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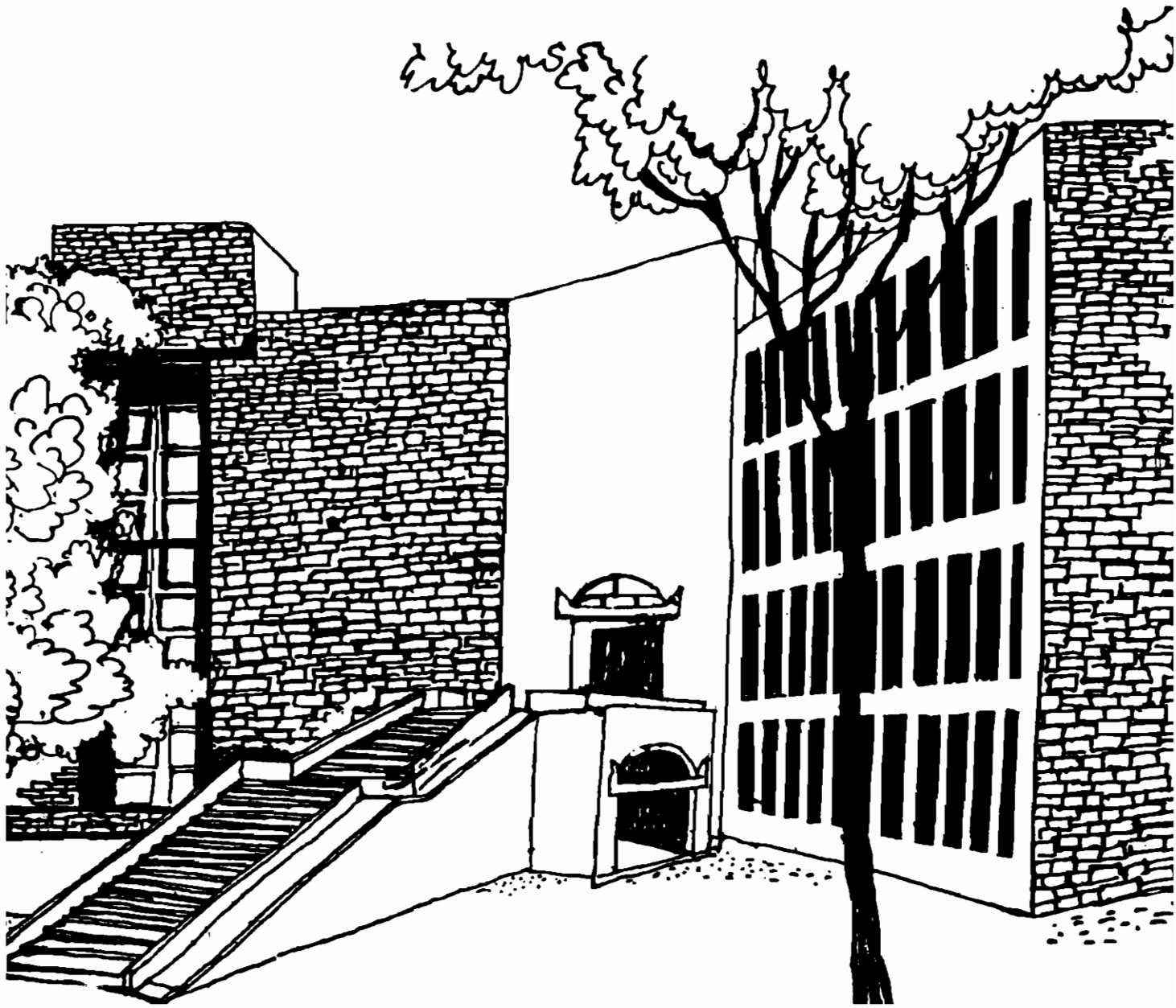

DEMAND FOR FOREST PRODUCTS IN INDIA: PAST TRENDS AND PROJECTIONS TO 2010

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Abstract

This paper provides a brief summary of the results of growth performance and projections of demand for forest products in India and uses these results to provide a background for discussion of implications for forest policy and management. The trends indicate that the production of most forest products grew slightly at slower growth rates than its consumption. The growth rates for production and consumption of many products during 1981-94 have been lower than for 1970-80 period. The model used to forecast the demand and supply of forest products performed satisfactorily in terms of goodness of fit and its predictability. The forecasts of demand and supply showed a deficit of all types of forest products at national level; except for wrapping and packaging paper and paperboard, which was sufficient for the next one and half decades. Demand for forest products is likely to increase from current levels, but the rate of increase is likely to be lower than in the past. Moreover, the forest products and the raw material required to produce them will change with the changes in the market and the substitutes of these products. Therefore, the national forest policy and management should take into account all these changes and their effect on extent and composition of demand for forest products.

Introduction

Forests play a dominant role in the economy of developing countries. A large segment of India's population depends on forests for energy, housing, timber and fodder. The demand for forest products and services in the country is increasing with the rapid economic growth and increase in population whereas the area under forests in the country is declining. The increased demand for forest products, fast population growth and poverty are putting great pressure on all resources including forests. The recorded forest area of the country is about 76.5 million ha (23% of the total geographical area). However, the tree cover is only about 64 million ha which is 19.45 per cent of total geographical area of the country, out of which 38.6 million ha has good forest cover having crown density of more than 40 per cent, 25 million ha is degraded with crown density between 10 to 40 per cent and some forests are virtually blank (Oberai, 1997). The per capita forest area in the country is 0.08 ha as compared to 0.82 ha in Pakistan, 1.02 ha in Malaysia and the world average of 0.64 hectare (Table 1).

