Desk-standard	3.0 cft	Stool	0.5 cft		

**STANDARD ENERGY CONVERSION**

Fuel Type	Energy Factor	
	BTU/lb	Kcal/kg
Cow dung	5,000	2,791
Jute Stick	5,400	3,015
Rice Straw	5,400	3,015
Rice Hulls	5,400	3,015
Bagasse	3,200	1,787
Firewood	5,532	3,089
Twigs, leaves	5,532	3,089
Other Waste	5,400	3,015

**APPENDIX 3  
POPULATION PROJECTION**

**STATISTICAL REPORT  
FOREST PRODUCTS DEMAND PROJECTION**

**APPENDIX 3  
POPULATION PROJECTION**

Year, 1991	Total	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII
Total Pop	107993000	26209901	23650467	14676249	11533652	17840444	13088752	993536
U.Total	16414936	2081066	6149121	1909380	1033415	3669779	1410967	155985
U.Rich	3282987	416213	1229824	381876	206683	733956	282193	31197
U.Poor	13131949	1664853	4919297	1527504	826732	2935823	1128774	124788
R.Total	91578064	24128835	17501346	12766869	10500237	14170664	11677784	837551
R.Rich	18315613	4825767	3500269	2553374	2100047	2834133	2335557	167510
R.Poor	73262451	19303068	14001076	10213495	8400190	11336531	9342227	670040
Lit.	27353072	6638968	5990663	3717494	2921474	4518984	3315381	251663
Illit.	80639938	19570933	17659804	10958755	8612178	13321459	9773371	741873

Year, 1993	Total	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII
Total Pop	112014545	27185930	24531185	15222777	11963153	18504803	13576163	1030534
U.Total	17967133	2386925	6584170	2108355	1172389	3961878	1577550	170450
U.Rich	3593427	477385	1316834	421671	234478	792376	315510	34090
U.Poor	14373706	1909540	5267336	1686684	937911	3169503	1262040	136360
R.Total	94047412	24799005	17947015	13114422	10790764	14542925	11998613	860084
R.Rich	18809482	4959801	3589403	2622884	2158153	2908585	2399723	172017
R.Poor	75237930	19839204	14357612	10491538	8632611	11634340	9598890	688067
Lit.	29213393	7090091	6397733	3970100	3119990	4826053	3540663	268763
Illit.	82801152	20095840	18133452	11252677	8843163	13678750	10035500	761771

Year, 1998	Total	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII
Total Pop	122068409	29626003	26732982	16589097	13036906	20165701	14794691	1123029
U.Total	20519700	2829283	7380976	2425326	1378001	4472753	1833062	194396
U.Rich	4103940	565857	1476195	485065	275600	894551	366612	38879
U.Poor	16415760	2263427	5904781	1940261	1102401	3578202	1466450	155517
R.Total	101548709	26796720	19352005	14163771	11658905	15692949	12961629	928633
R.Rich	20309742	5359344	3870401	2832754	2331781	3138590	2592326	185727
R.Poor	81238968	21437376	15481604	11331017	9327124	12554359	10369303	742906
Lit.	35228943	8550064	7715138	4787613	3762451	5819821	4269748	324106
Illit.	86839466	21075938	19017843	11801483	9274455	14345880	10524943	798923

Year, 2003	Total	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII
Total Pop	132122273	32066076	28934778	17955417	14110659	21826599	16013219	1215525
U.Total	23068549	3270740	8176968	2741792	1583216	4983013	2088124	218430
U.Rich	4613710	654148	1635394	548358	316643	996603	417625	43686
U.Poor	18454839	2616592	6541575	2193434	1266573	3986410	1670499	174744
R.Total	109053724	28795336	20757810	15213625	12527443	16843587	13923494	997095
R.Rich	21810745	5759067	4151562	3042725	2505489	3368717	2784699	199419
R.Poor	87242979	23036269	16606248	12170900	10021954	13474869	11138795	797676
Lit.	41248574	10011029	9033438	5605681	4405348	6814264	4999327	379487
Illit.	90873699	22055047	19901340	12349736	9705311	15012335	11013892	836038

Year, 2008	Total	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII
Total Pop	142176136	34506148	31136574	19321737	15184411	23487498	17231748	1308020
U.Total	25620140	3712862	8973561	3058631	1788724	5493726	2343518	242245
U.Rich	5124028	742572	1794712	611726	357745	1098745	468704	48449
U.Poor	20496112	2970289	7178848	2446905	1430979	4394981	1874814	193796
R.Total	116555996	30793287	22163013	16263106	13395688	17993772	14888230	1065775
R.Rich	23311199	6158657	4432603	3252621	2679138	3598754	2977646	213155
R.Poor	93244797	24634629	17730411	13010485	10716550	14395018	11910584	852620
Lit.	47259348	11469844	10349797	6422545	5047298	7807244	5727833	434786
Illit.	94916788	23036305	20786777	12899192	10137113	15680253	11503915	873234

Year, 2013	Total	S-I	S-II	S-III	S-IV	S-V	S-VI	S-VII
Total Pop	152230000	36946221	33338370	20688057	16258164	25148396	18450276	1400516
U.Total	28162550	4152755	9768142	3374222	1993251	6002922	2597799	266098
U.Rich	5632510	830551	1953628	674844	398650	1200584	519560	53220
U.Poor	22530040	3322204	7814514	2699378	1594601	4802338	2078239	212878
R.Total	124067450	32793466	23570228	17313835	14264913	19145474	15852477	1134418
R.Rich	24813490	6558693	4714046	3462767	2852983	3829095	3170495	226884
R.Poor	99253960	26234773	18856182	13851068	11411930	15316379	12681982	907534
Lit.	53280500	12931177	11668430	7240820	5690357	8801939	6457597	490181
Illit.	98949500	24015044	21669941	13447237	10567807	16346457	11992679	910335

**APPENDIX 4  
REFERENCES**

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**APPENDIX 4  
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