THE WOOD-USING INDUSTRIES
OF KERALA AND THEIR IMPLICATIONS
FOR FOREST LAND USE
AND DEVELOPMENT

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ABSTRACT

THE WOOD-USING INDUSTRIES OF KERALA
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AND DEVELOPMENT

By

Chandrasekharan Cherukat

The wood-using industries play an important role in the economy of Kerala State, Republic of India. But the forest area of the State has been fast dwindling due to pressure of population. The potential wood supply-requirements gap presents a problem, which calls for government decisions regarding the forest policy of the State.

The purpose of this study, therefore, is to appraise the requirements and supply outlook for wood in Kerala, to identify the policy issues on which the Government need to take decisions, and to provide information on the results and implications of the policy decisions.

The social and economic development goals for Kerala and the current status of its wood-using industries and forest resources provide the framework for this study.

Several different estimates of consumption and supply outlook for wood in the State during the next three decades have been made, adopting different models and parameter assumptions.

Wood requirements have been estimated separately for the different wood products. The official consumption targets based on certain minimum social goals with respect to standards of living have been accepted as one of the estimates. Alternative estimates have been made adopting projection models defining time-consumption relationship and income-consumption relationship.

The projections indicate that the total wood requirement in Kerala is expected to range between 7.9 and 9.2 million cubic meters in 1980 and from 10.2 to 14.8 million cubic meters in 2000. Labor and capital requirements of the wood industry sector and its contribution to the gross state product of Kerala have also been projected.

The wood supply outlook has been projected corresponding to the estimates of future forest land availability, in combination with the assumptions regarding future standards and intensity of management. While the official target regarding forest area has been taken as one of the estimates, the alternative estimates use mathematical functions correlating forest land availability with the levels of population and time period. The future availability of forest land in Kerala has been estimated to range from 7,500 to 8,500 square kilometers in 1980 and from 4,500 to 7,850 square kilometers in 2000.

Depending on the combinations of assumptions regarding forest land availability and short and long-run management measures, the 1980 wood supply has been projected to range from 6.7 to 9.0 million cubic meters and the 2000 wood supply from 5.6 to 12.3 million cubic meters. The wide range of supply possibilities and the related assumptions point out the policy issues on which decisions need be made by the Government. They are:

(i) To what extent will the Government control forest land withdrawals?

(ii) To what extent will the Government pay the costs for increasing output by improving harvesting methods and practices?

(iii) To what extent will the Government invest in timber growing?

These issues and the possible alternative decisions on each give a number of policy options to the Government. Depending on the decisions the wood supply will range as indicated above. The cost of each of the policy alternatives have been estimated. The implications of the decisions in terms of capital requirement, budget cost, employment and contribution to gross state product, and its impact on the wood-using industries of the State have also been examined.

In spite of the indications of consumption projection, the level of activity in the wood-using industries will be controlled by the actual availability of wood. Therefore, wood supply and requirements have to be considered together to assess the impact of the policy decisions.

Assuming harmonization of the objectives and policies of the forestry and wood industry sectors, the total requirement of capital investment will range from 757 to 2,872 million rupees during the 1965 - 2000 period. The total contribution to the gross state product will range from 227 to 625 million rupees, and the employment of labor from 37 thousand to 93 thousand, by 2000. Considering the 1965 level to be 100, the index of change will be from 132 to 364 for gross state product and from 78 to 198 for employment.

THE WOOD-USING INDUSTRIES OF KERALA AND THEIR IMPLICATIONS FOR FOREST LAND USE AND DEVELOPMENT

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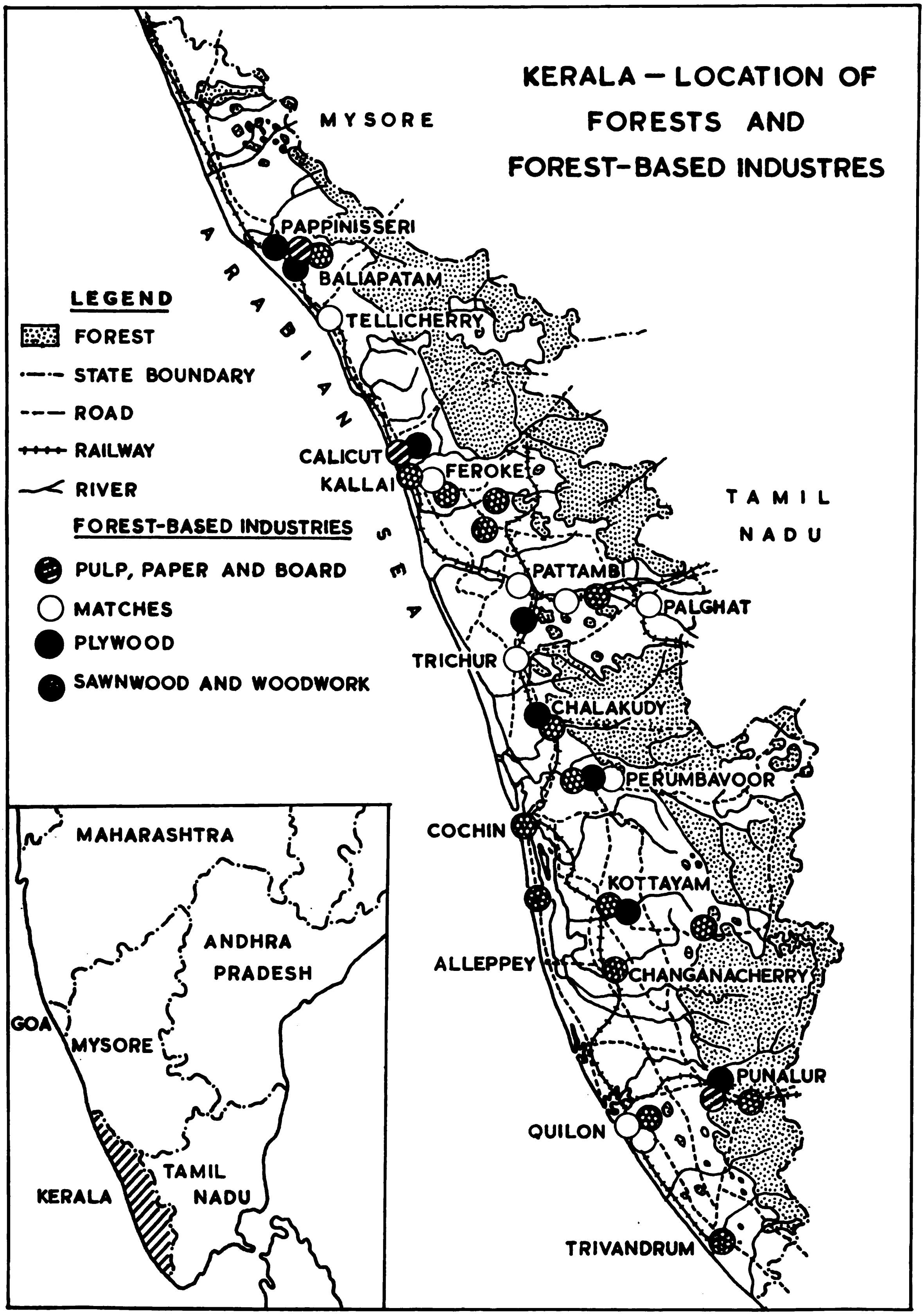
KERALA – LOCATION OF FORESTS AND FOREST-BASED INDUSTRES
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Chapter 1

INTRODUCTION

This chapter gives a brief statement about the research objective, the framework, the approach and the policy findings of the study.

THE RESEARCH OBJECTIVE

The objective of the study is to examine the economic conditions and outlook for the wood-using industries in Kerala State, Republic of India, and the implications of these projections for forest land use and development.

The socio-economic environment of Kerala is dominated by economic underdevelopment and unemployment. The characteristics of forestry and wood-using industries render them a potential catalyst for economic development since they provide an excellent means of alleviating the problems of underdevelopment and unemployment.

Timber is a dominant source of economic activity in Kerala. But, while the wood-using industries have played an important role in the economy of Kerala, the forest land area of the State has been fast dwindling. The future growth of population and the socio-economic goals of the State are expected to cause a steady increase in the consumption of wood and wood products. But, the pressure of population on forest land for subsistance farming lends an amount of uncertainty to the supply outlook. The threat of a severe gap between future requirements and supply of wood makes it necessary to identify the policy options and to examine the possible outcome of government decisions regarding wood supply.

The purpose of the study, therefore, is to appraise the requirements and supply outlook for wood in Kerala, to identify the policy options for forestry development and to provide information to the Government on the results and implications of policy decisions.

THE FRAMEWORK

The framework for the study is provided by the social and economic development goals for the State and by the past trends and current situation with regard to forestry and wood-using industries in the State.

Goals of Development

The development goals are to a great extent influenced by the current economic situation and the expectations about economic growth. Major social and economic goals pertain to employment, income, education and housing. The social and economic development goals for Kerala during the next three decades have been identified with specific reference to expected population growth.

Kerala is the most densely populated state of India. With 1.27 percent of the land area of India, Kerala accounts for 3.89 percent of India's population. Population of Kerala in 1971 was 21.3 million. The projected population for 1980 is 26 million, and for 2000 it is 33 million.

One of the severe social problems of the State is unemployment. In 1965, the labor force of Kerala was 32 percent of the total population and only 24 percent were fully employed. Only about 15 percent of the employed persons worked in the industrial sectors. From six million in 1965, the labor force of Kerala is expected to increase to 8.3 million by 1980 and to 10.5 million by 2000.

Even though, Kerala contributes about 3.5 percent of the Indian national income, the average per capita income of Kerala is only about 90 percent of the Indian average. The goal for Kerala is to bridge the gap between the average per capita income of the State and the Nation, within a period of about 15 years. From the 1965 level of 285 rupees, the planned per capita income of Kerala is to rise to 492 rupees in 1980 and to 1,735 rupees by 2000, in real terms.

Kerala State is the foremost in literacy in India, with a literacy percentage of 60, as against 29 percent for India. 18 percent of the population of

Kerala attend schools as against 8.3 percent in India. Kerala State is expected to keep up the lead by maintaining growth in the rate of literacy.

Kerala State also plans to accelerate construction activities to provide more adequate housing for the population.

Achievement of these goals depends on the resources of the State and its management. Forests and forest-based industries of the State are very important in this regard, and planned development of forestry and wood-using industries can make a significant contribution to the economic welfare of the State.

Current Status of Forestry and Wood-using Industries

Forests form a valuable natural resource of the State. The wood-using industries occupy an important place in the industrial scene of Kerala, even though the contribution of the industrial sectors to the economy of the State is rather small. The important wood-using industries of Kerala are sawmilling and plywood, fiberboard and particleboard, pulp and paper, and match manufacturing.

The output of the wood-using industries of Kerala accounted for ten percent of the national output of wood-using industries in 1965. The employment in the wood-using industries of Kerala was about three percent of the total industrial employment of the State and about eight percent of the employment in the wood-using industries of India. The value added by manufacturing in the wood-using industries of Kerala was 8.5 percent of the total value added by manufacturing of the industrial sectors of the State and about 9.5 percent of the value added in the wood-using industries of India.

The total wood consumption in Kerala in 1965 was 5.7 million cubic meters of which 1.5 million cubic meters were industrial wood and the rest fuelwood. Of the total industrial wood, sawlogs formed 53.5 percent. The per capita consumption of wood in Kerala, in 1965 was 0.32 cubic meters. The production of wood in Kerala amounted to 6.5 million cubic meters, with some wood being exported.

The extent of forests in Kerala in 1965 was 9,770 square kilometers, which represents 25.1 percent of the total land area of Kerala and 1.25 percent of the forests of India. The forest area in the State has progressively decreased from 12,850 square kilometers in 1940 to 9,400 square kilometers in 1970, as a result of the extreme pressure of a growing population on the land, particularly for subsistance farming.

Due to the climatic and other natural advantages the productivity of Kerala forests has always been much higher than the rest of India. The estimated growing stock in the forests of Kerala is 6.6 percent of the total forest growing stock of India. In spite of this, Kerala forests are not producing as much wood nor generating as much income and employment as they could.

Together, forestry and wood-using industries provided employment for 47,000 persons in Kerala and contributed 172 million rupees to the gross state product in 1965. In other words, one out of every hundred fully employed persons in Kerala was engaged in some phase or other of timber production and processing and one out of every 33 rupees of the gross state product was accounted for by forestry and wood-using industries.

While the current status of forestry and wood-using industries in Kerala is of some importance, the outlook for the future depends on the factors influencing consumption and supply of wood.

THE APPROACH

In the approach to accomplish the study purpose, projections of future wood consumption and wood supply have been made. These projections clearly present the nature and extent of the problem of wood supply-requirements gap in the future, and help to identify the policy issues with regard to wood supply, on which the Government must make decisions. For each of the issues, different decisions are possible. Combinations of the possible decisions give a wide range of policy options to the Government. In this study, the effects of the various policy options have been projected and analysed.

The Consumption Outlook for Wood

Several different estimates of the consumption outlook for wood have been made adopting different models and parameter assumptions. Wood requirements have been separately estimated for the different wood products or product groups. Estimated future consumption of fuelwood is also included in total requirement. It is not possible to disassociate fuelwood from any study on wood use in Kerala as most of the wood produced is consumed in this form.

The different estimates of future wood consumption give rough orders of magnitude of requirements under the different situations that may be encountered. Therefore, from the range of estimated values, two levels have been selected to represent the low and high estimates of the possible future consumption levels.

The projections are as follows:

Alternative estimates	Total wood requirement	
	1980	2000
	----millions of cubic meters----	
Low	7.9	10.2
High	9.2	14.8

Considering the 1965 wood consumption to be 100, the index of change in the total wood requirement will range between 138 and 160 in 1980 and between 178 and 258 in 2000

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The detailed projections by product have indicated that in the future pulp and paper will become the most important wood-using industry, that there will be a small decrease in the percentage of fuelwood in the total wood consumption, and that there will be a shift in the pattern of consumption of wood products.

The development of wood-using industries to meet the projected levels of consumption of the products will involve an investment ranging between 794 and 2,014 million rupees during the 1965 - 2000 period.

The value added by manufacturing in the wood-using industries has been estimated to range from 229 to 479 million rupees by 2000. Considering the value added by manufacturing in the wood industry sector in 1965 to be 100, the index of change in the value added will be between 277 and 582.

The employment of labor corresponding to the two levels of future wood consumption is indicated below:

Alternative estimates	Employment of labor	
	1980	2000
	--number of employees--	
Low	29,310	34,760
High	41,030	64,100

Considering the 1965 employment in the wood industry sector to be 100, the index of change in the employment of labor will range from 109 to 153 in 1980 and from 129 to 239 in 2000.

Growth of population influences wood requirements and wood supply differently. While wood requirements increase with increasing population, the extent of forest land will normally decrease due to the pressure of population.

The Supply Outlook for Wood

The supply outlook for wood in Kerala has been examined with two assumptions regarding forest land availability, two assumptions regarding wood yield as a result of short-run measures (more efficient logging and utilization), and three assumptions regarding wood yield as a result of long-run measures (investments in timber growing), giving 12 different combinations of assumptions. These combinations of assumptions give a wide range of supply possibilities. (These combinations are policy options for the decision maker and decision on the policy affecting wood supply would automatically affect the future of the wood-using industries.)

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The range of supply possibilities is shown below. At the low level of effort the supply outlook indicates a decreasing trend, while increasing supply will result at the high level of effort.

Alternative estimates	Wood supply	
	1980	2000
	--millions of cubic meters--	
Low	6.7	5.6
High	9.0	12.3

Considering the 1965 wood production to be 100, the index of change in wood supply ranges between 103 and 138 in 1980 and between 86 and 189 in 2000.

Given the assumptions underlying the estimates of wood supply outlook, the requirements for capital investment during the 1965 - 2000 period will be between 594 and 1,364 million rupees.

The contribution of wood supply to the gross state product has been estimated to range from 128 to 227 million rupees by 2000. Considering the contribution of forestry to the gross state product in 1965 to be 100, the index of change in the contribution to the gross state product will be between 143 and 254.

The employment of labor corresponding to the range of supply possibilities is indicated below:

Alternative estimates	Employment of labor	
	1980	2000
	--number of employees--	
Low	15,500	15,900
High	31,180	40,110

Considering the 1965 employment in forestry to be 100, the index of change in the employment of labor will range from 77 to 154 in 1980 and from 79 to 199 in 2000.

THE POLICY FINDINGS

Forestry and wood industry sectors are closely linked, and the changes in wood supply will have a direct impact on the wood-using industries. The various projections of requirements and supply of wood have indicated the range of future possibilities. But the actual situation will depend on the decisions of the Government on certain forest policy issues.

From the wide range of wood supply possibilities and the related assumptions, few major policy issues are clear. The policy issues are these:

(i) To what extent will the Government control forest land withdrawals?

(ii) To what extent will the Government pay the costs for increasing output by improving harvesting methods and practices?

(iii) To what extent will the Government invest in timber growing?