The forest and forestry sectors are shaped as much by the external economic, political, demographic and social trends as they are by forces working within the sector itself. Both the present and the future situation of forest products and services must be considered within the wider context of development, which has, as its ultimate goal, the improved well-being of present and future generations. Major factors which have an effect upon forests include: continued population growth and urbanisation; higher rates of economic growth and trade liberalisation. The impact of population growth on forest cover and condition is clearly demonstrated by the fact that deforestation in most of the countries in the Asian region has continued over the period 1990-95 and the demand for food to feed increasing population will continue to put pressure on forest lands (Table 1).

Table 1. Forest resources of selected Asian Countries

Country	*Proportion of forest area to geographical area (%)*	*Per capita forest area (ha.)*	*Annual de-forestation ('000 ha.)*	*Annual re-forestation ('000 ha.)*	*Per capita land (ha.)*
India	22	0.08	339	1009	0.32
Bangladesh	8	0.01	38	12.3	0.12
Nepal	37	0.27	54	4.3	0.63
Pakistan	3	0.82	77	4.2	0.58
Sri Lanka	29	0.11	27	6.0	0.35
Indonesia	64	0.64	1212	0.1	0.92
Malaysia	54	1.02	396	6.3	1.62
Myanmar	44	0.70	401	19.6	1.39
Philippines	27	0.13	316	-	0.44
South Asia	18	0.06	-	-	0.33
World	27	0.64	-	-	-

- : Data not available

Source: Vergara (1997)

Clearly, the forestry sector faces increasingly difficult challenges in the future. Population growth, changes in population distribution, economic pressures and efforts to alleviate poverty and ensure food security will lead to more intense scrutiny of forests' actual and potential contribution to development and of the relative benefits of retaining land in forests versus converting it to other land uses. The most obvious challenge within the sector is that how to meet growing demand for forest products while at the sametime safeguarding the ability of forests to provide a range of environmental services including among others, the conservation of biological diversity, mitigation of global climatic change, protection of desertification and protection of soil and water resources.

It is recognised that inappropriate policies have to a large extent aggravated the depletion of forest resources and there is now an urgent need to analyse and discuss the systematic and dynamic effects of some critical economic policies on long term forestry development. Forest policy analysis should reflect the dynamic movement of both demand and supply of forest resources, together with their social effects. This paper provides information on trends, status and future projections of demand for forest products in India and use these results to provide the background for discussion of implications for both forest policy and forest management. This study deals strictly with forest products derived from wood, such as industrial roundwood, fuelwood and charcoal, sawnwood, wood-based panels, paper and paperboards and the raw material needed to supply these products.

This paper is organised as follows. In the first section, the current status and past trends in forest resources will be examined. It provides information on the status of forest cover in the country and the role of forests in the economy. This is followed by a discussion of historical trends in production and consumption of forest products over the period 1970-94. In the second section, the forecasts of forest products demand and supply are made to 2010 on the basis of econometric model. The main task of this section is to present a forecast of the demand-and-supply balances for major forest products in the country to 2010. The third section will present the scenario of forest trade in the country and the concluding section summarizes the findings.

I. Trends and Status of Forest Products

Forests in the economy

Forests offer a wide range of both material and intangible benefits, all of which have a value but only some of which are currently expressed in monetary terms. Benefits which are difficult to quantify include goods which pass through the informal sector, non-marketed goods, and services. Major industries and small enterprises based on forest products are the source of considerable income and employment. Less recognised but also significant are the employment and income associated with the management of natural or plantation forests. Forest products can provide critical inputs into major industries in other sectors.

Forests tend to offer possibilities for income generation in rural areas, where few other opportunities may be available. Forestry also generates opportunities further afield due to their multiplier effects derived from their forward and backward linkages. No good estimates of forestry's economic contribution are available, but a partial indication is provided by its share in gross domestic product (GDP). In India forestry is estimated to contribute only 1.1 per cent of GDP. The conventional methods of national accounting greatly understate many indirect benefits which forests contribute to improvement of food security, to meeting rural subsistence needs, to generation of rural income and employment, to agricultural productivity and to protection of the environment. Forest and agricultural policies in India, have failed in the past to take into account these indirect contributions of forest resources to the national economy. Consequently, the conservation and management of these resources has been given a less priority in government development plans. The allocation of forestry sector has increased merely from 0.39 per cent in the First Five Year Plan to one per cent in the Eighth Five Year Plan (Oberai, 1997).

Forests provide a variety of environmental services like, conservation of biological diversity; protection of soil and water resources; support to agricultural productivity and sustainability; carbon sequestration and the mitigation of global warming; combating desertification and degradation of resources in arid and semi-arid regions; provision of

shade, amenity and recreation. However, the environmental services provided by forests are seldom fully valued or adequately reflected in forest planning and management decisions and are nevertheless given high priority in national and global debates on sustainable forestry.

Present scenario of forest cover

As per the State of Forest Report, 1995, which is fifth assessment of forest cover of India based on visual and digital interpretation of the satellite data pertaining to the period 1991-93, the total forest cover of the country is 639,600 km^2 which is 19.45 per cent of the total geographical area of the country. Out of this 385,756 km^2 (11.73% of geographical area) is dense forest with crown density of 40 per cent and above, 249,311 km^2 (7.58%) is open forest with crown density between 10 and 40 per cent and 4,533 km^2 (0.14%) are mangroves.

Table 2. Status of forests in India, 1995

Class	*Area (km^2)*	*% of total geographical area*
Dense forests (crown density 40% and above)	385,756	11.73
Open forest (crown density 10% to less than 40%)	249,311	7.58
Mangroves	4,533	0.14
Scrub area (tree land with less than 10% crown density)	60,528	1.84
Non-forest	25,87,135	78.71
Total	*32,87,263*	*100.00*

Source: Govt of India, 1997

Comparison of 1995 assessment with that of 1993 reveals that there has been a decrease of 507 km^2 in the extent of actual forest cover of the country, i.e. an annual reduction of 23,350 hectares. While the area under forests in the states of Delhi, Gujarat, Haryana, Karnataka, Rajasthan, Sikkim, Uttar Pradesh and West Bengal and in the Union Territory of Chandigarh has increased, the forest cover in the states of Andhra Pradesh,

Arunachal Pradesh, Assam, Bihar, Himachal Pradesh, Jammu & Kashmir, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab and Union Territories of Andaman & Nicobar Islands and Dadra and Nagar Haveli has decreased. There has not been any change in the forest cover in Goa, Daman & Diu, Kerala, and Tripura (Govt of India, 1997) .

Trends in production and consumption of forest products, 1970-94

In order to examine the trends in production and consumption of forest products the secondary data related to production, imports and exports of major forest products was collected from FAO Yearbooks of Forest Products for the years 1970-71 to 1994-95. The compound growth rates of production and consumption were estimated by fitting a log-linear trend function of the form:

$$Ln\ Q = a + bt$$

where 'Q' is production/ consumption and 't' represents the time variable.

Production of forest products

In 1996, the world produced about 3,327 million cubic metre of roundwood out of which India's share was 304 million cubic metres (9.14%). The growth in production of some of the major wood and wood products in India during 1970-94 is shown in Table 3. Total wood production (roundwood) has increased from 199.17 million cubic metres in 1970-80 to 261.07 million cubic metres in 1981-94, witnessing a compound growth rate of 2.19 per cent per annum. The production of fuelwood and charcoal increased from 182.85 million cubic metres to 237.6 million cubic metres during the same period and the annual compound growth rate of its production stood at 2.13 per cent per annum. The industrial use of wood has been growing at the growth rate of 2.87 per cent per annum and stood at 24.8 million cubic metres in 1995. More than 90 per cent of the wood continue to be used as fuel but the proportion of the wood used as raw material for industrial purposes increased steadily from 7.34 per cent in 1970 to 8.52 in 1994, which is a welcome feature for forest based industrial growth. The production of sawnwood

increased from 7.15 million cubic metres in 1970-80 to 16.21 million cubic metres in 1981-94 and the average annual production stood at 12.22 million cubic metres The annual growth in production of sawnwood was 6.54 per cent during 1970-94 period

Table 3. Trends in production of forest products in India, 1970-94

Forest products	*Production*			*Growth rates (% annum)*		
	1970-80	*1981-94*	*1970-94*	*1970-80*	*1981-94*	*1970-94*
*1. **Roundwood*** *(Million cubic metres)*	199.17	261.07	233.83	2.68	1.97	2.19
Fuelwood and charcoal	182.85	237.60	213.51	2.52	2.02	2.13
Industrial roundwood	16.32	23.46	20.32	4.52	1.51	2.87
*2. **Sawnwood*** *(Million cubic metres)*	7.15	16.21	12.22	9.72	3.00	6.54
*3. **Wood-based panels*** *(Million cubic metres)*	0.20	0.44	0.33	3.29	3.24	5.51
Plywood	0.15	0.33	0.25	3.54	4.10	5.83
Particle board	0.01	0.03	0.02	4.77	2.38	5.45
Fibreboard	0.03	0.04	0.04	0.18	2.52	2.95
*4. **Wood pulp*** *(Million metric tons)*	0.33	0.88	0.64	16.55	5.88	8.90
*5. **Paper and paperboard*** *(Million metric tons)*	1.08	2.00	1.60	7.60	4.59	5.31
Newsprint	0.05	0.26	0.16	3.61	8.83	11.83
Printing and writing paper	0.66	0.89	0.79	11.19	2.19	3.51
Other paper and paperboard	0.37	0.86	0.64	1.71	7.38	6.26
*6. **Wrapping and Packaging paper and paperboard*** *(Million metric tons)*	0.19	0.77	0.51	7.20	10.70	10.79

The production of wood-based panels more than doubled during the 1970-80 and 1981-94 period and the average annual growth rate stood at 5.51 per cent. Under wood-based panel category, plywood accounts for more than 80 per cent of the total wood-

based panels and its production registered the highest growth rate (5.83%) followed by particle board (5.45%) and the lowest (2.95%) in fibreboard. The wood pulp production in the country increased at a compound growth rate of 8.90 per cent per annum and stood at 1.21 million metric tons in 1995.