The first issue has both short and long-run aspects, whereas the second issue primarily concerns the short-run and the third one is of long-run significance. Decisions on each of these issues are of great importance to the economic and social progress in Kerala.

Different decisions are possible on each of these issues, and the alternative supply estimates correspond to the various combinations of policy decisions.

Outcomes of the Policy Decisions

The decisions on the policy issue regarding forest land withdrawals, assuming all other factors to remain constant at the 1965 level, will result in wood supply ranging between 6.7 and 7.0 million cubic meters by 1980 and between 5.6 and 6.8 million cubic meters by 2000. The combinations of decisions on policy issues regarding harvesting methods and practices and forest land withdrawals, assuming the investment on timber growing per hectare of man-made forest to remain constant at the 1965 level, will result in wood supply ranging from 6.7 to 8.4 million cubic meters by 1980 and from 5.6 to 7.4 million cubic meters by 2000. Relaxing the assumption on investment in timber growing, the annual wood production reasonably attainable for the various combinations of decisions will range between 6.7 and 9.0 million cubic meters by 1980 and between 5.6 and 12.3 million cubic meters by 2000.

The future status of forestry and wood-using industries in Kerala will depend on the decisions made by the Government on each of these issues. The factors influencing the policy decisions are the costs and benefits of the policy options.

Annual Budget Cost and Profit

For the various levels of future wood supply, corresponding to the various policy decisions, the annual budget cost has been estimated to range from 80.6 to 131.8 million rupees in 1980 and from 70.1 to 189.3 million rupees in 2000. Correspondingly, the average budget cost per cubic meter of wood will range from 13.42 rupees to 16.47 rupees in 1980 and from 14.10 rupees to 18.00 rupees in 2000. The average budget cost per unit of output is comparatively high for all the alternative supply levels under the high assumption regarding forest land availability. This is due to the additional cost involved in controlling forest land withdrawals. For the same reason, the percentage of annual profit is comparatively low for these alternatives.

Depending on the policy decisions, the annual profit from wood supply is expected to range between 84.6 and 110.6 million rupees in 1980 and between 70.6 and

130.5 million rupees in 2000, at the future price assumed on the basis of compounded cost per additional unit of output for plantations. (At the 1965 price level the profit will only be between 10.9 and 27.8 million rupees in 1980 and between 2.3 and 24.9 million rupees in 2000.)

Effects of Policy Decisions on the Wood Industry Sector

The level of activity in the wood industry sector depends entirely on the wood supply. Therefore, it will be realistic to assume that the outlook for the wood industry sector will be commensurate with the future wood supply.

Total Effect of Policy Decisions on Employment and Income

In assessing the total effect of the policy decisions on employment and income, forestry and wood industry sectors are considered together.

Employment. The total effect of the various policy decisions on employment of labor in forestry and wood-using industries will be as follows:

Alternative estimates	Total employment of labor	
	1980	2000
	---number of employees---	
Low	40,360	36,680
High	71,320	93,380

Considering the total employment in 1965 in forestry and wood-using industries to be 100, the index of change in total employment will range from 86 to 151 in 1980 and from 78 to 198 in 2000.

Contribution to the gross state product. The total contribution of forestry and wood industry sectors to the gross state product by 2000 will range between 227 and 625 million rupees. Considering the contribution of these sectors to the gross state product in 1965 to be 100, the index of change will be between 132 and 364.

The projections of the total effect of policy decisions on employment and income assume harmonization of the objectives and policies of the forestry and wood industry sectors.

Chapter 2

SOCIAL AND ECONOMIC DEVELOPMENT GOALS FOR KERALA STATE

This chapter presents and examines the social and economic development goals for Kerala during the next three decades, considering the special situation of the State with respect to its geography, history and economic state.

SITUATION

Bordering the Arabian Sea, Kerala sprawls along the west coast of India, towards the southern most extremity. It is a narrow belt of coastal plain, and forms a distinct region delimited on its eastern side by the mountain range of Western *Ghats*, sandwiching as it were, an undulating tract in between. Land area of Kerala is 38,855 square kilometers, representing 1.27 percent of the land area of India. The length of the coast line of Kerala is about 580 kilometers and the width from the coast to the hills varies from 32 to 120 kilometers.

As a political unit, Kerala came into existence in November, 1956 at the time of reorganisation of states on linguistic basis, through the integration of the erstwhile princely States of Travancore and Cochin and the Malabar District and Kasargode Taluk of Madras State.

HISTORY

Politically, Kerala was under feudal rule in the past. In Travancore and Cochin it was centralised paternal despotism of the rulers and in Malabar it was highly decentralized semi-feudal suzerainty. Under British supremacy (1729 - 1947), Kerala was governed as three separate administrative units. While Travancore and Cochin were ruled by their respective rulers, Malabar was annexed by the East India Company, who directly assumed its government in 1792.

Ancient Kerala had extensive commercial and cultural contacts with the countries of the outside world. History records that teak timber was exported to the countries of Persian Gulf region as early as from 18th century B.C. (Ayyar 1966, pp. 1-30).

The establishment of foreign rule in India destroyed the economic order in the country, and resulted in the decline of Indian handicrafts. Towards the latter half of 19th century two new forms of industrial activities were introduced - "first was the plantation, a form of industry to be found extensively in most of the tropical possessions of the European countries and the other the factory industry, the peculiar product of the latest economic transition in Europe" (Gadgil 1954, p. 45). Some of the earliest plantations of tea, coffee and rubber were established in Kerala.

Kerala society, in the past, was not based on

principles of social freedom and equality. The caste system was prevalent. A unique feature of the social system of Kerala was Marumakkattayam (a matrilinial family system) and the social convention abhorred revolution (Ayyar 1966, p. 6). The rigidity of the social order eased during 1930s and it has undergone considerable change during succeeding years.

INDEPENDANCE AND ADVENT OF ECONOMIC PLANNING

India became independant in August 1947. The constitution adopted by free India clearly laid down the policies for economic development and social reforms. Article 39 of the Constitution declares that -

> "the state shall direct its policy towards securing
>
> (a) that the citizen, men and women, equally have the right to an adequate means of livelihood,
>
> (b) that the ownership and control of the material resources of the community are so distributed as best to subserve the common good,
>
> (c) that the operation of the economic system does not result in the concentration of wealth and means of production to the common detriment."

and article 41 stipulates that -

> "the state shall within limits of its economic capacity and development, make effective provision for securing the right to work, to education and public assistance in cases of unemployment, old age, sickness and disablement and in other cases of undeserved want."

To implement the policy of economic development and social change, the Government of India launched the first of its Five Year Plans in 1950. The main objective of planning, as declared by the Government of India, are ...."an increase in national income, a sustained increase in employment opportunities, a substantial rise in the standard of living of the people, a reduction in regional imbalances and correction of excessive inequalities in income and wealth" (Government of India 1960, pp. 5-9).

DEVELOPMENT STRATEGY

Adelman and Morris (1968) have identified the degree of modernisation of outlook, extent of leadership commitment, extent of dualism, level of adequacy of physical overhead capital, size of traditional agricultural sector, degree of improvement in financial institutions, extent of literacy, rate of improvement in human resources and so forth, as the variables of socio-economic development in underdeveloped countries.

India is an underdeveloped country. An underdeveloped country is one characterised by (i) mass poverty which is chronic and not the result of some temporary misfortune and (ii) obsolete methods of production and social organisation which means that poverty is not entirely due to poor material resources. Some of the other characteristics listed by various economists are: lack of consistancy in approach, lack of probity in public officials, emphasis in public sector for industrialization and economic development, paper targets for private sector, interest in spectacular projects, a multiplicity of

controls, and lack of clearly defined priorities (Kuznets 1966, Chandrasekhar and Hultman 1966, Adelman and Morris 1967, Bhagwati 1969). All these characteristics may not be evident in India, but some of them surely are present.

The economic development of an underdeveloped country is impeded by the different problems of specific goals and approach. For example, in India a question often arises as to whether the Five Year Plans should aim primarily for more output or for more employment. And these objectives some times clash. It has now been accepted generally that an economy which is solely employment oriented may not turn out to be a developing economy at all (Metha 1960).

The strategy adopted for economic development in India is one of balanced growth, to attain growth with stability. It envisages a co-ordinated and balanced development of scientific agriculture, village and small scale industries, medium sized industries as well as heavy and basic industries. The pace of development should be rapid and much in advance of the rate of growth of the population.

The economic development of an overpopulated underdeveloped country is normally associated with the progressive transfer of population from agriculture to industry, or in other words, in the process of industrialisation. In view of the smallness of the market for consumer goods, underdeveloped countries have to bring this about deliberately (Dhar 1960). As industrialization takes place, per capita national income will rise by the transfer of surplus labor to industries. Increased agricultural production is also vital from the point of view of raising the standards of living of the 70 to 80 percent of the population living in the villages and of ensuring a proper balance between the growth of rural and urban incomes.

The model for Indian planning was developed by the Indian Statistician-Economist Mahalanobis. Mahalanobis recognised that the rate of growth should be considered both in terms of capital capacity and in terms of the absorption of a growing labor supply. He also recognized that the productivity of labor and effectiveness of capital use are the immediate factors in economic growth but that ultimately they depend on the scientific, educational and organizational apparatus of the country (Bhatt 1965). Mahalanobis (1956) has expressed the view that the rate of development over a long period is inevitably connected with the pattern of development.

APPRAISAL OF THE ECONOMIC AND SOCIAL SITUATION

Nearly four percent of India's population resided in Kerala, while the State has only 1.27 percent of the land area of India. Per capita land area is about 0.19 hectare.

The economy of Kerala State is primarily agrarian. The proportion of net area sown to the total area of the State in 1967 - 68 was 55 percent, against about 40 percent for India. Per capita land area under cultivation was about 0.11 hectare.

A notable aspect of the State's agricultural sector is the existance of a highly enlightened peasantry, much receptive to the modern techniques of agricultural management. Kerala tops the list of states in India both in respect to net output per hectare and net output per agricultural worker (Mazumdar 1964). Similarly labor input per hectare in agriculture is also highest in Kerala.

There are no modern industries worth the name in Kerala to relieve the intensive pressure on land. Although the industrial sector in Kerala absorbs a high proportion of the working force compared to all India average, the majority of them are engaged in jobs of low productivity. Industrial concerns are mostly agro-based and are technically backward. As a result, productivity of labor in the industrial sector (both factory and non-factory) in Kerala is low. The industrial sector in Kerala does not create any sizeable reinvestable capital surplus and the process of capital formation is badly hampered. The type of industries in which Kerala predominates (coir and cashewnut), also have not aided the development of entrepreneurial talent (National Council

of Applied Economic Research 1962, pp. 139-146). An unexpected feature of the development in the recent past has been that while the share of agriculture in state income, measured at constant prices, declined from 54.5 percent in fiscal 1956 to 52.8 percent in fiscal 1968, the share of industry also declined from 17 percent to 16.4 percent over the same period.[1] In other words, the tertiary or services sector increased at the expense of both industry and agriculture, in terms of relative share in the state income. But the most important thing to note in this recent history is the lack of any significant change in economic structure.

Per capita income in Kerala in fiscal 1969 was 304.50 rupees at constant prices (fiscal 1961). The average monthly consumption expenditure in Kerala is lower than the average for all India, indicating a somewhat lower standard of living. Nearly 60 percent of total household consumption (and 85 percent of the commodity consumption of households) is comprised of agricultural products or manufactured goods based principally on agricultural raw materials.

In short, across the two decades of planned development, the economy of Kerala has remained relatively stagnant and the major economic problems retained their

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[1]Fiscal year is from April to March and fiscal 1956 refers to the period April 1955 to March 1956.

intractability.

Special Problems

Kerala is often described as a problem state. The special problems of the State can be summarized as:

(a) a very high density of population,

(b) prevalance of a significant number of unemployed persons,

(c) a lack of heavy industries,

(d) a shortage of social overhead facilities,

(e) a shortage of food,

(f) political instability.

All these have resulted in low wages, poor standard of living and low per capita income.

A high density combined with a fast growth of population has been responsible for the most acute problem of Kerala, namely, the abnormally high rates of unemployment. Unemployment might not have been so severe had there been a correspondingly rapid development of industries over the past two decades. But such development was sadly lacking.

ECONOMIC STATE AND GOALS

The social and economic development goals for Kerala have to be examined against the background of the general development pattern for the whole country and considering the special problems confronting the State.

Population

In 1971, the population of Kerala was 21.30 million persons representing 3.89 percent of the population of India. Density of population was 548 persons per square kilometer as against 182 persons per square kilometer for India. During the period 1901 - 1971, the population has increased about 233 percent in Kerala as against the all India increase of only 132 percent. The rate of growth of population in the State has shown an increasing trend since 1901 except for two breaks, one between 1911 and 1921 and the other between 1931 and 1941. The annual rate of population growth was 2.25 percent during 1951 - 1961 and 2.30 percent during 1961 - 1971 (Table 2.1).

A rapid increase in population retards economic development. Rapid increases in populations with high birth rates imply an age pyramid with a heavy base. 41 percent of the population of the State is below 15 years of age. Continued increase in this unproductive segment of the population for a prolonged period results in heavy expenditure on public health, education, maternity and child care. It also worsens the unemployment and underemployment situation. It is therefore essential that the growth of population of Kerala be effectively controlled.

Compared to the other states of India, increasing emphasis is given in Kerala to programs of family planning

Table 2.1 Growth of Population in Kerala

Year	Population	Decinnial growth of population	Rate of growth of population per annum
	--millions--	--percent--	--percent--
1901	6.40		
1911	7.15	+11.75	+1.12
1921	7.80	+ 9.16	+1.00
1931	9.51	+21.85	+2.01
1941	11.03	+16.04	+1.50
1951	13.55	+22.82	+2.14
1961	16.90	+24.76	+2.25
1971*	21.30	+25.89	+2.30

*Provisional.

Source: Government of India, Registrar General, Provisional Population Totals - Census of India, 1971 (Delhi : 1971).

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in order to reduce the birth rate. The national birth control target suggests a reduction in birth rate from about 40 per 1000 in the Fourth Plan period (1969 - 1974) to below 20 per 1000 in the Seventh Plan period (1984 - 1989) (Government of Kerala, Demographic Research Centre 1965).

According to the Registrar General's projections, the total population of India would increase at a rate of around 2.5 percent during the Fourth Plan (1969 - 1974). The rate would fall thereafter reaching 1.7 percent per year by 1980 - 81. Important in this projection is the assumption that there will be a decrease in the birth rate from 39 per 1000 of population in 1968 to 26 in 1980 - 81, on the basis of active family planning programs now underway, and a decline in death rate from 14 per 1000 of population to nine, over the same period. If population growth is brought down to 1.7 percent by 1980 - 81 and averages about 1.2 percent in subsequent years, the population in India by 2000 will be 870 million (Government of India, National Planning Commission 1969, pp. 30-31).

Projections for Kerala, adopting the assumptions made by the Registrar General of India, give the population estimates for the years 1980, 1990 and 2000 as 26 million, 30 million and 33 million respectively (Figure 2.1).

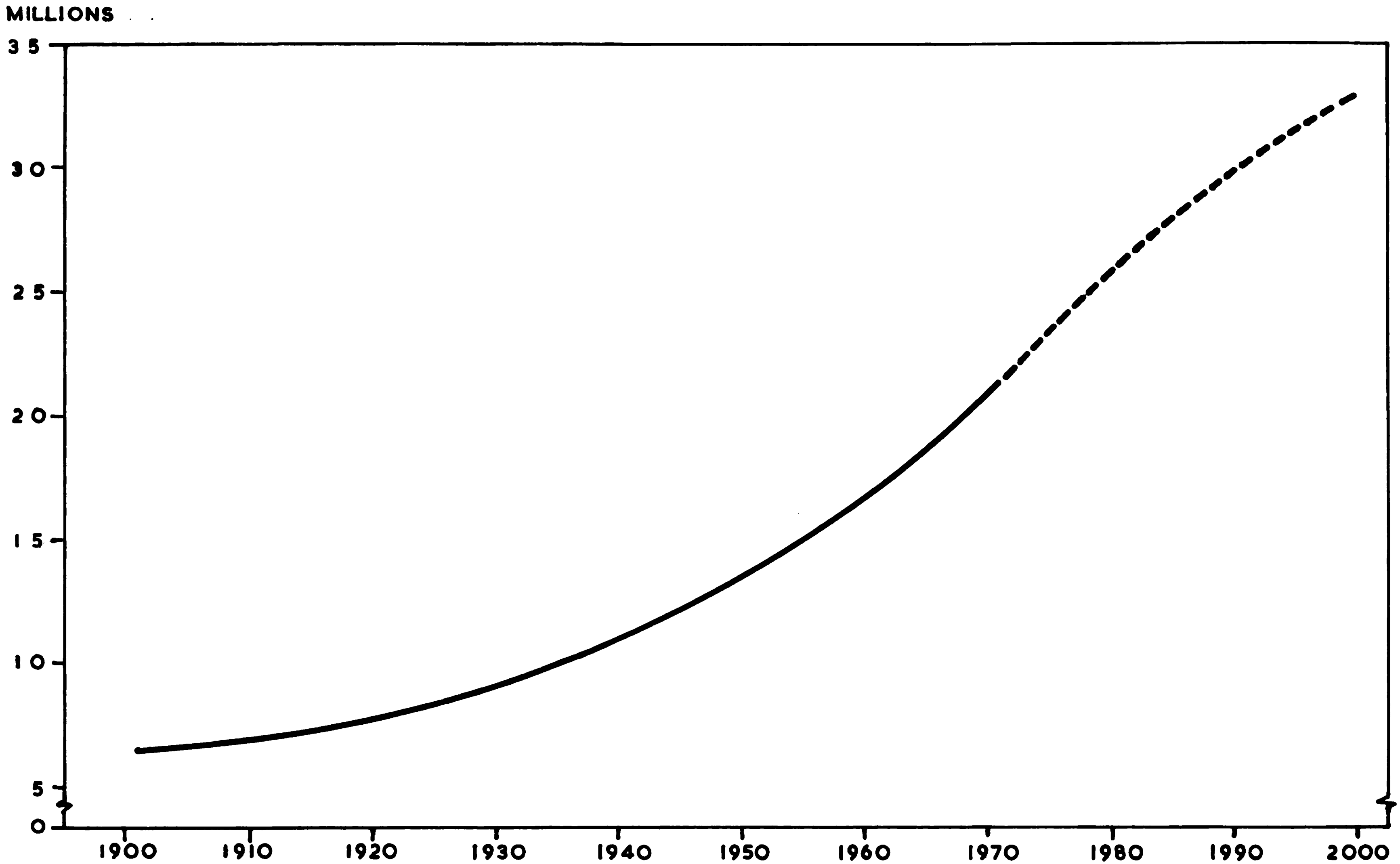

FIGURE 2·1
POPULATION GROWTH IN KERALA

<u>Labor Force and Employment</u>

The labor force includes persons falling within the age group 15-59, who are engaged in any productive work and those who are unemployed but are seeking and are available for work. Those out of the labor force include students, rent receivers, pensioners and past savings holders, house workers, the infirm and disabled, and those either too young and too old to work. The labor force includes all those who are engaged in any productive work, irrespective of age, however.