The paper and paperboard production has increased from 1.08 million metric tons 1970-80 to 2 million metric tons in 1981-94 at a compound growth rate of 5.31 per cent. Newsprint registered a growth rate of 11.83 per cent per annum during 1981-94 period. Wrapping and packaging paper and paperboard showed a compound growth rate of more than 10 per cent per annum during 1970-94 period.

The results of compound growth rates during sub-periods, 1970-80 and 1981-94, show that the annual compound growth rates for most of the forest products were higher in 1970-80 compared to 1981-94 period except for plywood, newsprint, other papers and paper board and wrapping and packaging paper and paper board.

Consumption of forest products

Forest product consumption in the country experienced a considerable growth in the past two and half decades. Roundwood consumption grew from 199.14 million cubic metres in 1970-80 to 261.52 million cubic metres in 1981-94. Consumption expansion was more substantial for industrial roundwood, growing 47 per cent, from 16.30 million cubic metres in 1970-80 to 23.92 million cubic metres in 1981-94. The fuelwood and charcoal consumption grew approximately 30 per cent between 1970-80 and 1981-94. The share of industrial roundwood in total wood consumption increased from about 8 per cent in 1970-80 to 9 per cent in 1981-94. Conversely the share of fuelwood and charcoal contracted over the same period, from 92 per cent to 91 per cent (Table 4).

Consumption of sawnwood, wood-based panels, wood pulp and paper and paperboards has been particularly dynamic. Consumption of sawnwood has increased significantly from 7.15 million cubic metres in 1970-80 to 16.22 million cubic metres in 1981-94 and its growth rate stood at 6.55 per cent per annum. Consumption of wood-based panels has increased steadily (at an average growth rate of 6.11 per cent annually) over the past 25 years. Consumption growth has been particularly significant in plywood.

There has been particularly rapid growth in the consumption of wood pulp. So rapid has this group been, that its consumption has increased at a compound growth rate of 8.43 per cent per annum during 1970-94.

Table 4. Trends in consumption of forest products in India, 1970-94

Forest products	*Production*			*Growth rates (%/annum)*		
	1970-80	*1981-94*	*1970-94*	*1970-80*	*1981-94*	*1970-94*
*1. **Roundwood*** *(Million cubic metres)*	199.14	261.52	234.07	2.68	1.99	2.21
Fuelwood and charcoal	182.84	237.60	213.51	2.52	2.02	2.13
Industrial roundwood	16.30	23.92	20.57	4.53	1.74	3.03
*2. **Sawnwood*** *(Million cubic metres)*	7.15	16.22	12.23	9.73	2.99	6.55
*3. **Wood-based panels*** *(Million cubic metres)*	0.18	0.43	0.32	3.59	3.33	6.11
Plywood	0.13	0.32	0.24	5.77	4.01	6.44
Particle board	0.01	0.03	0.02	4.11	3.92	5.40
Fibreboard	0.03	0.04	0.03	2.14	2.44	3.81
*4. **Wood pulp*** *(Million metric tons)*	0.39	1.01	0.74	13.66	6.31	8.43
*5. **Paper and paperboard*** *(Million metric tons)*	1.21	2.25	1.81	7.07	3.89	4.94
Newsprint	0.66	0.45	0.35	3.45	2.73	5.44
Printing and writing paper	0.38	0.92	0.81	11.35	2.15	3.72
Other paper and paperboard	0.38	0.87	0.66	1.83	7.32	6.24
*6. **Wrapping and Packaging paper and paperboard*** *(Million metric tons)*	0.19	0.77	0.52	7.37	10.65	10.79

The consumption of paper and paperboard grew from 1.21 million metric tons in 1970-80 to 2.25 million metric tons in 1981-94, registering a growth rate of 4.94 per cent. The consumption of wrapping and packaging paper and paperboard increased

two projection models were developed for present study. One was based on regression analysis of trends in consumption and production of forest products. The other used the elasticity and time trend coefficients. Where two projections differed significantly, the one that best seemed to reflect what could be expected to happen was adopted. Forward projections to 2000, 2005 and 2010 were developed for the country.

The models used in this study to obtain projections of demand and supply for different forest products are as follows:

$$Z_{it} = \alpha_0 \; Y_t^{\alpha 1} \; e^{\alpha 2 T} \; u_{it} \qquad \textit{(Demand equation)}$$

$$Q_{it} = \beta_0 \; CF_t^{\beta 1} \; e^{\beta 2 T} \; v_{it} \qquad \textit{(Supply equation)}$$

$$Ln\, Z_{it} = Ln\, \alpha_o + \alpha_1 \, LnY_t - \alpha_2 \, T + Ln\, u_{it} \qquad (i)$$

$$Ln\, Q_{it} = Ln\, \beta_o + \beta_1 \, LnCF_t - \beta_2 \, T + Ln\, v_{it} \qquad (ii)$$

Where Z_{it} is consumption of product i at time period t in physical units (the concept of consumption used in this study is the apparent consumption that is total production plus imports minus exports); Y_t is the gross domestic product (GDP) at time t in crore rupees measured at 1980-81 constant prices; Q_{it} is the quantity of product i produced at time period t; CF_t is the gross capital formation in forestry and logging sector in crore rupees measured at 1980-81 constant prices; α and βs are the parameters to be estimated and u_{it} and v_{it} are the error terms. Demand and supply functions for all the products were estimated using Ordinary Least Squares technique (OLS).

Demand forecasts

Although there is a considerable controversy on the meaning of the terms 'forecasts' and 'requirements', (Gregory, 1966), one pragmatic interpretation is as follows:

- Given alternative, either planned or expected, rates of demographic and economic growth in India, what levels of consumption are most likely to prevail, in the next 10 to 15 years?

One of the most pressing questions regarding the future outlook and demand for the sector is whether there is enough wood to meet expected demand. To work towards a clearer view of the future, an attempt has been made to forecast the future requirements of forest products in India to the year 2000, 2005 and 2010. Estimates of projections of demand for forest products obtained with both the approaches were compared and it was observed that demand projections based on both the approaches did not differ significantly. The results resulting projections, from elasticity and time trend coefficient model are summarised in Table 5.

In order to test the validity of the projections and thus the methodology employed before making any inferences, the original values of production/apparent consumption for the year 1992-94 were compared with the estimated/predicted values for 1992-94. It was observed that there was a very little variation between the observed and the predicted values for all the products, which supports the validity of the methodology employed for projections of demand for and supply of forest products in the country.

Given the assumed changes in income, the total roundwood demand is expected to rise to the level of 414.48 million cubic metres by the year 2010 as compared to the present level of 289.31 million cubic metres. The fuelwood and charcoal requirements are expected to increase from 264.20 million cubic metres in 1992-94 to 371.56 million cubic metres in 2010. Most of the sawnwood is used in the construction activity and is expected to increase in the near future. Projections of sawnwood demand result in an estimated increase in annual consumption from present level of 17.46 million cubic metres to 64.93 million cubic metres in 2010.

Plywood, the most heavily used wood-based panel, is primarily used in building and construction and furniture, which also accounts for about 80 per cent of the total wood-based panels. Demand for furniture and building and construction activities is expected to grow more rapidly than in past. The demand projections result in annual consumption of wood-based panels increasing by more than six times. The plywood consumption increased at higher rate in the 1980s, as compared with 1970s, and the forecasts are that plywood consumption will accelerate further during the 2000s ending at 1.18 million cubic metres of plywood in 2010.

Table 5. Actual and projected consumption of forest products in India, 1970-2010

Forest products	*Actual consumption*			*Projected consumption*		
	1970-72	*1980-82*	*1992-94*	*2000*	*2005*	*2010*
*1. **Roundwood***	178.31	228.69	289.31 (293.71)	334.08	372.13	414.48
(Million cubic metres)						
Fuelwood and charcoal	164.95	208.86	264.20 (265.90)	301.40	334.65	371.56
Industrial roundwood	13.36	19.83	25.11 (27.67)	32.65	37.61	43.31
*2. **Sawnwood***	4.76	10.99	17.46 (23.43)	34.11	47.08	64.93
(Million cubic metres)						
*3. **Wood-based panels***	0.17	0.22	0.42 (0.60)	0.83	1.11	1.49
(Million cubic metres)						
Plywood	0.03	0.17	0.34 (0.45)	0.65	0.87	1.18
Particle board	0.01	0.02	0.03 (0.04)	0.06	0.07	0.10
Fibreboard	0.03	0.03	0.04 (0.05)	0.06	0.07	0.09
*4. **Wood Pulp***	0.20	0.58	1.29 (1.37)	2.17	3.21	4.75
(Million metric tons)						
*5. **Paper and paperboard***	1.02	1.98	2.86 (2.65)	3.64	4.73	6.15
(Million metric tons)						
Newsprint	0.21	0.39	0.51 (0.45)	0.90	1.61	2.90
Printing and writing paper	0.45	1.02	1.13 (1.16)	1.41	1.66	1.97
Other paper and paperboard	0.36	0.58	1.22 (1.14)	1.67	2.29	3.14
*6. **Wrapping and Packaging paper and paperboard***	0.15	0.45	1.13 (1.28)	2.42	4.11	7.00
(Million metric tons)						

Figures in the parentheses are the predicted values

Wood-based panels consumption increased very little between 1970-72 and 1980-82 period. The forecasts show instead a progressive increase in consumption during the 1990s and a sharp acceleration in the 2000s, leading a yearly consumption of 1.49 million cubic metres in 2010.

The paper and paperboard group comprises three distinct product categories, which have been analysed separately: newsprint, printing and writing paper and other paper and paperboard. The demand for wood materials used for paper and paper board production has increased from 1.02 million metric tons in 1970-72 to 2.86 million metric tons in 1992-94. The requirement of paper and paperboard by 2010 is estimated at 6.15 million metric tons as against the current annual production of 2.86 million metric tons. Newsprint consumption was predicted to increase by more than five-fold during next 15 years ending at about 2.90 million metric tons in 2010. The consumption of printing and writing paper, which had increased sharply during the 1970s, was wiped out by the recessions of 1980s. The forecasts of requirement of this product show an acceleration of consumption during the 2000s. The consumption of other paper and paperboard showed an increasing trend and is expected to reach at 3.14 million metric tons in the year 2010. Wrapping and packaging paper and paperboard consumption increased very little in 1970s, however, the forecasts show a significant acceleration in consumption during the 1990s and 2000s, reaching 7 million metric tons of consumption per year in 2010.