A state wide sample survey of employment conducted during November - December, 1965 by the Bureau of Economics and Statistics, indicated that in 1965 the labor force in Kerala was 6.02 million or 32 percent of the population (Government of Kerala, Bureau of Economics and Statistics 1966). According to this survey the number of employed persons was 5.47 million, out of which 1.21 million were available for additional work, if such work was forthcoming.

It is interesting to compare the results of the 1965 sample survey with that of the surveys done in 1957 and 1962 (Table 2.2). While the labor force increased by 0.36 and 0.54 million between 1957 - 1962 and 1962 - 1965, the increase in equivalent full employment was 0.18 and 0.45 million.

The increase in the labor force in Kerala during the last 45 years has been on the order of four million.

Table 2.2 Results of Sample Surveys of Employment in Kerala

Item	Year of sample survey		
	1957	1962	1965
	------million persons-------		
1. Total employment	4.47	4.72	5.47
2. Unemployment	0.66	0.76	0.55
3. Labor force (1 + 2)	5.13	5.48	6.02
Change in labor force	+0.36	+0.54	
4. Partially employed under (1)	1.52	1.89	1.21
5. Full employment equivalent of (4)	0.93	1.23	0.75
6. Equivalent full employment	3.88	4.06	4.51
Change in equivalent full employment	+0.18	+0.45	

<u>Source</u>: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

At the same time the employment participation rate (ie. the percentage of employed to the total population, irrespective of age) has been steadily decreasing as can be seen from the following tabulation.

Year	Percentage of employed persons to total population
1901	44.5
1931	42.9
1961	33.3

Source: Government of Kerala, Bureau of Economics and Statistics, Fact Book on Man Power (Trivandrum : 1965).

While only about a third of the State's population was engaged in gainful activities in 1961, the proportion for India was 43 percent. In 1961, of all employed persons in Kerala, 47 percent worked in primary sector, 19 percent in secondary sector and 34 percent in tertiary sector as against 72 percent, 12 percent and 16 percent respectively for India.[2]

The employment pattern for the 1951 and 1961 censuses and the 1965 sample survey shows that there has not

[2]The primary sector comprises agriculture, plantations, animal husbandary, forestry and fisheries. The secondary sector covers mining and industry. The tertiary sector comprises the various service activities like commerce, banking, transport and communication, arts, and domestic services.

been much employment generated in the manufacturing industries of the State. On the other hand, there seems to be a growing reliance on agriculture, in spite of the congestion already existing there. The following tabulation illustrates the point.

	Percentage distribution of employment		
	1951	1961	1965
Primary sector	56	47	53.75
Secondary sector	19	19	14.90
Tertiary sector	25	34	31.35

The sectoral distribution of workers in Kerala presents a paradox. Clark (1940, p. 7) has generalised that a high proportion of the working population engaged in tertiary production and a law percentage in primary production is associated with a high level of income. Kerala offers an example of a low income economy with a tertiary sector which employs a large proportion of the working population. As Kusnets (1959, p. 45) points out, such situations occur "only because population pressure on the land, and the limitations of employment opportunities in the manufacturing sector, drive the surplus labor into low paid service activities." Panicker (1964) and Kurup (1967) have also argued that the situation in Kerala only reflects the rapid growth of population and the arrested

growth of the economy.

Unemployment

Unemployment has been considered to be the most serious problem of the State. As shown by the sample survey conducted in 1965, the number of persons totally unemployed in Kerala was 0.55 million, which formed 9.1 percent of the labor force (or 2.9 percent of the population). This unemployment was in spite of the fact that 0.43 million persons had migrated for work away from Kerala.

The number of unemployed persons has been increasing in Kerala during the last few years as shown in this listing.

Year	Number of unemployed persons
	------thousands------
1956	530
1961	760
1965	550
1966	620
1967	710
1968	780

Source: Government of Kerala, State Planning Board, Fourth Five Year Plan: 1969 - 1974 (Trivandrum : 1970).

The shape of things is not expected to improve in the immediate future. The birth rate has been, and continues to be, very high (about 40 per 1000). It is expected to fall to about 26 per 1000 by 1980 - 81, and to about 20 per 1000 by 1989 - 90. Therefore, a steady increase in the labor force is expected up to 1985 with a declining trend beyond. And, if the employment participation rate remains the same, the lower age group (0-14) and the upper age group (60 and up) can be expected to be excluded almost completely from the working population.

The Expert Committee on Population appointed by the National Planning Commission has made projections of the labor force in Kerala for 1971 and 1976 at 6.9 million and 7.8 million respectively. Adopting the same assumption (ie. a falling participation rate) I have estimated the size of the labor force at 8.3 million by 1980, 9.6 million by 1990 and 10.5 million by 2000 (Figure 2.2).

A worsening of the unemployment situation due to new additions to the labor force can be prevented by setting up a large number of small scale industries which are labor intensive, by rehabilitating traditional industries and by rural industrialisation (Government of Kerala, Bureau of Economics and Statistics 1970). There is also a scheme to rehabilitate the rural unemployed by providing cultivable lands, cleared from forests. The long-range plan is to clear about 100 to 120 thousand hectares of forest land for agriculture, of which 22 thousand hectares are presently being cleared.

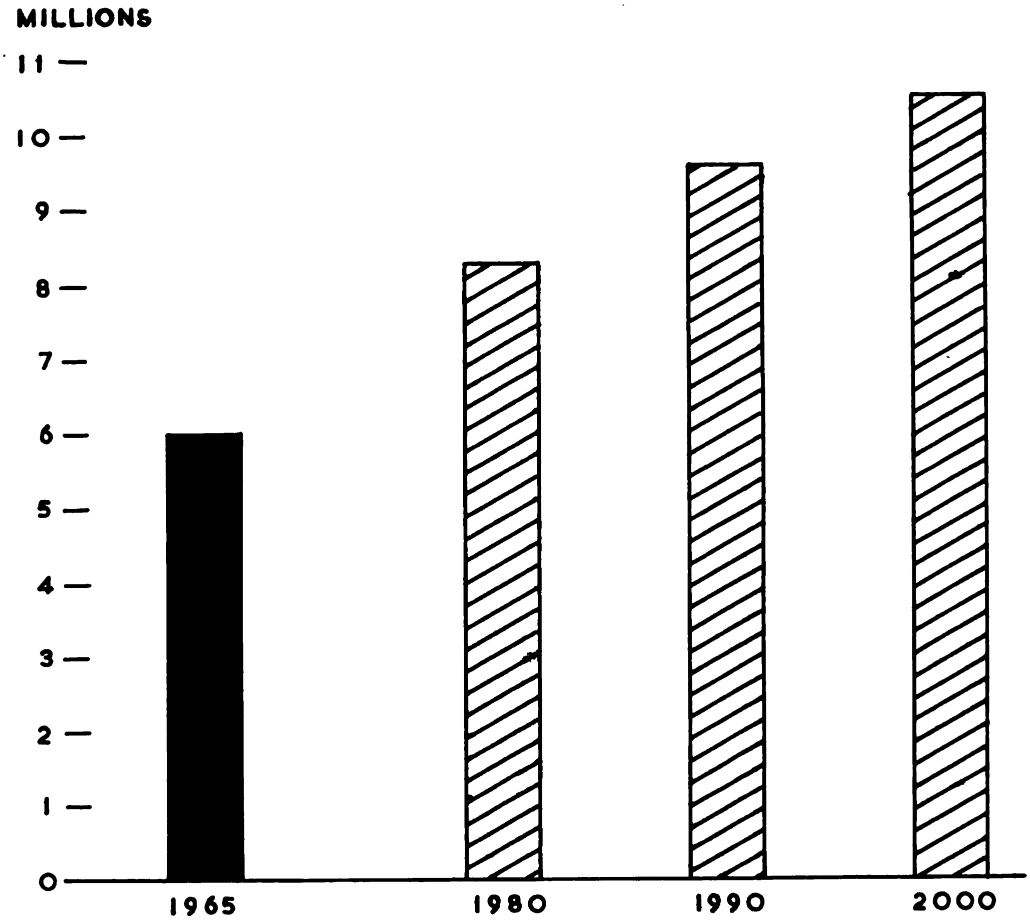

FIGURE 2·2
ESTIMATED GROWTH OF LABOR FORCE
IN KERALA

Income

During the fiscal period 1961 to 1969, the annual rate of income growth of Kerala in 1961 rupees was 3.5 percent as against 2.6 percent for India (Table 2.3).

The contribution of Kerala to the national income (net national product) is about 3.5 percent.[3] In spite of this, the per capita income of Kerala lags behind that of India (Table 2.4). The reason for it is that Kerala has accounted for an increasingly larger proportion of India's population.

As in the case of employment, the distribution of state income by the sector of origin indicates a disproportionate growth of the services sector in Kerala. In fiscal 1967, the percentage share of the industrial sector in the net domestic product of Kerala was only 16.7 percent as against 23.5 percent for India. Distribution of the net domestic product by sector of origin for Kerala is given in the following tabulation.

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[3]Net national product (NNP) is obtained by deducting the net income from abroad from the net domestic product (NDP). To get gross national product (GNP) we add the allowance for depreciation to the net national product. Income from abroad does not come into the income account of the State and therefore, state income and net domestic product of the state will be the same.

Table 2.3 Growth of State Income of Kerala

Fiscal year	State income	Rate of growth of income per annum	State income of Kerala in relation to national income
	millions of 1961 rupees	--percent--	--percent--
1961	4620		3.4
1962	4676	1.2	3.4
1963	4852	3.8	3.3
1964	5107	5.5	3.4
1965	5280	3.8	3.2
1966	5390	2.4	3.5
1967	5614	4.9	3.5
1968	5895	6.1	3.5
1969*	6103	3.5	3.6
Annual growth rate for the fiscal period 1961 - 1969		3.5	

*Provisional.

Sources: Government of India, Ministry of Finance, Department of Economic Affairs, Economic Survey, 1970 - 71 (Delhi : 1971).

Government of Kerala, Bureau of Economics and Statistics, Economic Review - Kerala 1969 (Trivandrum : 1970).

Table 2.4 Growth of Per Capita Income of Kerala

Fiscal year	Per capita income	Rate of growth of per capita income per annum	Per capita income of Kerala in relation to per capita income of India
	--1961 rupees--	--percent--	--percent--
1961	276.30		89.0
1962	272.40	-1.4	86.1
1963	275.50	1.1	87.8
1964	282.80	2.6	87.3
1965	285.30	1.0	84.1
1966	284.40	-0.4	90.1
1967	289.40	1.8	92.3
1968	297.10	2.8	92.5
1969*	304.50	2.5	92.3
Annual growth rate for the fiscal period 1961 - 1969		1.22	

*Provisional.

Sources: Government of India, Ministry of Finance, Department of Economic Affairs, Economic Survey, 1970 - 71 (Delhi : 1971).

Government of Kerala, Bureau of Economics and Statistics, Economic Review - Kerala 1969 (Trivandrum : 1970).

	Percentage distribution of NDP		
	Fiscal 1961	Fiscal 1965	Fiscal 1968
Primary sector	55.0	53.4	52.8
Secondary sector	17.0	16.9	16.4
Tertiary sector	28.0	29.7	30.8

Source: Government of Kerala, Bureau of Economics and Statistics, Economic Review - Kerala 1969 (Trivandrum : 1970).

The goals in respect to the growth of the Nation's economy has been specified by the National Planning Commission (1969, pp. 357-360). The economy is to achieve an annual increase of about 5.5 percent during the Fourth Plan period (fiscal period 1970 - 1974) and the growth target for the Fifth Plan and up to fiscal 1981 is about six percent per annum. This rate is to be raised to about eight percent during the fiscal period 1981 to 1991 and to ten percent during 1991 to 2001. On this basis the net domestic product at constant prices in fiscal 1981 would be nearly double the level attained in fiscal 1968, and by the end of the century it would be nine to ten times that of the fiscal 1968 level. By the same time, the per capita income would be about five times that of fiscal 1968.

The goal of Kerala's planning is to bridge the gap between the per capita income in the State and that at the

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at the national level in a period of about 15 years. For achieving this the net domestic product of Kerala will have to rise at a rate of about 6.25 percent during the Fourth Plan, about 6.8 percent during the Fifth Plan and about 7.25 percent during the Sixth Plan.

The state income and per capita income required to meet these goals for Kerala have been estimated in the following listing and are also shown in Figure 2.3.

Fiscal year	State income	Per capita income
	--millions of 1961 rupees--	--1961 rupees--
1980	12,790	492
1990	26,400	880
2000	57,260	1,735

Investment

The questions which arises, then, regarding the rate of development are these. What is the required size of capital investment? What should be the pattern of investment? And how are these resources to be found? Broadly speaking, the resources for investment have to come out of the production of the community from year to year. That is, the investable surplus depends on the difference between the value added by the workers and the value of their consumption. This necessarily involves a restraint on the growth of consumption, and unless the


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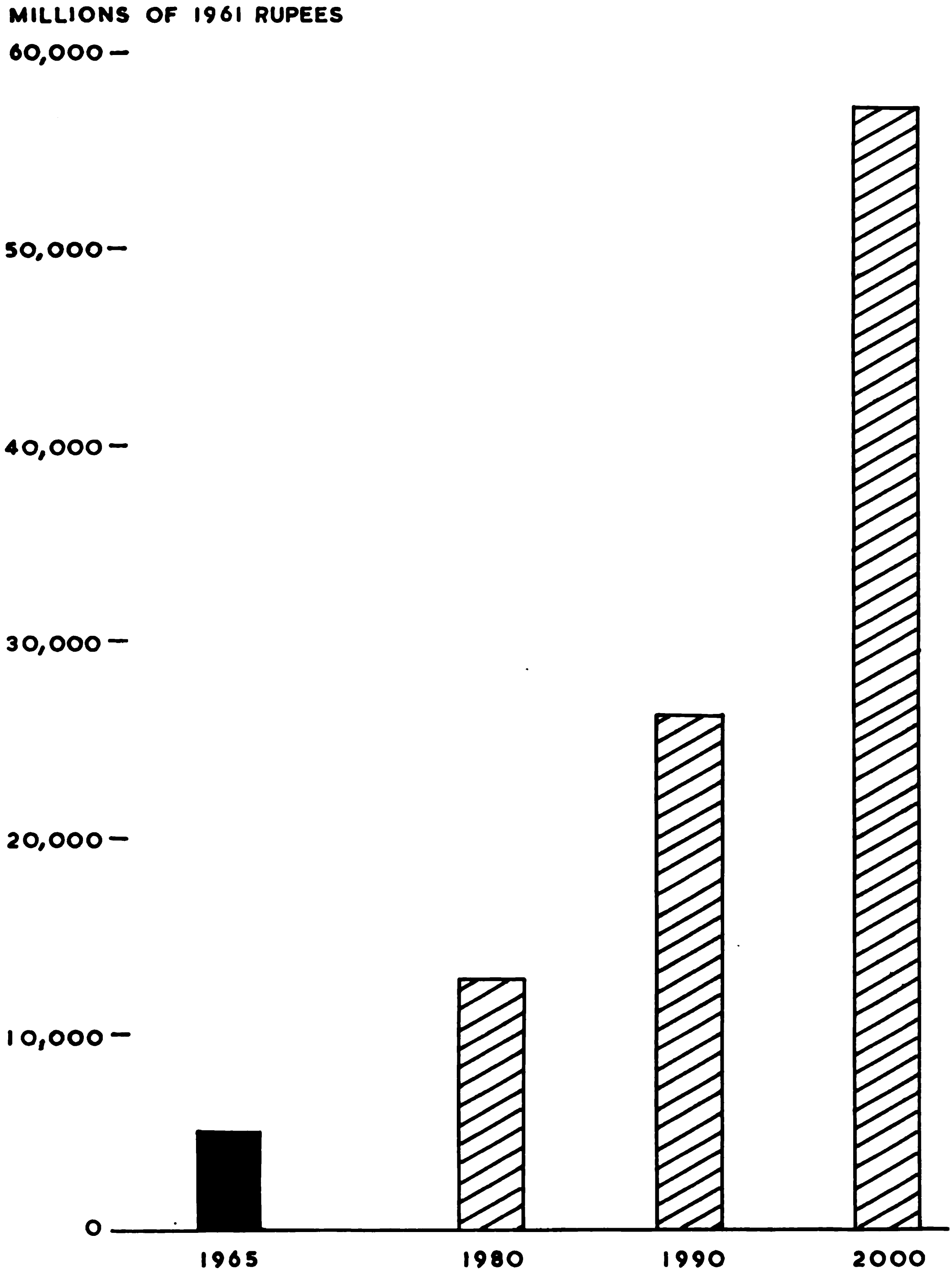

FIGURE 2.3
ESTIMATED GROWTH OF INCOME IN KERALA

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value added is very high there will not be any sizeable contribution to savings. Savings rate has to be high for income to grow at the stipulated rate. Due to the low level of income in India, the domestic capital formation will fall far short of the investment needs.