Supply Potential

Significant growth in the supply can be expected for all forest products in the country. It can be seen from the table 6 that the supply potential of roundwood will increase from the present level of 288.91 million cubic metres to 396.65 million cubic metres by 2010. It is most likely that there will be a shortage of roundwood in the country, which suggests that country should intend to create new forest resources or purchase wood or wood products from other countries. But the question of comparative advantage and policy implications should be analysed properly. The supply of sawnwood is expected to reach at a level of 38.90 million cubic metres by the year 2010.

Table 6. Actual and projected supply of forest products in India, 1970-2010

Forest products	*Actual supply*			*Projected supply*		
	1970-72	*1980-82*	*1992-94*	*2000*	*2005*	*2010*
*1. **Roundwood*** *(Million cubic metres)*	178.32	228.68	288.91 (290.22)	226.10	359.65	396.65
Fuelwood and charcoal	164 95	208.85	264.21 (264.64)	297.19	327.89	361.76
Industrial roundwood	13.38	19.83	24.69 (5.73)	29.16	32.10	35.33
*2. **Sawnwood*** *(Million cubic metres)*	4.75	10.98	17.46 (19.48)	25.74	31.64	38.90
*3. **Wood-based panels*** *(Million cubic metres)*	0.18	0.23	0.44 (0.54)	0.75	1.00	1.24
Plywood	0.13	0.18	0.36 (0.42)	0.61	0.80	1.05
Particle board	0.01	0.02	0.03 (0.03)	0.04	0.05	0.06
Fibreboard	0.03	0.03	0.05 (0.05)	0.06	0.07	0.08
*4. **Wood pulp*** *(Million metric tons)*	0.15	0.48	1.09 (1.18)	1.76	2.42	3.31
*5. **Paper and paperboard*** *(Million metric tons)*	0.84	1.67	2.59 (2.49)	3.04	3.65	4.40
Newsprint	0.04	0.11	0.32 (0.36)	0.95	1.73	3.17
Printing and writing paper	0.45	0.99	1.08 (0.98)	0.88	0.87	0.87
Other paper and paperboard	0.35	0.56	1.20 (1.17)	1.94	2.83	4.11
*6. **Wrapping and Packaging paper and paperboard*** *(Million metric tons)*	0.14	0.45	1.13 (1.15)	2.45	4.19	7.17

Figures in parentheses indicate the predicted values

The production of wood-based panels is projected to increase to 1.24 million cubic metres in 2010. In case of wood pulp, the additional supply will be 2.23 million metric tons annually by 2010, an increase of more than 300 per cent over the present supply. The supply of paper and paperboard and wrapping and packaging paper and paperboard is also expected to increase considerably in the future.

On the basis of the projections of demand for and supply of forest products, it can be observed that while demand for most of the products will increase at a much faster rate than supply and the demand for most products will outstrip supply.

Assessing gap between demand and supply

Knowing future requirements of the country for each of the major forest products and the estimated supply, it is possible to know the what amount of forest products would be needed in the country. The demand-supply imbalances were calculated as:

$$\textit{Demand-supply imbalance (\%)} = \frac{Q_{it} - Z_{it}}{Z_{it}} * 100$$

where Q_{it} is the supply of i^{th} product at time t and Z_{it} is the demand for product i at time t.

Average demand levels of most forest products are expected to increase at a much faster rate than supply. It may be observed from the table 7 that the supply of most forest products was higher than demand during 1970-72, but the demand-supply imbalances increased thereafter and the demand for most of the forest products exceeded the supply during 1980-82. Except for newsprint, packaging paper and paperboard, which would have surplus supply, the growth in demand is projected to outstrip supply potential for almost all forest products, leading to fast growth in imports by the year 2010. This would lead to substantial increase in the import dependence of the country for most of the forest products requirements for the country.

It is evident from the above results that demand for most products will far outstrip supply. Since the supply of forest product is constrained by forest area, concentrated

efforts to increase forest area to the level of one-third of total land area, as suggested by the forest policy, becomes an urgent economic necessity.

Table 7. Demand-supply imbalances for forest products in India, 1970-2010

Forest products	*Demand-supply imbalances (%)*					
	1970-72	*1980-82*	*1992-94*	*2000*	*2005*	*2010*
*1. **Roundwood***	0.01	-0.01	-0.14	2.44	-3.46	-4.49
Fuelwood and charcoal	0.00	-0.01	0.00	-1.42	-2.06	-2.71
Industrial roundwood	0.15	0.00	-1.70	-11.97	-17.13	-22.59
*2. **Sawnwood***	-0.21	-0.09	0.00	-32.52	-48.80	-66.91
*3. **Wood-based panels***	5.55	4.35	4.54	-10.67	-11.00	-20.16
Plywood	76.92	5.55	5.55	-6.56	-8.75	-12.38
Particle board	0.00	0.00	0.00	-146.00	-40.00	-66.67
Fibreboard	0.00	0.00	20.00	0.00	0.00	-12.50
*4. **Wood pulp***	-33.33	-20.83	-18.36	-23.29	-32.64	-43.50
*5. **Paper and paperboard***	-21.43	-18.56	-10.42	-19.74	-29.59	-39.77
Newsprint	425.00	-254.54	-59.37	5.26	6.94	8.52
Printing and writing paper	0.00	-3.03	-4.93	60.23	-90.80	-126.44
Other paper and paperboard	-2.86	-3.57	-1.67	13.92	19.08	23.60
*6. **Wrapping and Packaging paper and paperboard***	-7.14	0.00	0.00	1.22	1.91	2.37