A developing economy is bound to need a substantial inflow of external capital for some time. At this stage of planned development for India, internal sources have to be supplemented by external sources. This is so because investments of foreign loans and grants and investments of private capital do not impose immediate sacrifice of the consumption of the community (Metha 1960).

The Indian economy is a mixed one, where the public and private sectors play complementary roles. Investment in India has been mainly under the public sector. India's five year plans envisage a sizeable investment within the private sector, and the policy of the government is to encourage the private sector and to get at least a matching share from it. But the private sector has been lacking in initiative, and investment has been far less than expected.

The assumption in the private sector plan is that most of the capital resources required for it are to be supplied by savings within the sector, including credit made available by the Reserve Bank to the co-operative and commercial sectors and the loans extended to individuals

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by specialised financial institutions (Madan 1960). Probably, the fact that the investment in the public sector has to expand at a significantly larger rate limits the possibilities of expansion of investment in the private sector above a moderate level.

India's progress has suffered due to the insufficiency of internal capital resources. The insufficiency of capital resources is at once the cause and the effect of poor industrialisation. And the amount of capital resources that can be obtained is not independant of the rate at which capital resources are growing.

India's first plan (fiscal period 1951 to 1955) was mainly preparatory in character. It was primarily a rehabilitation program for an economy which was severely effected by the war and the partition of the sub-continent. The Second Plan (fiscal period 1956 to 1960) was a step towards industrialization and it called for resources, both financial and organisational, on a large scale (Metha 1960, p. 75). The subsequent plans are meant to maintain and improve upon the tempo of development created by earlier plans.

Kerala's five year plans form part of the national plans and the programs included therein have to be approved by the National Planning Commission. As the capital resources of Kerala are meagre, a considerable portion of the investment needs of the State have to be met by central financial assistance. Even in the private sector,

investment in Kerala to a great extent depends on external sources.

Plan investment in Kerala has been far short of her needs. The plan outlays and actual investments for Kerala have been as follows.

	Plan outlay	Actual investment
	--millions of rupees at current prices--	
First Plan (fiscal period 1951 - 1955)	300	259
Second Plan (fiscal period 1956 - 1960)	870	851
Third Plan (fiscal period 1961 - 1965)	1,700	1,823
Fiscal period 1966 - 1969	1,400	1,370
Fourth Plan (fiscal period 1970 - 1974)	2,600	n.a.

<u>Source</u>: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

In the first two five year plans, the investment in Kerala was insignificant and industrial development in the State was totally neglected. A beginning has been made in the Third Plan to strengthen the slender industrial base of Kerala.

To meet the goal of catching up with the national standard in respect of per capita income, Kerala would need stepped up investment. To achieve that end, Kerala has to attract

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attract outside capital, for which rational management of the natural resources of the State is vital.

Education

It has been observed by many economists that investment is at best a necessary condition for growth, surely not a sufficient condition. About 50 percent of the rate of growth is considered to be attributable to the so called residual factors, of which education is the most important (Solow 1962). Education raises aspirations, and low aspirations are one of the causes of low achievement (Lewis 1966). Transferance of labor from low to high productivity occupations is a distinctive mark of economic development and this can be affected only through education.

Kerala is foremost in literacy in India. The 1971 population census has shown that 60 percent of Kerala's population is literate as against 29 percent for India. In 1961 the percentage of literates in Kerala was 47 percent, which indicates a literacy growth rate of 2.50 percent per annum between 1961 and 1971.

About 18 percent of the population of Kerala attend schools and colleges as against only 8.3 percent in India (Government of Kerala, Planning Board 1970). The enrollment rate in primary, middle and secondary classes in Kerala is very much higher than the national rates and Kerala's per capita expenditure on education is the highest in India. The enrollment rate for Kerala during

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1961 is shown in the following tabulation.

Grade level	Corresponding age group	Proportion of students in the age group enrolled
	--years--	--percent--
Primary (I-V)	6 - 11	88.86
Middle (VI-VIII)	12 - 14	58.74
Secondary (IX-XI)	15 - 17	59.58
University	18 - 23	3.14

Sources: Government of Kerala, Bureau of Economics and Statistics, Fact Book on Man Power (Trivandrum : 1965).

National Planning Commission, Fourth Five Year Plan : A Draft Outline (Delhi : 1969).

In Kerala, during the years 1961 to 1966 the annual increase in enrollment had been 3.99 percent in primary classes, 4.75 percent in middle classes, 13.10 percent in secondary classes and 12.61 percent in university classes. Experts have not been in agreement with regard to the optimum rate of educational development in India nor on its pattern (Laska 1968). Suggested rates of growth in the number of literate and educated persons vary between two to eight percent per annum.

The rate of literacy increase in developing countries rises to a maximum and decreases slowly thereafter, due to the fact that school attendance and literacy have a saturation value. Based on the present school

attendance by age, the present adult literacy by age and the age pyramid of the population, the annual growth rate of literacy for Kerala in the years 1980, 1990 and 2000 are estimated to be 2.5, 2.0 and 1.5 percent respectively.

Health and Housing

With regard to the availability of medical services also, Kerala is in the forefront of the states of India. The target of one hospital bed for one thousand persons, laid down in the expert committee report (1965) has already been achieved in the State, as against the national average of one bed for every two thousand persons. In 1967 there were 21,000 hospital beds and about four thousand doctors in Kerala. Kerala has also made remarkable progress in the control of communicable diseases and in family planning.

On housing, hardly any statistical information is available. There is no organized housing industry in the State and residential buildings are constructed individually. The 1971 census shows the total number of establishments and households in Kerala to be 4.59 million, registering an increase of 35 percent over the number of establishments and households in 1961. Residential houses formed 74 percent of the listed households and establishments in 1971 as against 81 percent in 1961. A reasonable projection is that there will be additional housing in Kerala constructed at the rate of about 96,000

units annually between 1971 - 1980, 117,000 units annually between 1981 - 1990 and 121,000 units annually between 1991 - 2000.

Power and Transportation Facilities

An obvious first step in economic development and in correcting regional and area imbalances is to provide an appropriate social capital infrastructure. In this respect Kerala is ahead of other states.

Power. There are no proven fossil fuel resources in Kerala. A vast potential for generation of low cost hydro-electric power makes up for the absence of fossil fuels.

The hydro-electric power potential of India has been estimated at 40 million kilowatts. With 1.27 percent of the total land area of India, Kerala's power potential has been estimated to be more than two million kilowatts or five percent of the total for India. Due to the high density of population, the power potential in Kerala is the same on a per capita basis as for India.

Kerala at present has a power surplus of 139,500 kilowatts and when the projects under construction are completed, the power surplus is likely to increase. The present hydro-electric power situation in Kerala is summarised below.

Power source	Capacity
	--kilowatts--
Present generating capacity	621,500
Capacity of projects under construction	805,000
Further potential available	1,205,000

Source: Kerala State Electricity Board, Trivandrum.

Transport. The transport system of Kerala consists mainly of the following.

(1) 885 kilometers of railway running more or less along the coast line.

(2) A fairly well developed network of roadways totalling 17,400 kilometers. It represents about 45 kilometers of road per 100 square kilometers, and far exceeds the national average. The State has about double the vehicle density per kilometer of road and five times as much per square kilometer of area, compared to the national average.

(3) A unique system of inland waterways of over 1,890 kilometers, which represents 20 percent of the internal waterways of India.

(4) 13 ports to handle coastal shipping.

CONCLUSION

Kerala is the most densely populated state of India. In spite of certain apparent advantages like a higher percentage of literacy and better medical and infrastructural facilities, Kerala remains an economically backward state. Per capita income of Kerala in fiscal 1969 was only 304 rupees as against the national average of 330 rupees. A high rate of unemployment, a low contribution from the industrial sector to the State's economy and the inordinate burden being carried by the tertiary sector have made Kerala one of the poorer states of India. Political instability and the burden of past social and institutional forms are also responsible for the backward situation.

Social and economic development goals for Kerala have to be identified within the general frame work of national policy. Assuming a sound national policy of development, and assuming social and institutional changes favourable to the State's economy, the social and economic goals for the State are these:

1. To reduce the rate of growth of population from 2.30 percent at present to 1.12 percent by 2000.

2. To create new advances in employment to meet the annual increase in labour force (at about 1.6 percent) and to completely absorb the existing jobless persons by stages within a period of about ten years. This is to be achieved by increased industrial employment and by providing land for those who cannot be absorbed in the industrial sector.

3. To raise the state income (net domestic product) from 6,103 million rupees in fiscal 1969 to 57,260 million rupees in 2000 and to increase the per capita income from 304 rupees in fiscal 1969 to 1,735 rupees in 2000 at constant (fiscal 1961) prices.

4. To step up investment to a rate at least equal to the rate for all India. Investment in Kerala in 1965 was about 11 percent of the net domestic product of the State. The average rate of investment in Kerala as a percentage of the state

income is to increase to 21 percent in 2000.

5. To increase literacy at an annual rate of 2.5 percent, two percent and 1.5 percent by the year 1980, 1990 and 2000 respectively and to achieve educational development in a properly structured manner.

6. To provide additional housing annually at the rate of about 96,000 units between 1971 - 1980, 117,000 units between 1981 - 1990 and 121,000 units between 1991 - 2000.

7. To provide adequate power and transportation infrastructure to meet the requirements of the developing economy.

Industrial development will be the spearhead to achieve overall growth of the State's economy. It is the only alternative left, whichever way we look at it, for enhancing employment opportunities, increasing productivity and for raising living standards. Industrial development can be achieved only by an integrated and rational plan for the development of the natural resources of the State and the establishment of industrial units to utilise these resources.

Forests form a valuable natural resource of Kerala, and planned development of forestry and forest industries can contribute to the economic welfare of the State. The expected demands for forest land and forest products estimated from an assessment of the current situation would serve as a basis for such planned development and the most efficient use of the available forest resources.

Chapter 3

CURRENT STATUS OF WOOD-USING INDUSTRIES AND FOREST RESOURCES OF KERALA STATE

Wood and wood-using industries are very important in the economy of Kerala. Together, forestry and wood-using industries contributed 172 million rupees towards the gross state product and employed 44,700 persons.

Total production of wood in 1965 in Kerala was 6.5 million cubic meters and the consumption of wood and wood products in terms of roundwood equivalents was 5.7 million cubic meters. The per capita production of wood in Kerala in 1965 was 0.35 cubic meters as against 0.28 cubic meters for India. The per capita consumption of wood in Kerala in 1965 was 0.32 cubic meters as against 0.29 for India.

WOOD-USING INDUSTRIES OF KERALA STATE

It is useful briefly to review the industrial sectors in Kerala as an aid in understanding the importance of wood-using industries to the State.[1]

A Review of the Industrial Sectors of Kerala

The industrial sectors have been broadly classified into two groups, factory sectors and non-factory sectors. Factory sectors include those manufacturing establishments where production is carried out in factories as defined in the Factories Act (1948). In the Factories Act a factory is defined as any premises -

(a) whereon ten or more persons are working, and in any part of which a manufacturing process is being carried on with the aid of power or is ordinarily so carried on

(b) whereon twenty or more persons are working and in any part of which a manufacturing process is being carried on, without the aid of power or is ordinarily so carried on.

Non-factory sectors comprise household industry units and a few of the non-household units which are not defined as factories.[2]

<u>Factory sectors</u>. In the year 1965, in Kerala, there were 1,967 registered factories, accounting for 676

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[1] Bamboos and reeds are used as the main raw material for pulp and paper in Kerala and in India. For purposes of this study the industries using bamboos and reeds also are considered to be wood-using industries.

[2] By definition a household industry is conducted by the head of the household and/or mainly by the members of the household at home or within the village in rural areas and only at home in urban areas. A household industry should relate to production, processing, servicing or making and selling of goods and services.

million rupees of fixed capital and employing 193 thousand persons.[3] Value added by manufacturing was 446 million rupees. The corresponding figures for India were 48,456 registered factories, 48,320 million rupees of fixed capital, 4,700 thousand employees and 18,830 million rupees of value added by manufacturing.

For the purpose of collection of statistics, the factory sectors (which are covered by an Annual Survey of Industries) is further divided into two sub-groups, namely, census sectors and sample sectors. This sectoral classification was made by the Central Statistical Organisation for the purpose of collecting and compiling data pertaining to manufacturing industries. Coverage of the survey extends to all factory sectors, except the sectors engaged in defence production, factories engaged in storage and distribution of oil, and technical training institutions not producing anything for sale or exchange. Factories employing 50 or more workers aided by power, or 100 or more workers without the aid of power, are completely enumerated and therefore such factories come under the so called census sectors. The remaining factories, namely, those employing ten to forty-nine workers aided by power, or 20 to 99 workers without the aid of power, are covered annually on the basis of

[3] The employment figure represents the average daily employment obtained by dividing the total attendance (man-days worked) during a year by the total number of working days during the same year.

probability samples and are therefore called the sample sectors. The sample sectors contribute very little to the value added by manufacturing. The sample sectors, however, have a large percentage share in respect to the total number of factories. In 1965 the census sector factories accounted for only 31 percent of the registered factories in Kerala; but it accounted for 87 percent of the value of fixed assets, 82 percent of the total employment and 82 percent of the total value added by manufacturing (Table 3.1).

The factory sectors also are classified differently, depending on capital investment, into size classes (as small, medium and large). Small scale sectors consist of manufacturing establishments with fixed capital (net of depreciation) up to and including one half million rupees. Medium scale sectors consist of those establishments with a fixed capital of over one half million rupees but not exceeding two and one half million rupees. Large scale sectors consist of those with a fixed capital of over two and one half million rupees.

With its strikingly capital intensive character, the large scale sectors are responsible for about two thirds of the aggregate income generated by the entire factory sectors. Small and medium groups, which predominate numerically are labor intensive. Together they account for about 47 percent of the number of persons employed, 42 percent of the gross value of output and 33

Table 3.1 Major Characteristics of the Factory Sectors of Industries in Kerala, 1965

Item	Sector	Measure of characteristics: Unit	Measure of characteristics: Quantity	Sectoral representation
				--percent--
Number of factories	Census sector	Number	626	31.5
	Sample sector	"	1,341	68.5
	Total		1,967	100.0
Fixed capital	Census sector	Million rupees	587	86.9
	Sample sector	"	89	13.1
	Total		676	100.0
Number of employees	Census sector	Number	158,360	82.3
	Sample sector	"	34,200	17.7
	Total		192,560	100.0
Value added by manufacturing	Census sector	Million rupees	358	81.6
	Sample sector	"	88	18.4
	Total		446	100.0

Sources: Government of Kerala, Bureau of Economics and Statistics, Report on the Annual Survey of Industries, Kerala State 1965 (Trivandrum : 1971).

Government of India, Central Statistical Organization, Annual Survey of Industries 1965 : Capital, Employment, Output Estimates for Factory Sector by Capital Size (Delhi : 1970).

percent of the value added by manufacturing in Kerala.

The relative economic significance of the three sectors further emerges from the fact that the fixed capital per employee, which denotes the degree of mechanisation, is 2,017 rupees in the small scale, 4,044 rupees in the medium scale and 17,752 rupees in the large scale sectors. The value added by manufacturing per unit of employment, which will serve as a rough measure of productivity, works out to 2,359 rupees in the small scale, 3,815 rupees in the medium scale and 5,216 rupees in the large scale sectors.