III. Forest Products Trade

The Govt. of India is not encouraging export of unprocessed forest products. The forestry industry serves mainly domestic market, some trade, however, does occur. The details of exports and imports from 1970-94 are given in Tables 8 and 9.

Exports Trends

The exports of most products in the country have declined significantly during the 1981-94 period as compared to 1970-80 period (Table 8).

Table 8. Trends in export of forest products in India, 1970-94

Forest products	*Exports*			*Growth rates (%/annum)*		
	1970-80	*1981-94*	*1970-94*	*1970-80*	*1981-94*	*1970-94*
1. Roundwood *(Million cubic metres)*	43.64	29.43	35.68	7.02	1.97	-1.35
Fuelwood and charcoal	12.45	12.00	12.20	19.64	-0.22	1.44
Industrial roundwood	31.18	17.14	23.32	1.90	4.00	-2.84
2. Sawnwood *(Million cubic metres)*	4.55	11.00	8.16	10.00	14.27	8.52
3. Wood-based panels *(Million cubic metres)*	21.09	17.21	18.92	0.13	6.73	-0.13
Plywood	15.09	10.29	12.40	0.24	13.59	-0.30
Particle board	0.55	2.93	1.88	21.67	-9.08	5.56
Fibreboard	3.73	1.29	2.36	-13.41	7.86	-7.17
4. Wood pulp *(Million metric tons)*	0.00	0.00	0.00	0.00	0.00	0.00
5. Paper and paperboard *(Million metric tons)*	5.82	6.57	6.24	-15.94	18.13	2.80
Newsprint	0.00	0.14	0.08	0.00	30.77	20.19
Printing and writing paper	3.55	4.29	3.96	-20.26	19.90	3.34
Other paper and paperboard	2.45	2.21	2.32	-8.89	14.39	0.99
6. Wrapping and Packaging paper and paperboard *(Million metric tons)*	0.27	0.50	0.40	20.00	-1.32	4.23
7. Total exports (thousand US $)	***23978***	***24688***	***24376***	***6.13***	***6.01***	***1.75***

The export volume of roundwood was 43.64 million cubic metres in 1970-80 and declined to 29.43 million cubic metres in 1981-94. The linear growth rate of its exports stood at -1.35 per cent per annum during 1970-94. Similarly industrial roundwood exports also witnessed a negative growth rate during the same period. However, there has been a quantum jump in the export of sawnwood and its growth rate stood at 8.52 per cent. The wood-based panels showed a declining trend in export volume. Exports of paper and paperboard rose from 5.82 million metric tons in 197080 to 6.57 million metric tons in 1981-94, with a linear growth rate of 2.80 per cent per annum during 1970-94 period. The exports of wrapping and packaging paper and paperboard increased during 1970-80 and then declined during 1981-94 period. The growth rate of total exports of forest products was higher during 1970-80 as compared to 1981-94 period. The total exports of forest products rose from US$ 23,978 thousand in 1970-80 to US$ 24,688 thousand in 1981-94, thus showing a growth rate of 1.75 per cent per annum during the period 1970-94.

Imports

Forest product imports in the country are dominated by industrial roundwood, paper and paperboard and newsprint. Total imports of forest products rose from 95,139 thousand US$ in 1970-80 to 319,171 thousand US$ in 1981-94, thus showing s growth rate of 7.87 per cent per annum during 1970-94. However, the analysis of indivisual commodities shows that the imports of roundwood increased substantially from 14.27 million cubic metres in 1970-80 to 483.43 million cubic metres during 1981-94, thus registering an annual growth rate of 13.67 per cent during 1970-94. The imports of fuelwood and charcoal have declined significantly in the recent years, while that of industrial roundwood has increased from 5.91 million cubic metres in 1970-80 to 476 million cubic metres in 1981-94, at a linear growth rate of 14.11 per cent. The imported timber is mostly used by the building and construction industries.

There has been a quantum jump in the import of sawnwood. During 1970-80, there were no imports of wood-based panels but in the recent years we have started importing wood-based panels. Similar trend was observed in case of wood pulp. In case

of paper and paperboard, the imports rose from 180.55 million metric tons in 1970-80 to 253 71 million metric tons in 1981-94, registering a growth rate of 2.03 per cent per annum. The import of wrapping and packaging paper and paperboard has increased at a growth rate of 5.86 per cent. The imports of fuelwood and charcoal showed the negative growth rate (-1.64%), followed by newsprint (0.93%).