The pace of advance of the factory sectors of industry has been poor in Kerala. While the value added by manufacturing increased by 60 percent and employment by 26 percent in India during the period 1961 - 1965, the corresponding increase in Kerala was only 43 percent and 12 percent. This clearly indicates the backward nature of industrial development in Kerala.

Non-factory sectors. In 1965, there were 400 thousand non-factory units in Kerala employing 664 thousand persons. Value added by manufacturing in the non-factory sectors was 526 million rupees. (The corresponding figures for India were 13,460 thousand non-factory units, employing 20,320 thousand persons; value added by manufacturing was 14,850 million rupees.)

Over 70 percent of the persons working in the

non-factory sectors of Kerala are employed by five industries, namely coir, handloom textiles, jaggery making, coconut oil crushing and reed works.

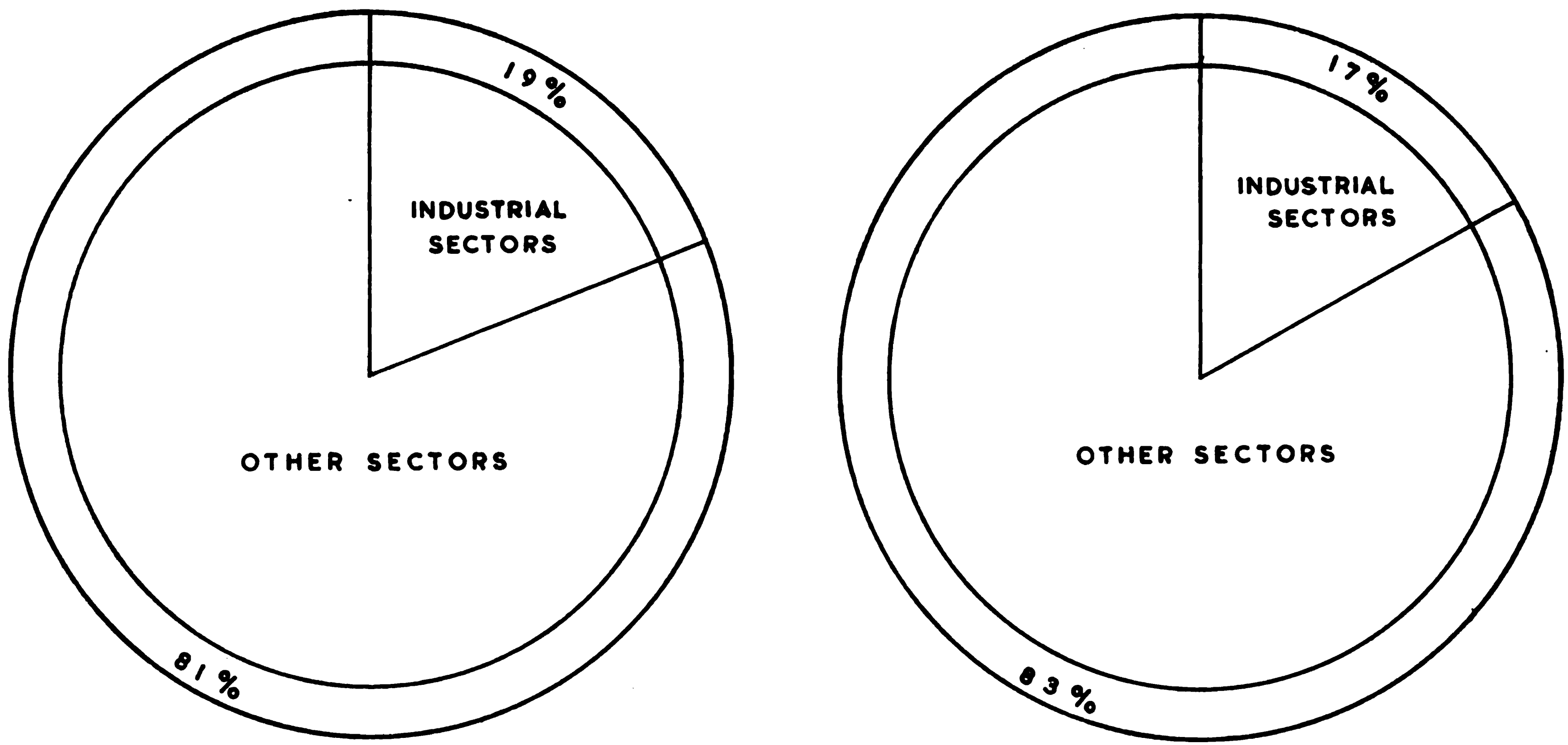
Summary of economic characteristics for the industrial sectors. The major economic characteristics for the entire industrial sector (both factory and non-factory) for Kerala for the year 1965 (the latest year for which complete date are available) is given in the following tabulated statement and in Figure 3.1.

Details	Quantity	Proportion of total for all sectors
		--percent--
Total employment (thousand persons)	857	19
Value added by manufacturing (million rupees)	972	17

Source: Compiled from Annual Survey of Industries, 1965 and National Sample Survey - 20th round, 1965.

A Review of the Current Situation of the Wood-using Industries of Kerala

The characteristics explained in respect of the industrial sectors apply generally to the wood-using industries as well. The performance of wood-using industries has not been impressive in India compared to other countries, even though the history of wood-using industries



EMPLOYMENT

VALUE ADDED BY MANUFACTURING

FIGURE 3.1
ECONOMIC CHARACTERISTICS OF THE INDUSTRIAL SECTORS IN KERALA, 1965

can be traced back to as early as 1884. The backward condition of wood-using industries is equally evident in Kerala. But due to locational advantages wood-using industries are much more important to Kerala than to the nation as a whole.

Kerala is a coastal state and a mountainous region and its wood-using industrial plants are located along the sea coast. In Kerala there is a concentration of conventional types of wood-using industries, like sawmills, plywood plants, furniture plants and establishments producing splints, veneers and packing cases. Other wood-using industries important to Kerala are pulp, paper and allied products and boat building.

Statistical data on the wood-using industries has been collected from the Annual Survey of Industries carried out by the Central Statistical Organisation and the National Sample Surveys conducted by the National Sample Survey Organisation. The statistics encompasses wide variation in individual plants. Mills differ in the number of products manufactured, the sizes and grades and the extent of finishing and remanufacturing. Firms also often differ in the kinds of equipments operated and degree of mechanisation.

The classification of industries followed in India is more or less the same as the United Nations Organisation classification and consists of a large number of groups and sub groups. A classification of wood-using industries is given in Appendix A.

In analyzing the current situation several industrial groups and sub-groups have been combined for ease of identification and to avoid the difficulty of obtaining data for small sub-groups and for certain minor groups. The following wood-using industries or industry groups are discussed in the following pages with respect to its current situation.

Sawmilling for timber
Plywood manufacturing
Fiberboard and particleboard manufacturing
Pulp and paper manufacturing
Match production
Other wood-using industries

The groups and/or sub-groups included in each of the above are given in Appendix B.

Sawnwood. Sawmilling is by far the most important wood-using industry in Kerala. Sawmilling has developed during the last two decades as a result of industrialisation, rural development, house building and construction programs and a rise in the standard of living.

Large organised units are few in the sawmilling industry in Kerala and the structure of this industry is dominated by small scale units. Sawmills are located, in large numbers, in big towns and around the timber distribution centers and depots. Sawing of timber is also carried out as a household industry, using hand-operated saws (Government of India, Department of Food and Agriculture 1968, p. 13). Apart from the large number of

non-factory units, most of the factory sector units are small, operating with one band saw. Even the so-called bigger units usually lack facilities for seasoning, storage and preservative treatment. The total number of saw-milling units in 1965 in Kerala was more than 1,000 of which 48 units were large enough to be classified under the census sector. Products of this industry are mainly sawnwood, sleepers and boxboards.

While the sawmills in advanced countries manufacture seasoned, treated and regular sized finished products ready for customer use, there are only few sawmills provided with treatment and seasoning facilities in India. Currently the outturn of sawnwood from round logs is only 60 percent of the cubic volume and the rest forms the residue. Sawmill residues are comprised of seven to twelve percent sawdust and the rest solid residues such as slabs, edgings, offcuts and bark. Sawmill residues are mainly used as fuelwood.

Over the years there has not been any conspicuous trend towards modernisation of sawmilling; and the non-factory sector continues to predominate in the industry. In the factory sector, the sawmilling industry is characterised by outmoded plants and general inefficiency (UN/ECAFE 1968). A very high proportion of the sawmills use a narrow horizontal band saw as a breakdown rig followed by a hand-fed smaller vertical band saw. Occasionally a circular rip saw is also used.

The sawmilling industry in Kerala (and in India) is operated almost at full capacity.

Plywood. The development of the plywood industry in Kerala is associated with its development at the national level.

Plywood was first used in India as a packing material, mainly for tea. It was about the year 1905 that plywood tea chests were introduced in India, using imported plywood.

With a slow start, the Indian plywood industry expanded rapidly under the sudden and vast demand which manifested itself during and after the Second World War. The number of approved plywood factories in the country has increased from three at the beginning of Second World War to 71 in 1965 and 74 in 1968. Production also registered a great increase from about four million to about twenty-three million square meters during the period 1915 to 1965.

The first plywood factory in Kerala was established in 1920. The total number of plywood factories in Kerala in 1965 was 13. The total installed capacity was 8.7 million square meters (4 mm. thickness), whereas the actual production was 4.6 million square meters or about 53 percent of the installed capacity. Scarcity of raw material has been the main reason for the underutilized capacity in the industry (Chirayath 1966, p. 39).

In Kerala (and India), plywood is popular for many uses, even though the predominant use is for tea chests. Plywood has replaced sawnwood in many of its traditional uses in building construction, furniture manufacturing and packaging.

The plywood mills of Kerala, and in India, are mostly small. Most of the factories have small sized peeling lathes and only few factories are equipped with slicers. The unutilised central core in peeling is about 7.5 centimeters to 18 centimeters in diameter. The average outturn from the mills is only 40 percent of the cubic volume of the log and the waste consists of end cuts, waste veneers, trimmings and the unusable core. Of the wastes, 80 percent is fed back into the boilers and the balance is used for packing cases and as raw material for boards.

Fiberboard and particleboard. Fiberboard and particleboard represent a very large "progressive product front" both from the point of view of economy in wood utilization and economy of labor in their application (FAO 1966, p. 35).

Fiberboard is a broad generic term encompassing sheet materials of widely varying densities, manufactured from refined or partly refined wood and other fibers. It derives its primary bond from the arrangement of the fibers and their inherent adhesive properties. However, binding agents are incorporated to increase strength, resistance to moisture, fire and decay and other desirable properties. Fiberboards include insulation boards, medium density fiberboards, hardboards and special densified hardboards.

Particleboards are different from the conventional fiberboards in that they are composed of distinct particles of wood or other lignocellulosic fibrous substances, which are bonded together with an organic binder. Particleboards are classified as low density, medium density and high density boards.

Fiberboards and particleboards have not yet become popular with the consumers in India. The main uses for the fiberboards and particleboards are as core stock for veneer and other over-laid furniture and as panel material.

The development of the fiberboard and particleboard industry in India has occured since 1958 when the first factory was established near Bombay. In 1965 there were 12 units manufacturing fiberboard and particleboard in India. In Kerala there were only one unit of each. In that year the actual production was only about 38 percent of installed capacity in India and 48 percent in Kerala. The reasons for the underproduction are believed to be the consumer resistance and non-availability of resin at acceptable prices (Rasch 1967).

<u>Pulp and paper</u>. The beginning of the pulp and paper industry in India dates back to 1832 when the first paper machine was established at Serampore in West Bengal

(Narasimhan 1964). However, the growth of the industry was very slow. At present there are 60 mills producing paper and paper boards, one mill producing newsprint, two mills producing rayon grade pulp and one mill producing paper grade pulp in India.

Of the pulp and paper mills in India 39 units are small in size, producing not more than ten tons per day. Only ten units produce above 100 tons per day.

The paper mills in India manufacture almost all the common varieties of writing, printing and wrapping papers and boards, excluding certain special types of papers such as Manila paper, condenser, cable and other electrical insulation papers, photographic base paper, carbonizing tissues, glassine and vegetable parchment paper, high strength kraft paper for multiwall bags, kraft liner, foil paper and ivory boards. Steps have already been taken to establish units to produce some of these varieties of papers. Production of newsprint is restricted in India due to the lack of coniferous raw material.

In Kerala there are two large units under this industrial group. One is a rayon pulp mill and the other a paper mill. In addition, there are three small units producing writing, printing and wrapping papers. The paper mills are integrated units including both pulp and paper manufacturing.

The actual production compared to the installed capacity of the pulp and paper industry in Kerala has been consistantly high and production has been going on almost at full capacity.

<u>Matches</u>. The first match factory in India was set up in 1895 in Ahamedabad. The period 1895 to 1920 witnessed the establishment of several small factories in different parts of the country. In the 1920s a Swedish enterprise entered the match industry with the establishment of Western India Match Company (WIMCO) in 1923.

Introduction of cottage match manufacturing in South India in the thirties was a very significant development as it paved the way for the emergence of flourishing match manufacturing centers which have competed very well with the mechanized sector. The match industry in India is concentrated in Maharashtra, Tamil Nadu, Uttar Pradesh, West Bengal and Kerala.

It was in the 1920s that the match industry had its beginnings in Kerala. Since then, it has developed into an important industry in the State.

The term "match industry", as applied in Kerala especially, has to be understood with a qualification. The match industry in the State is of a composite nature, having two distinct categories of units. Factories which make only splints and veneers, the basic sources of match sticks and boxes are one type. The second type of factory engages in the chemical treatment of the match sticks and the assembling of the match boxes and is popularly known

as a dipping factory. Some of the dipping factories are integrated units, meeting their requirement of splints and veneers partly by production in their own factories. In Kerala, the former type far out-number the latter. (In 1965 there were 197 units of the former type and 11 of the latter.)

The proportion of Kerala produced splints and veneers utilised by dipping factories in Kerala is only 2.5 percent of the total production. The rest is exported to Tamil Nadu to be utilised by the dipping factories there. The reason given for the lack of dipping factories in Kerala is the high rainfall and humidity, which renders it difficult for the sticks to be dipped and dried suitably over a considerable part of the year (Chirayath 1968).

The match industry in Kerala is faced with several problems, the most important of which is an inadequate supply of matchwood logs of suitable quality. Because of this the actual production has only been about 60 percent of the installed capacity (Sharma 1968).

Other wood-using industries. Under this group are included the wood-using industries which are not dealt with separately (See Appendix B). Major items of production in this group are wooden furniture and fixtures, joinery, turnery, wood carvings, wooden toys, containers, boats and other products which use industrial round wood. This group is dominated by small scale factory units and

household units. This group also covers the use of roundwood in the construction industry.

The industries included in this group partly use products from other wood-using industries like sawmilling and plywood as well as considerable quantity of roundwood, and hence are combined into one group. In 1965, there were 112 units under this group in Kerala in the factory sector.

Raw Material Use in the Wood-using Industries of Kerala

Raw material use per unit of output is an indication of the level of technological development and efficiency in production. In 1965, the wood use in cubic meters of roundwood per unit of output was as follows (also see Table 3.2).

Industry	Unit of output	Raw material use per unit of output in roundwood
		--cubic meters--
Sawnwood	Cubic meter	1.66
Plywood	Thousand square meters (4 mm. thickness)	10.00
Fiberboard	Metric ton	3.25
Particleboard	Metric ton	3.10
Pulp and paper		
Pulp	Metric ton	6.80
Newsprint	Metric ton	3.40
Writing and printing papers	Metric ton	4.80
Industrial papers	Metric ton	3.50
Matches	Million boxes of 50 sticks each	36.00

Table 3.2 Raw Material Use in the Wood-using Industries of Kerala in 1965

Industry	Unit of output	Production	Consumption of industrial wood	Raw material use per unit of output	Recovery ratio
		--thousands--	--thousand cubic meters--	--cubic meters--	--percent--
Sawnwood	Cubic meter	490.0	813	1.7	60
Plywood	Thousand square meters (4mm. thickness)	4.6	46	10.0	40
Fiberboard	Metric ton	4.8	16	3.2	55
Particleboard	Metric ton	0.3	1	3.1	60
Pulp and paper					
Pulp	Metric ton	47.2	321	6.8	25 - 28
Newsprint	Metric ton	nil	nil	3.4	58 - 62
Writing and printing papers	Metric ton	12.0	58	4.8	40 - 42
Industrial papers	Metric ton	6.0	21	3.5	50 - 55
Matches	Million boxes of 50 sticks each	1.2	44	36.0	n.a.
Others (Industrial roundwood)	Cubic meter (round)	199.0	199		
Total			1,519		

Sources: Government of India, Directorate of Technical Development, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

Specifications for raw materials vary from industry to industry. Almost all wood species can be used for lumber depending on the use to which the sawnwood is to be put.

There are relatively stringent specifications for plywood logs. The Indian Standards Institution has laid down the standard specifications for plylogs and has listed 69 Indian timber species as suitable for plywood manufacture under three different classes.