Table 9. Trends in import of forest products in India, 1970-94

Forest products	*Imports*			*Growth rates (% annum)*		
	1970-80	*1981-94*	*1970-94*	*1970-80*	*1981-94*	*1970-94*
*1. **Roundwood** (Million cubic metres)*	14.27	483.43	277.00	21.08	11.72	13.67
Fuelwood and charcoal	8.36	7.29	7.76	20.65	-19.75	-1.64
Industrial roundwood	5.91	476.00	269.16	20.15	12.21	14.11
*2. **Sawnwood** (Million cubic metres)*	4.73	21.57	14.16	30.38	-0.02	7.72
*3. **Wood-based panels** (Million cubic metres)*	0.00	5.50	3.08	0.00	16.36	15.91
Plywood	0.00	4.50	2.52	0.00	15.95	15.75
Particle board	0.00	4.50	2.52	0.00	15.95	15.75
Fibreboard	0.00	0.79	0.44	0.00	15.45	15.56
*4. **Wood pulp** (Million metric tons)*	0.00	0.07	0.04	0.00	25.00	19.23
*5. **Paper and paperboard** (Million metric tons)*	180.55	253.71	221.52	3.84	-0.79	2.03
Newsprint	162.64	198.21	182.56	3.73	-2.60	0.93
Printing and writing paper	5.91	35.07	22.24	7.54	5.57	9.33
Other paper and paperboard	12.27	20.64	16.98	3.19	5.71	4.37
*6. **Wrapping and Packaging paper and paperboard** (Million metric tons)*	1.73	3.21	2.56	25.26	4.56	5.86
*7. **Total imports (thousand US $)***	***95139***	***319171***	***220597***	***14.21***	***5.37***	***7.87***

The above results clearly show that there has been a quantum jump in recent years in the imports of forest products while the exports have declined and are negligible. India, historically self sufficient in forest products has become a major importer.

Conclusions

The results of this study indicate that the growth rates for production and consumption of many forest products during the 1991-94 period have been slower than for 1970-80 and the production of most forest products grew slightly at lower growth rate than their consumption. The production and consumption of sawnwood, wood-based panels, pulp and other paper commodities grew much faster than fuelwood and charcoal. There is a broad agreement that demand on forests are growing and will continue to grow and on the primary factors that contribute to higher demand are: population growth and continuing economic growth. Demand and supply projections indicate that there will be a deficit of most forest products in the country. Although the demand for forest products is likely to increase from present levels but the rate of increase is likely to be lower than in the past. Demand-supply balance situation is disturbing and could become desperate if positive policies are not adopted.

References

Arnold, Mike, Jack Easton, Kevin, Crockford and Washington Bgoni (1993), "Forestry Industry Development and Supply of Industrial Wood." In P.N. Brandley and K Mcnamara (*Eds*), *Living With The Trees: Policies for Forestry Management in Zimbabwe*, World Bank Technical Paper Number **210**, The World Bank, Washington, D.C., pp. 243-304.

Buongiorno, Josef., Patrice Harou, Abodunrin C. Omoluabi and Lawrence Ogundare (1994), "Timber Demand and Supply in Nigeria: Models and Forecasts to 2010", *Journal of Word Forest Resources Management*, Vol. 7, No. 1, pp. 101-127.

Chandrakanth, M.G., J.V. Venkatram, K.N. Ranganatha Sastry, R. Ramanna, S. Bisaliah and K.S. Arun Kumar(1979), "Consumption of Forest Products in India", *Indian Journal of Agricultural Economics*, Vol. **34**, No. **3**. pp. 51-60.

EPW Research Foundation (1997), "*National Accounts Statistics of India 1950-51 to 1995-96 (Revised Edition)*", EPW Research Foundation, Mumbai.

FAO, (1982), "*FAO Yearbook of Forest Products, 1969-1980*", United Nations Food and Agriculture Organisation, Rome.

FAO, (1994), "*FAO Yearbook of Forest Products, 1982-94*", United Nations Food and Agriculture Organisation, Rome.

Govt of India (1997), "*Annual Report 1996-97*", Ministry of Environment and Forest, Govt of India, New Delhi, pp 29-31.

Govt. of India (1997), "*National Accounts Statistics*", Central Statistical Organisation, Department of Statistics, Ministry of Planning and Programme Implementation, Govt. of India, New Delhi.

Gregory, G.R. (1966), "Estimated Wood Consumption with particular reference to the Effects of Income and Wood Availability," *Forest Science*, Vol. **12**, No. **1**, pp. 104-117.

Guleria, Amar S. (1988), "Current Production and Future Requirement of Wood Products in India," *Indian Journal of Agricultural Economics*, Vol. **43**, No. **3**, pp. 270-276.

Kalla, Jagdeesh C. (1988), "Forestry and Economic Development," *Indian Journal of Agricultural Economics*, Vol **43**, No. **3**, pp. 237-257.

Oberai, C.P. (1997), "Sustainable Afforestation : Key to Sustainable Development", *Yojna*, Vol. **41**, No. **8**, pp. 31-33.

Rai, K.N., Shri Niwas and R.K. Khatkar (1983), "Demand and Supply Analysis of Forest Products in India", *Indian Journal of Agricultural Economics*, Vol. **38**, No. **3**, pp. 300-308.

Vergara, Napoleon (1997), "*Wood Materials From Non-Forest Areas*", FAO-APFSOS Working Paper No. **19**, Forestry Policy and Planning Division, Regional Office for Asia and Pacific, Bangkok.