Technically speaking, nearly all species of wood or other lignocellulosic fiber sources may be used as the raw material to produce fiberboard and particleboard. Normally, a large number of species can be mixed to produce fiberboard and particleboard. Industrial wood residues, logging and forest management residues, cull timber and species which have no other industrial use can also be used as raw material for this industry. There is however, a limitation in the degree of mixture. Non-wood materials such as agricultural residues also are used for board manufacture.

Bamboos are the main raw material used for the manufacture of pulp and paper in Kerala (and India). But bamboo forests are dwindling rapidly and substitutes like Eucalyptus species and selected hardwoods are taking the place of bamboo. Considering the dwindling of bamboo resource and the shortage of coniferous raw material for pulp and paper industry, intensive work has been done on

pulping of hardwoods, individually and in mixture, at the Forest Research Institute, Dehra Dun (Guha 1968). The results show that hardwoods compare very favourably with bamboo as raw material for paper. Hardwoods have also proved to be good raw materials for rayon pulp. The pattern of raw material usage over the years indicates increasing use of hardwoods for the manufacture of pulp and paper in this country, and it had reached 12 percent in 1965 and 17 percent in 1968 (FAO 1970).

The main raw material used by the match industry is softwood logs. There are rigid specifications regarding the color, hardness and smell of the matchwood, and 25 species have been listed as suitable for match manufacture, by the Indian Standards Institution.

Some of the industries like pencil manufacturing, sporting goods, boat building and textile machinery included in the miscellaneous group of "other industries" require specific qualities for the wood raw material. Others like furniture and agricultural implements are not so specific about the qualities of wood. Specifications of roundwood for construction industry are also not very rigid.

Total wood use. In 1965, the total use of industrial wood in round form was 1,519 thousand cubic meters in Kerala as against 15,100 thousand cubic meters in India (Figure 3.2).

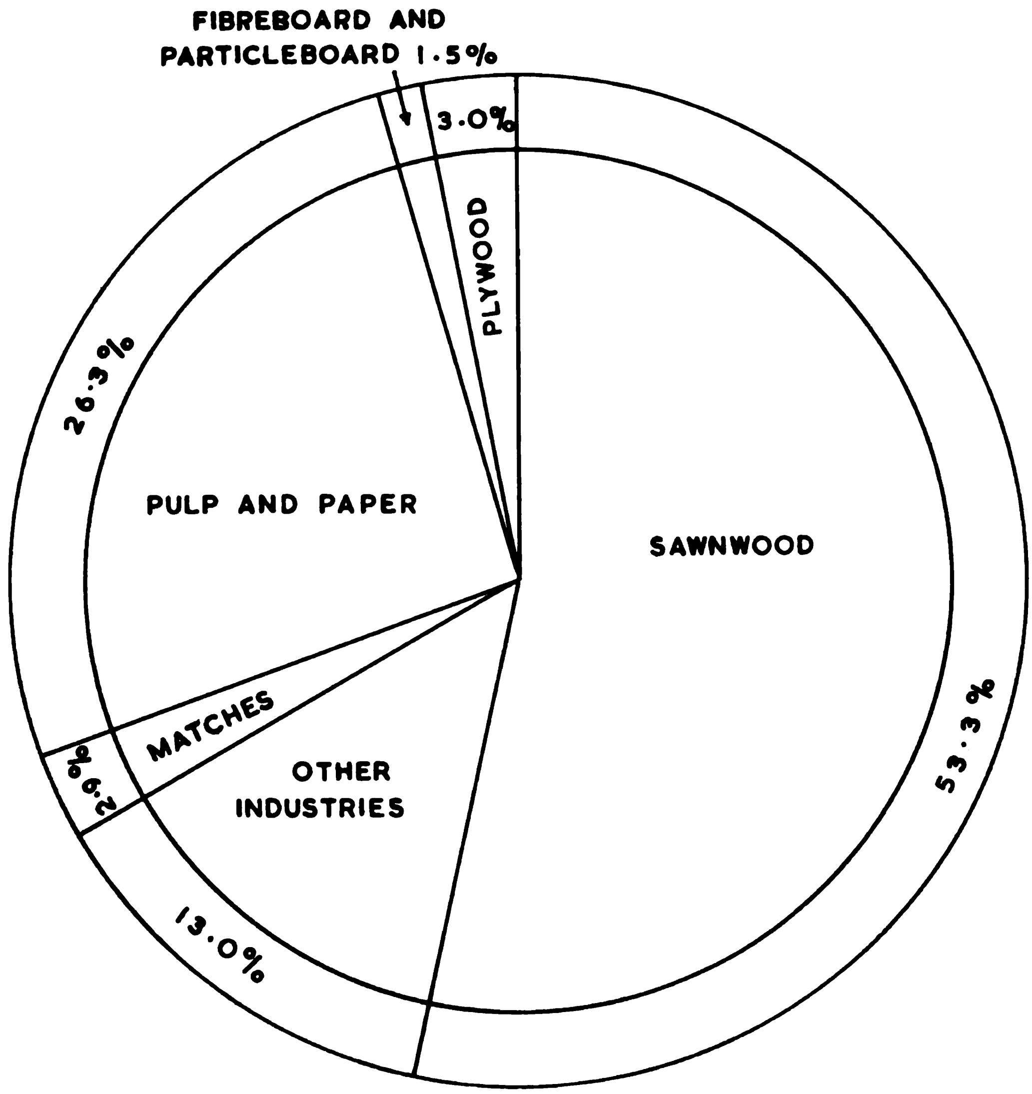


FIGURE 3.2
INDUSTRIAL WOOD USE IN KERALA, 1965

Employment in the Wood-using Industries of Kerala

The number of persons employed in an industry per unit of output is of significance, economically. It also gives an indication of the level of mechanization in the industry.

Employment per unit of output in 1965 is shown in the following tabulation (Table 3.3).

Industry	Unit of output	Employment per unit of output
		--man-days--
Sawnwood	Cubic meter	4.0
Plywood	Thousand square meters (4 mm. thickness)	135.0
Fiberboard	Metric ton	26.0
Particleboard	Metric ton	26.0
Pulp and paper		
Pulp	Metric ton	5.5
Newsprint	Metric ton	4.5
Writing and printing papers	Metric ton	28.0
Industrial papers	Metric ton	22.0
Matches	Million boxes of 50 sticks each	1,500.0
Others	Cubic meter (round)	14.0

The intensity of employment varies from industry to industry depending on the extent of processing and the level of mechanization. Sawmilling in Kerala is a labor intensive industry. Labor productivity in sawmilling is also poor. Daily output per man is less than one-third cubic meter, which is about five percent of what might be

Table 3.3 Employment in the Wood-using Industries of Kerala in 1965

Industry	Unit of output	Production	Employment	Employment per unit of output
		--thousands--	--number--	--man-days--
Sawnwood	Cubic meter	490.0	6,540	4.0
Plywood	Thousand square meters (4 mm. thickness)	4.6	2,080	135.0
Fiberboard	Metric ton	4.8	420	26.0
Particleboard	Metric ton	0.3	30	26.0
Pulp and paper				
Pulp	Metric ton	47.2	870	5.5
Newsprint	Metric ton	nil	nil	4.5
Writing and printing papers	Metric ton	12.0	1,120	28.0
Industrial papers	Metric ton	6.0	440	22.0
Matches	Million boxes of 50 sticks each	1.2	6,080	1,500.0
Others (Industrial roundwood)	Cubic meter (round)	199.0	9,290	14.0
Total			26,870	

Sources: Government of India, Central Statistical Organization, Annual Survey of Industries 1965 : Capital, Employment, Output Estimates for Factory Sector by Capital Size (Delhi : 1970).

Government of India, Directorate of Technical Development, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

considered normal in other countries.

Employment per unit of output is very high in the plywood industry compared to the world average. This is due to the fact that a number of operations in the manufacturing process are not mechanized.

Fiberboard and particleboard are moderately labor intensive industries. They are still in their infancy in Kerala (and India) and considerable improvements in the production techniques can be expected.

Pulp and paper is a mechanized industry and compared to the processing involved, the employment potential is low. The match industry on the other hand is a labor intensive one, since most of the operations are done manually.

Under the miscellaneous group of "other industries", processing is mostly carried out in household or small scale units and as such it is highly labor intensive.

Total employment. In 1965, total employment in wood-using industries in Kerala was 26,870 as against 338,650 for India (Figure 3.3).

Value added in the Wood-using Industries of Kerala

Value added by manufacturing indicates the contribution of the industries to the state and national income. Value added per unit of output is therefore an important

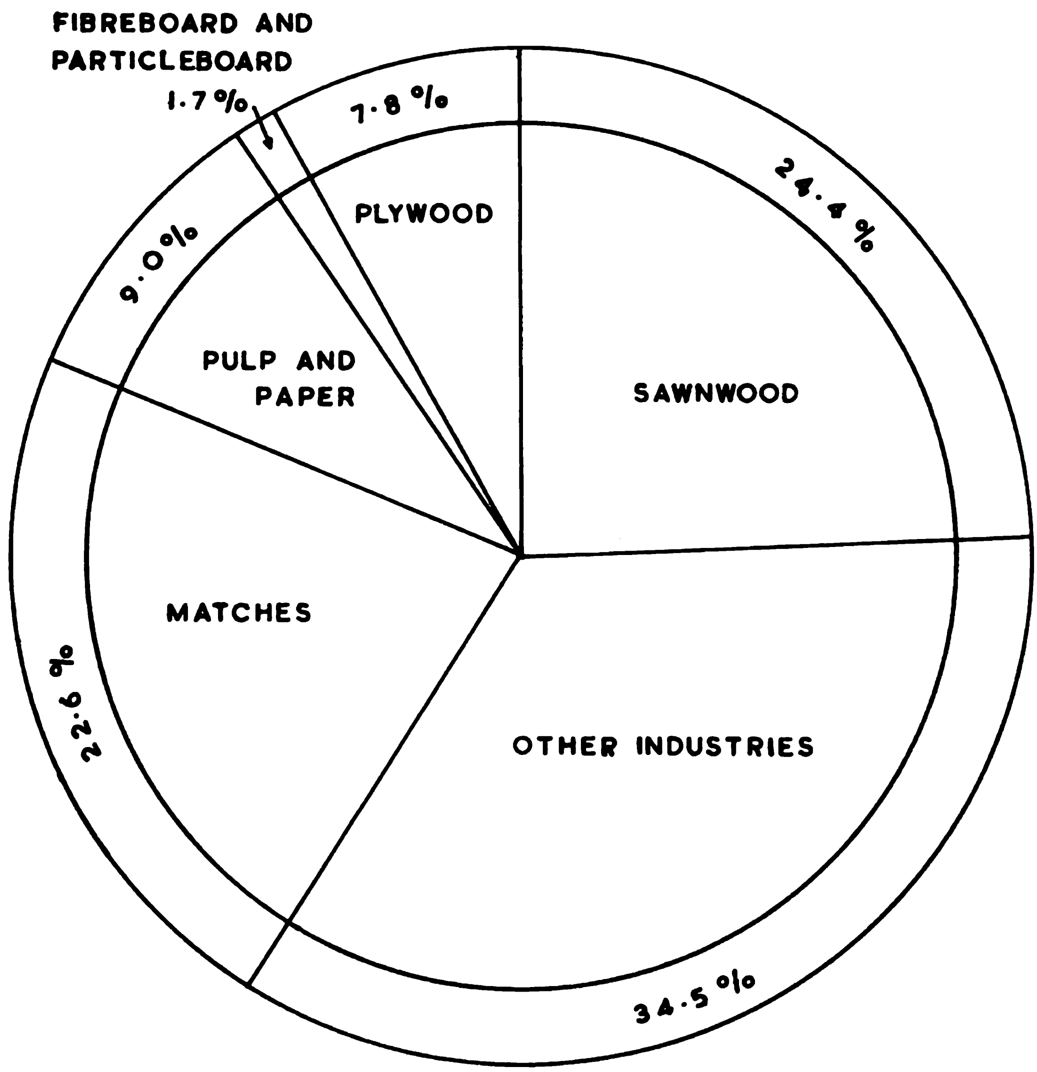


FIGURE 3.3
EMPLOYMENT IN THE WOOD-USING INDUSTRIES OF KERALA, 1965

economic indicator of the industry (Table 3.4).

Industry	Unit of output	Value added per unit of output
		--rupees--
Sawnwood	Cubic meter	58
Plywood	Thousand square meters (4 mm. thickness)	1,192
Fiberboard and particleboard	Metric ton	291
Pulp and paper	Metric ton	459
Matches	Million boxes of 50 sticks each	6,831
Others	Cubic meter (round)	44

In the sawmilling industry the value added by manufacturing is very low. It is comparatively high in pulp and paper, fiberboard and particleboard, and in plywood. Value added per unit of raw material is the highest for the match industry.

Total value added by manufacturing. The total of value added by manufacturing in the wood-using industries of Kerala in 1965 was 82.4 million rupees as against 864 million rupees for India (Figure 3.4).

Economic Importance of the Wood-using Industries for Kerala

Wood-using industries represent one of the State's most important economic activities. The economic importance of Kerala's wood-using industries for India is evident from the fact that Kerala produced ten percent of the total

Table 3.4 Value added by Manufacturing in the Wood-using Industries of Kerala in 1965

Industry	Unit of output	Production	Value added by manufacturing	Value added per unit of output
		--thousands--	--million rupees--	--rupees--
Sawnwood	Cubic meter	490.0	28.4	58
Plywood	Thousand square meters (4 mm. thickness)	4.6	5.5	1,192
Fiberboard	Metric ton	4.8	1.5	291
Particleboard	Metric ton	0.3		
Pulp and paper	Metric ton	65.2	29.9	459
Matches	Million boxes of 50 sticks each	1.2	8.3	6,831
Others (Industrial roundwood)	Cubic meter (round)	199.0	8.8	44
Total			82.4	

Sources: Government of India, Central Statistical Organization, Annual Survey of Industries 1965 : Capital, Employment, Output Estimates for Factory Sector by Capital Size (Delhi : 1970).

Government of India, Directorate of Technical Development, New Delhi.

Government of India, Bureau of Economics and Statistics, Trivandrum.

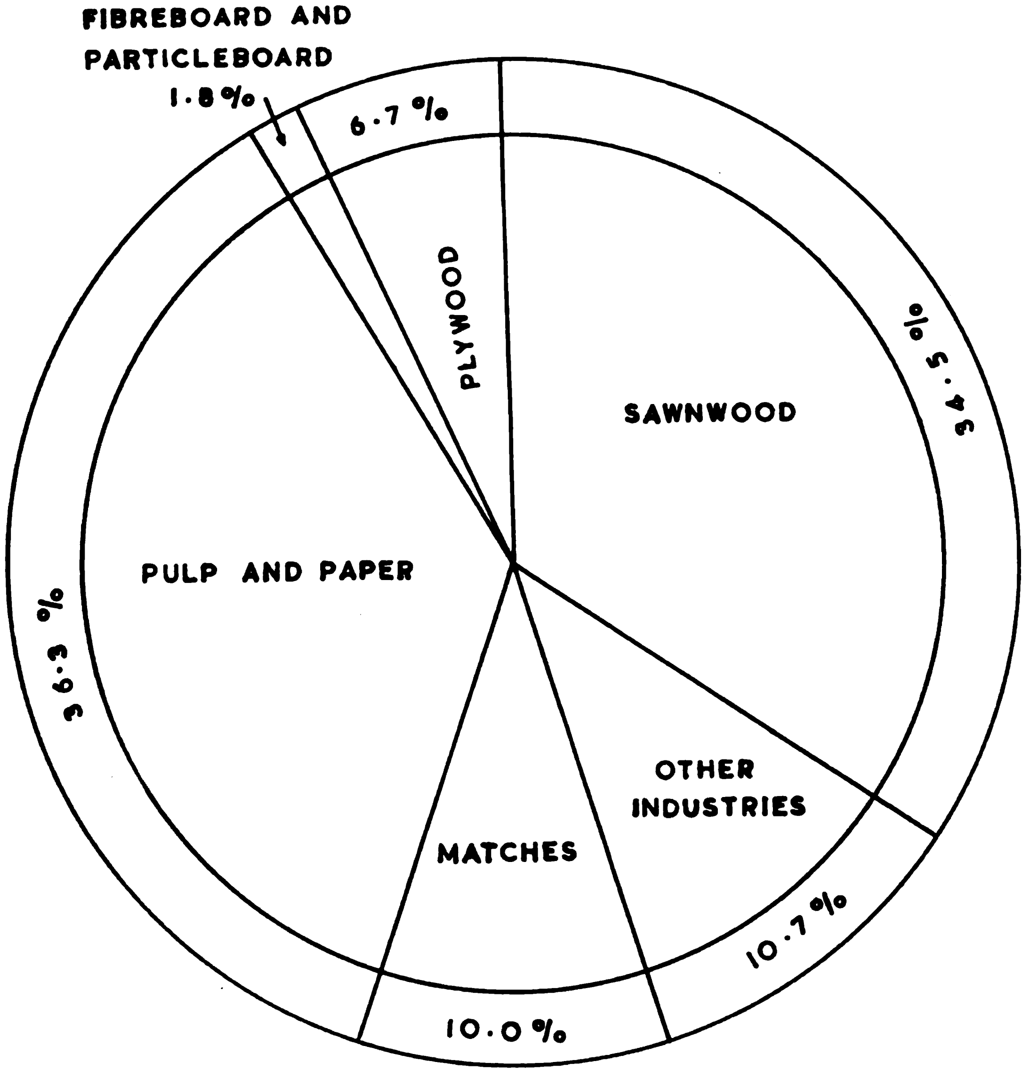


FIGURE 3·4
VALUE ADDED BY MANUFACTURING IN THE WOOD-USING INDUSTRIES OF KERALA, 1965

output of all the wood-using industries in India in 1965, while the land area and population of the State were only 1.27 percent and 3.87 percent of all India, respectively. The following tabulation gives the output of the wood-using industries of Kerala expressed as a percentage of the national output.

Industry	Proportion of national output
	--percent--
Sawnwood	10.3
Plywood	20.3
Fiberboard and particleboard	25.9
Pulp and paper	4.2
Pulp	100.0
Newsprint	0.0
Writing and printing papers	3.5
Industrial papers	2.3
Matches	15.3
Others	5.4

The total productive capital employed in the wood-using industries of Kerala in 1965 amounted to 289 million rupees against 2,992 million rupees in India.[4]

Location quotient. The location quotient is an indicator of the concentration of an industry in a region.

[4]Productive capital consists of fixed and working capital.

The location quotient can be measured in terms of employment, value added by manufacturing or by any other economic characteristics (Tiebout 1962, p. 47). A location quotient of, say, 2.6 for employment in an industry indicates that the industry concerned is 2.6 times more concentrated in the state or region than the average for the nation, when employment in the industry is taken as the measure of concentration.

The location quotient of all the wood-using industries in Kerala in 1965 was 2.3 for employment and 3.3 for value added by manufacturing, as can be seen from the following tabulated statement.

Industry	Location quotient	
	Employment	Value added by manufacturing
Sawnwood	3.0	4.5
Plywood	5.9	5.6
Fiberboard and particleboard	5.7	6.5
Pulp and paper	1.3	3.2
Matches	4.5	2.5
Others	1.6	2.0
Total	2.3	3.3

FOREST RESOURCES OF KERALA STATE

In 1965 the percentage of forest area in Kerala was 25.1 and in 1970 it was 24.1 percent. The general land use pattern in Kerala in 1965 indicated that agriculture occupied more than one half of the area of Kerala State.

The Land Use Pattern

There has been a progressive increase in the area under agriculture and reduction in the area under forests. Classification of land in Kerala by use in 1965 and 1970 is given below.

Land use	Percentage of land area	
	1965	1970
Agriculture	55.1	56.2
Forestry	25.1	24.1
Potentially productive land not in use	9.0	8.9
Not available for agriculture or forestry	10.8	10.8

Source: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

The percentage of forest land in Kerala is less than the optimum of one third of the land area as laid down in the National Forest Policy of India (Government of In

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National Forest Policy

The National Forest Policy of India has been formulated on six major considerations, namely -

(1) the need for evolving a system of balanced and complementary land use, under which each type of land is allotted to that form of use under which it would produce most and deteriorate least,

(2) the need for checking denudation in mountainous regions on which depends the perennial water supply of the river system whose basins constitute the fertile core of the country, the need for checking the erosion progressing apace along the treeless banks of the rivers leading to ravine formation,

(3) the need for ensuring progressively increasing supplies of grazing, small wood for agricultural implements and in particular of firewood to release the cattle dung for manure,

(4) the need for establishing tree lands wherever possible, for the amelioration of physical and climatic conditions, and for promoting the general well being of the people,

(5) the need for a sustained supply of timber and other forest products required for defence, communication and industry,

(6) the need for the realization of the maximum annual revenue in perpetuity, consistant with the fulfilment of the needs enumerated above.

The states are expected to practise forestry within the guidelines contained in this National Forest Policy.

Forests and Forestry in Kerala

History. Very little is known about the early history of the management of forest resources in Kerala

State. Forests were in the possession of the native rulers and species such as teak, rosewood, ebony and sandalwood, which had a recognized value as goods of export, were proclaimed 'royal trees'.

The earliest information available on forest management in Kerala dates back to the last quarter of the eighteenth century. Large quantities of teak were extracted for shipbuilding, for railways and for use by the military. These extractions resulted in heavy depletion of the forest and steps towards a system of forest management were taken in 1828.

In 1842 the first teak plantation was established in Nilambur to replace those forests which had been destroyed. While in Travancore and Cochin the forests were managed by the respective rulers, in Malabar the British Government acquired forest areas in stages from the local rulers to the extent of about 1,800 square kilometers. Plantations of teak were established in suitable areas and forests were put under definite schemes of management.

The first forest working plan was prepared in 1895 for the forests of Nilambur. All the government forests were covered by regular working plans in the subsequent years.

In the years immediately following the independence of India, the 'royalty' of valuable tree species was eliminated.

<u>Influence of population pressure</u>. The allocation of land for forestry, agriculture and other uses has evolved over many centuries according to the requirements of the people as well as such factors as soil characteristics and climate. Pressure on land has largely determined such allocations. Better lands were permanently allocated for agriculture and cash crops such as coffee, tea, cardamom and rubber. In general, forests are confined to remote or hilly areas and sites characterised by comparatively poor soil conditions. With large scale development in recent times, of irrigation and power projects, large areas of forest even in remote regions have been submerged in reservoirs, and still other forest areas had to be made available for rehabilitating the people displaced from submerged lands.

Due to the heavy pressure of population the problem of encroachment or unauthorized occupation of forest land has also assumed greater proportions. It was in 1940 that the Government sanctioned <u>Kuthagapattom</u> (exclusive right for cultivation) in State Forests for the first time. Since then a continuous encroachment, assignment of forest land for cultivation and resettlement of displaced persons has occured.

Thus, in spite of the guidelines contained in the National Forest Policy, the forest management policy of the State necessarily was decided largely by the socio-political situation. And the forest area in Kerala has been reduced from 12,850 square kilometers in 1940 to 9,400 square kilometers in 1970 (Table 3.5). The loss of forest area has occured at an annual rate of 0.75 percent between 1940 and 1950, 1.3 percent between 1950 and 1960, 1.25 percent between 1960 and 1965 and 0.75 percent between 1965 and 1970. The actual extent of forest in 1970 was 24.1 percent of the total land area of the State. Of this total, the area under the direct control of the State Government was only 19.3 percent.[5]

Forest types. The major forest types met with in Kerala are as follows (Chandrasekharan 1962).

a. Tropical wet evergreen forest or tropical rain forest,

b. Tropical semi-evergreen forest,

c. Tropical moist deciduous forest,

d. Tropical dry deciduous forest,

e. Montane sub-tropical forest,

f. Montane temperate forest.

The tropical wet evergreen forest is characterized by a bewildering multiplicity of vegetational forms. Lofty and dense, the evergreen forest consists of several tiers, the highest reaching 50 meters or more in height and the lowest containing dense evergreen shrubby growth (Richards 1952). The tropical semi-evergreen forest is a

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[5]With the passing of the Malabar Private Forests (Vesting and Assignment) Act of 1971 all the forests under private ownership have vested with the Government.

Table 3.5 Changes in the Area under Forest in Kerala

Item	Year				
	1940	1950	1960	1965	1970
	--square kilometers--				
i. Forest area under public ownership	9,030	8,610	7,930	7,680	7,490
ii. Forest area under private ownership*					
a. Private forests of Malabar	3,350	2,830	2,020	1,680	1,500
b. Forests under the control of large estates	240	240	260	290	310
iii. Grasslands suitable for planting, under public ownership	90	90	90	30	30
iv. Grasslands suitable for planting, under private ownership*	140	140	120	90	70
Total of (i) to (iv)	12,850	11,910	10,420	9,770	9,400
Percentage of the total of (i) to (iv) to the total land area of Kerala	33.1	30.6	26.8	25.1	24.1

*With the passing of the Malabar Private Forests (Vesting and Assignment) Act of 1971, all the forests under private ownership have vested with the Government.

Source: Compiled from the publications of Kerala Forest Department.

closed high forest with a heterogeneous mixture of evergreen and deciduous species, the former generally predominating.

The tropical moist deciduous forest is a closed high forest of about 35 meters in height in which the dominant species are deciduous. In areas where the availability of soil moisture is high, a few evergreen species may be met with, but generally they are excluded. The tropical dry deciduous forest is typically 15 to 25 meters in height and is formed by a mixture of trees practically all of which are deciduous during the dry season, usually for several months, though some for a short period only.

The montane sub-tropical forest is more or less of an ecotonic or transitional nature, between tropical and temperate formations. In Kerala, this type has been considerably interfered with and is now mostly under tea and coffee gardens. The montane temperate forest is a combination of temperate closed evergreen forest, locally known as <u>sholas</u>, the height of which rarely exceeds 15 meters, and rolling grasslands. <u>Sholas</u> are usually found in patches in protected pockets or in declivities in the grassland (Champion 1936).

The climate of Kerala is especially favourable for fast growth, with an average rainfall of about 250 centimeters and a dry season of three to four months (December/January to March/April). The mean temperature is around 27 degrees centigrade with little variation between winter and summer. While the climate and soil tend to develop the vegetation to its natural equilibrium, the biotic factors exert their influence in preventing such a progression. The forests and their composition in Kerala have been influenced by external agencies, mainly human activities and interference. According to Champion (1939), the deciduous forest is perhaps the most characteristic in this region and it has displaced evergreen forests in several places. Owing to the sensitiveness of the evergreens to exposure, to fire, and probably to soil changes which have taken place, the return of the evergreens is usually a slow process and the deciduous type appears very stable.

Forest Classification

The forest area can be classified according to its vegetational type, function and exploitability.

Classification by vegetational types. There is an extraordinary diversity of forest resources in Kerala. The distribution of forest by vegetational types in 1970 has been as follows.

Type	Area
	--square kilometers--
Evergreen and semi-evergreen forests	3,350
Moist deciduous forests	4,810
Dry deciduous forests	120
Montane sub-tropical and temperate forests	100
Plantations	1,020
Total	9,400

Classification by function. About 88 percent of the total forest area in Kerala can be classified as production forest and 12 percent as protection forest. Protection forests include those which are not available for timber production at present. The position in 1970 was as follows.

Functional classification	Area
	--square kilometers--
Production forests	8,300
Cardamom leases*	260
Wildlife sanctuaries**	615
Areas unsuitable for timber production	225
Total	9,400

*The area under cardamom leases will not be available for timber production, as cardamom can be grown only under perpetual shade.

**The areas set apart for wildlife management carry timber growth and can also be managed for timber, if deemed essential.

Classification by exploitability. With respect to its exploitability the forests of Kerala can be classified as follows.

	Area in square kilometers
Currently exploitable	7,200
Potentially exploitable	1,715
Other	485
Total	9,400

The currently exploitable forest area in Kerala is 76.6 percent of the total forest area as against 63.8 percent in India.

Wood Production in 1965

The total wood production in 1965 from forest and non-forest[6] sources in Kerala was about 6.5 million cubic meters as against 136 million cubic meters in India. Of this, a quantity of 5.7 million cubic meters was consumed inside Kerala and the rest exported as unprocessed wood. Fuelwood accounted for 71 percent of the total wood use. Contribution of non-forest sources to the total was about 26 percent. The break down of wood production in 1965 is given in Table 3.6.

The uses of wood, like all human activities, are to some extent controlled by deep rooted custom. Certain

[6]Non-forest sources are mainly rubber and cashew plantations, wood lots, groves and small tree lands.

Table 3.6 Wood Production in Kerala by Category and Source, 1965

Category	Source	Production	Consumption	Export
		----------thousands of cubic meters----------		
Industrial timber	Forest	1,703		
	Non-forest	163		
	Total	1,866	1,519	347
Fuelwood	Forest	3,082		
	Non-forest	1,506		
	Total	4,588	4,220	368
Total	Forest	4,785		
	Non-forest	1,669		
	Total	6,454	5,739	715

Sources: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

National Planning Commission, Joint Technical Group for Transport Planning, *Commodity Transport Studies : Timber and Timber Products* (Delhi : 1967).

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species and sizes of logs, and particular logging methods, are used because historically they have served the needs. The fact that in spite of excessive timber fellings the wood-using industries of Kerala do not get sufficient quantities of raw materials of their choice and preference points to the possibility that the established timber harvesting customs are no longer entirely appropriate.

Logging methods. An important aspect of wood production in Kerala is the age old technique of incomplete harvesting of the wood resources. Felling is mostly done by axe and there is considerable waste of wood. The backwardness of the social and economic infrastructure and the heterogeneity of growing stock have delayed the mechanization of logging. It has been estimated that from standing tree to round logs there is a wastage of about 12 percent. If logging methods can be improved wastage of wood at this level can be reduced.

Intensity of Forest Management

Important and valuable forests are covered by working plans. Working plans are essentially management plans based on stock mapping of the forest area, supported by partial enumeration of the more valuable species. About 80 percent of the forest area in Kerala is covered by working plans as against only 46 percent in India.

Of the forest area under public ownership in Kerala, about 25 percent is included in conversion working

circles, 40 percent is under selection working circles and 35 percent is under protection working circles. Conversion working circles include the existing plantations and areas which are likely to be converted into plantations within the next ten to fifteen years. Selection working circles include areas which will be worked under some form of selection system for removal of mature and over-mature trees. Protection working circles include areas which are not to be worked for timber (except removal of dead and dying trees) and are to be retained for maintenance of site, prevention of erosion, maintenance of stream flow, and so forth. This classification by working circles is very rough and is made for convenience in specifying intensity of management. Only the areas included under conversion working circles are managed intensively.

The main forest management activity in Kerala is the clearance of areas required for raising plantations and raising plantations of economic species. The plantation schemes suggested in working plans are also included as part of the development schemes under the five year plans.

The five year plans of the forestry sector also aim at increasing the overall productivity of the forests, improving techniques of forest management, and increasing output through better techniques of timber extraction.

Plantations. Even though the first plantation

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in Kerala was established in 1842, planting was carried out only on a very small scale until the advent of the five year plans and an increased tempo in planting has been evident only since 1960 - 61.

Under the five year plans the most important steps taken to build up the forest resources through intensive forest management are:

(a) replacement of the low yielding forests and less valuable species by high yielding and more valuable species (reforestation), and

(b) planting the barren and degraded lands with useful species (afforestation).

Large scale plantations have been established in Kerala both under reforestation and afforestation schemes. By the end of 1965, the total area under forest plantations in Kerala was 73,560 hectares as against 934,000 hectares in India. By 1970, the area under plantations in Kerala has been increased to 101,770 hectares. A break down of plantations by species, as of 1970, is as follows.

	Area in hectares
Pines	240
Teak	53,486
Eucalyptus species	23,173
Softwoods	16,924
Other	7,947
Total	101,770

The success of plantations depends on a number of factors, the most important of which are the species and the care given to maintenance. In the selection of species for planting, especially exotics, one has to study the genetic variability, plasticity and hybrid vigor, growth pattern, tolerance to climatic variations, resistance to diseases and pests, ease of propogation, timber quality and other attributes. In the haste to get spectacular results, many of these aspects were not properly studied and the results in many cases have not been encouraging. Indegeneous species with proven attributes have also failed in certain cases due to neglect. Such failures, at least partially, can be classified as institutional failures. In Kerala, 22.7 percent of the total area of plantations can be classed as poor, based on the density of stocking (Table 3.7).

Growing stock. Growing stock is the volume of all the trees growing in the forest or a specified part of it. There are 1,018 square kilometers of forest plantations and 8,382 square kilometers of natural forests in Kerala. The natural forests in Kerala are extremely heterogeneous with a large number of species occuring in intimate mixture. Only about 40 species are of commercial importance at present as sawlogs and veneer logs (FAO 1970). With the available information on the quality of site, management intensity and so forth the growing stock

Table 3.7 Classification of Forest Plantations in Kerala by Density of Stocking

Classification by percentage density of stocking	Species							
	Teak	Soft hardwoods	Eucalyptus	Cashew	Other hardwoods	Bamboo	Pines	Total
	hectares							
Good (80 to 100)	36,394	10,630	13,490	815	230	nil	240	61,799
Satisfactory (60 to 80)	7,744	3,112	3,813	206	1,410	510	nil	16,795
Poor (30 to 60)	3,938	1,262	3,020	194	506	nil	nil	8,920
Very poor (less than 30)	5,410	1,920	3,210	2,010	1,523	187	nil	14,260
Total	54,386	16,924	23,533	3,225	3,669	697	240	101,774

Source: Kerala Forest Department.

in the forests of Kerala has been estimated to be 171 million cubic meters, which works out to 182 cubic meters per hectare on an average, as against an estimated growing stock of 2,600 million cubic meters in India.[7]

Timber producing trees continue to be more valuable and presently there is very little demand for the miscellaneous tropical hardwoods as industrial wood. Therefore, a considerable quantity of the growing stock from tropical forests is converted into fuelwood. The break down of the growing stock by categories at the current level of technology is given in Table 3.8.

Even though the total growing stock is over 171 million cubic meters, only about 81 million cubic meters are available as sawtimber, the rest being fuelwood, small wood and bamboos. A considerable quantity is also left in the forest during extraction.

Dawkins (1958) has observed that the tropical high forest appears to be incapable of producing a yield of sawtimber greater than 20 cubic foot per acre per annum under a polycyclic system of management, and that 60 cubic foot per acre per annum seems to be the upper limit under a monocyclic system. When the tropical hardwoods become usable as pulpwood and the secondary species are utilized for timber, panels etc., it will be possible to utilize

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[7]The growing stock includes bamboos and reeds.

Table 3.8 Growing Stock in the Forests of Kerala

Type of forest	Break down of growing stock*							Total growing stock
	Teak	Superior hard-woods	Soft hard-woods	Miscella-neous timber species	Eucaly-ptus	Bamboo and reeds	Fuel-wood	
	---thousands of cubic meters---							
Plantations	2,380	200	325	50	980	15	550	4,500
Evergreen and semi-evergreen forests	nil	6,600	6,300	28,100	nil	3,600	43,200	87,800
Moist deciduous forests	2,460	23,600	nil	15,400	nil	4,300	31,840	77,600
Dry deciduous forests	30	210	nil	260	nil	nil	440	940
Sub-tropical and montane temperate forests	nil	nil	nil	250	nil	nil	250	500
Total	4,870	30,610	6,625	44,060	980	7,915	76,280	171,340

*This classification of growing stock is arbitrary and will change with technological development.

Source: Kerala Forest Department.

the forest growing stock more fully. It is to be borne in mind that the concept of what is economically available will change with time through technological change and long-term price changes.

Allowable cut. The removal of wood from forests of Kerala has amounted to 2.75 percent of the total growing stock. In the absence of adequate data on gross annual increment and annual losses due to pests and disease, it is not possible to work out a conventional allowable cut. Strictly, allowable cut is a dynamic concept and is a function of accessibility, management strategy and so on; and therefore, the percentage removal need not, as such, cause any concern.

Economic Importance of Forestry for Kerala

In fiscal 1965, the revenue from forests in Kerala formed seven percent of the total revenue of the State Government as against 2.4 percent in India. The State's revenue from forests (52 million rupees) expressed as a percentage of revenue from forests in India (818 million rupees) was 6.3. The revenue from forests (which is mainly the stumpage) does not indicate the real contribution of forests to the economic welfare. While the revenue from the forests in Kerala in the fiscal year 1965 was only 52 million rupees, the contribution of forests and forest-based industries to the gross state product of Kerala was 171.8 million rupees. This multiplier effect means that for every rupee obtained as direct revenue from forest the domestic product attributable to forestry was 3.3 rupees.

Contribution of forestry to the gross state product. The contribution of forestry (including logging) to the gross state product of Kerala, in fiscal 1965, was 89.4 million rupees in real terms, accounting for 1.7 percent of the total. Corresponding figures for India were 1,990 million rupees and 1.2 percent.

Employment in forestry. Employment in forestry and logging has increased considerably in the recent past. In 1965, the number of persons employed in forestry and logging in Kerala was 20,200 as against 441,200 in India. Employment in forestry and logging accounted for 0.76 percent of the primary sector employment in Kerala and 0.32 percent in India.

ACCOUNT OF CASH FLOW IN THE KERALA FOREST ECONOMY

In 1965 forestry and wood-using industries in Kerala together employed 47,070 persons and contributed 171.8 million rupees to the gross state product (Table 3.9 and 3.10). Value of exports of wood and wood products from Kerala in 1965 was 219.7 million rupees.

Table 3.9 Forestry and Forest Industry Accounts of Kerala, 1965

Selling sector	Unit	Purchasing sector: Forestry and wood-using industries: Forestry and logging	Sawnwood	Plywood	Fiberboard and particleboard	Pulp and paper	Matches	Other wood-using industries	Final demand: Manufacturing	Consumption	Export	Total
Forest growing stock	Thousands of cubic meters (r)	7,335	-	-	-	-	-	-	-	-	-	7,335
Industrial wood	Thousands of cubic meters (r)	-	813	46	17	400	44	199	-	-	347	1,866
Fuelwood	Thousands of cubic meters (r)	-	8.8	5.2	-	8	-	12	1,016	3,170	368	4,588
Sawnwood	Thousands of cubic meters (s)	-	-	-	-	-	-	20	12	323	135	490
Plywood	Thousands of square meters	-	-	-	-	-	-	210	-	2,590	1,816	4,616
Fiberboard and particleboard	Metric tons	-	-	-	-	-	-	880	-	1,340	2,930	5,150
Pulp and paper	Thousands of metric tons	-	-	-	-	-	.5	-	-	14.5	50.2	65.2
Matches	Millions of boxes	-	-	-	-	-	-	-	-	406	809	1,215
Other wood-using industries	Thousands of cubic meters (r)	-	-	-	-	-	-	-	-	191	8	199
Employment	Number of persons	20,200	6,540	2,080	450	2,430	6,080	9,290	-	-	-	47,070
Value of other inputs	Millions of rupees	28.1	18.7	4.6	3.2	62.2	2.8	21.6	-	-	-	141.2
Value added by manufacturing	Millions of rupees	89.4	28.4	5.5	1.5	29.9	8.3	8.8	-	-	-	171.8

r = round.
s = sawn.

Table 3.10 Transactions of Forestry and Wood-using Industries of Kerala, 1965

Selling sector	Purchasing sector										
	Forestry and wood-using industries							Final demand			Total
	Forestry and logging	Sawnwood	Plywood	Fiberboard and particle-board	Pulp and paper	Matches	Other wood-using industries	Manufac-turing	Consum-ption	Export	
	millions of 1961 rupees										
Forest growing stock	103.5	-	-	-	-	-	-	-	-	-	103.5
Industrial wood	-	117.6	6.4	1.7	36.2	5.7	24.8	-	-	44.3	236.7
Fuelwood	-	0.2	0.1	-	0.2	-	2.4	20.0	62.4	7.0	92.3
Sawnwood	-	-	-	-	-	-	6.5	4.0	108.9	45.5	164.9
Plywood	-	-	-	-	-	-	0.8	-	9.3	6.5	16.6
Fiberboard and particleboard	-	-	-	-	-	-	1.1	-	1.7	3.6	6.4
Pulp and paper	-	-	-	-	-	1.0	-	-	28.6	98.9	128.5
Matches	-	-	-	-	-	-	-	-	6.5	11.3	17.8
Other wood-using industries	-	-	-	-	-	-	-	-	63.4	2.6	66.0
Value of other inputs	28.1	18.7	4.6	3.2	62.2	2.8	21.6	-	-	-	141.2
Value added by manufacturing	89.4	28.4	5.5	1.5	29.9	8.3	8.8	-	-	-	171.8
Total	221.0	164.9	16.6	6.4	128.5	17.8	66.0	24.0	280.8	219.7	1,145.7

SUMMARY

The economy of Kerala is highly timber dependant. There is a concentration of wood-using industries in Kerala, facilitated by the availability of forest resources in the State. In 1965 total consumption of wood in the State was 5.7 million cubic meters as against a production of 6.5 million cubic meters, the difference being accounted for by export of unprocessed wood. Kerala accounted for about five percent of the total wood production in India. Per capita outturn of wood in Kerala in 1965 was 0.35 cubic meters as against 0.28 cubic meters in India. Forestry and wood-using industries together accounted for 5.2 percent of the total industrial employment in the State and 17.7 percent of the gross state product from the industrial sector.

The extent of forests in Kerala state has steadily dwindled from 12,850 square kilometers in 1940 to 9,400 square kilometers in 1970, and the availability of forest land per capita in 1965 was 0.05 hectares.

Chapter 4

THE CONSUMPTION OUTLOOK FOR WOOD IN KERALA STATE

The demand for wood depends on the level of activity in the consuming sectors. In estimating the wood requirement, analysis has been carried out at the product level (sawnwood, plywood, fiberboard and particleboard, pulp and paper, matches etc.), where the impact of demand factors is more direct and more clearly defined.

THE TOTAL WOOD REQUIREMENT

The total wood requirement to meet the projected consumption of wood and wood products in Kerala by the year 2000 is estimated to be between 1.78 and 2.58 times the 1965 level of consumption. Correspondingly, the industrial wood requirement by the year 2000 is expected to be between 1.84 and 3.16 times the 1965 level of consumption (Figure 4.1).

The estimates of wood requirements are summarized in the following tabulation.

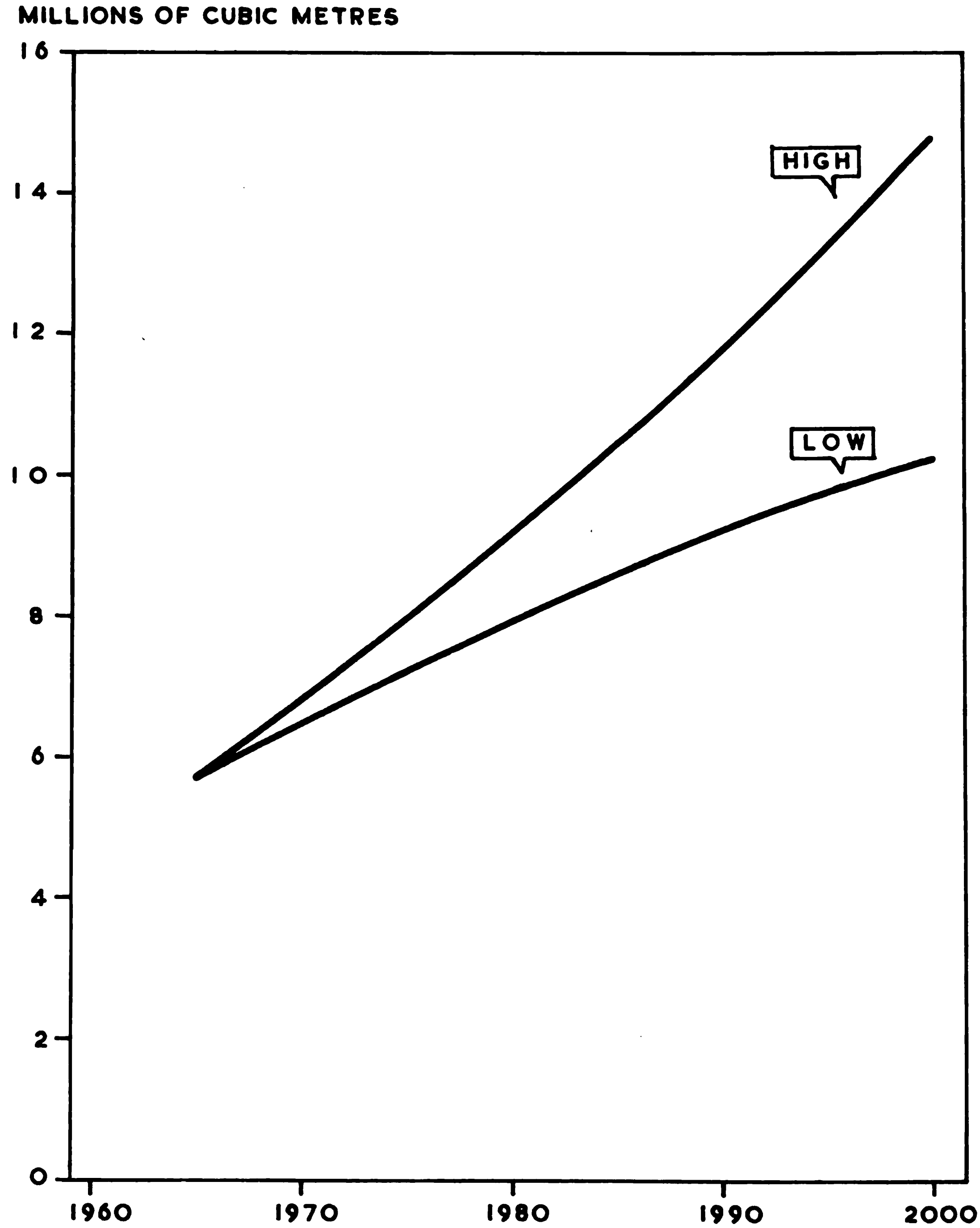

FIGURE 4 · 1
ESTIMATES OF TOTAL WOOD REQUIREMENT IN KERALA

Year	Alternative estimates of wood requirements*	
	Low	High
	--millions of cubic meters--	
1980	7.922	9.205
1990	9.241	11.768
2000	10.171	14.802

*The estimates are inclusive of the requirements for bamboo and reeds.

Two indications are obvious from the projections of wood requirement.

(i) The bulk of the consumption will continue to be as fuelwood and therefore, changes in consumption of industrial wood will not strongly influence the total requirement for wood (Table 4.1).

(ii) It should be possible to meet higher consumption of industrial wood by reducing the fuelwood consumption through the substitution of other energy sources for wood.

ESTIMATION OF THE TOTAL WOOD REQUIREMENT

Wood requirements have been projected, corresponding to two alternative estimates of consumption outlook, separately for the various wood products or product groups and summed up to obtain the two alternative estimates of total wood requirements shown above. In estimating the wood requirement for a product, the future consumption of the product in Kerala, the consumption outlook for the product including export consumption and the future technology of the industry manufacturing the product have been

Table 4.1 Estimates of Wood Requirements in Kerala

Use category	Alternative estimates of wood requirements					
	Low			High		
	1980	1990	2000	1980	1990	2000
	millions of cubic meters					
Industrial wood	2.172	2.491	2.771	3.005	3.968	4.802
Fuelwood	5.750	6.750	7.400	6.200	7.800	10.000
Total	7.922	9.241	10.171	9.205	11.768	14.802

taken into consideration. Thus the first step in the estimation of wood requirements is the projection of future consumption for the product.

Projections of Future Consumption

Projections of consumption are, in general, based on clear and definable relationship between consumption and one or more factors influencing consumption (e.g., income, price, population, time period), and use an appropriate mathematical function to correlate consumption to the level of these factors.

A wide variety of projection techniques can be used to make these forward estimates, ranging from the simple extention of consumption time trends, where only the effect of time is taken into consideration, to elaborate models which involve functions relating consumption to a number of determining variables. Because of the paucity and general weakness of data, only simple projection models are adopted in this study.

The price factor normally causes substantial change in end-use patterns through competition from substitutes and the use of the product as substitute for others. Unfortunately, the lack of adequate and comparable price data on wood products precludes any quantitative analysis of the price effect on consumption. Arnold (1968) expresses the view that the prices of wood have not changed over time at anything like the rate at which

incomes have changed. The fact that income elasticity is usually much higher than is price elasticity means that income is a far more important variable in the analysis and projection of forest products consumption than is price. Westoby (1968) has also observed that there is a marked tendency for the amount of wood consumption to be responsive to increases in the standard of living, and that with economic development come sharp and permanent changes in the consumption of various wood products.

This study, therefore, uses the available data on income, population and wood products consumption for making projections of future consumption for wood products. Income and population data for Kerala are available for the last several years but data on wood products consumption are available only from 1950, in most cases at an interval of five years. The latest available consumption data is for the year 1967/1968.

Several estimates of future consumption of wood products have been worked out utilising these data and adopting appropriate models and parameter assumptions. Projections have been made separately for sawnwood, plywood, fiberboard, particleboard, writing and printing papers, newsprint, industrial papers, rayon pulp, matches, industrial roundwood and fuelwood (Appendix C).

Projection Models for
Estimating Consumption

(i) Official targets. Some consumption targets have been fixed by the National Planning Commission and government agencies, arbitrarily employing certain assumptions, for products and end-uses. These targets are based on certain minimum social goals with respect to standards of living. The targets are either given specifically or guidelines (sometimes clear and sometimes vague) are indicated. The targeted consumption figures available directly or indirectly are accepted as one of the estimates of future consumption.

(ii) Extention of consumption time trend. In time trend studies the influence of all the factors on consumption is aggregated and is expressed as a compound annual rate factor, and consumption is considered as a function of time. Consumption estimates based on extention of time trends assume some degree of continuation of trends similar to those that have prevailed in the past.

The time-consumption data for wood products with respect to Kerala have followed a straight line when plotted on a ratio chart (semi-log paper). A linear trend of the data suggests that the rate of change in consumption in the period considered has been constant. The mathematical relationship of the variables in such cases is:

$$\ln Y = a + bt$$

where Y is the annual total consumption of the product in year t_n,

t is the time period in number of years between t_n and t_0, and

a, b are constants.

The above equation, when solved for Y gives:

$$Y = e^{a + bt}$$

This relationship can be used as a model to predict consumption in the future. Values for the constants a and b can be estimated by fitting a straight line for:

$$\ln Y = a + b(t_n - t_0)$$

where t_n stands for any year in the time period for which consumption data is available and

t_0 is the year from which the time period begins or the year from which the data for trend analysis is available.

(iii) The income-consumption relationship. Per capita income is taken as the main factor in making consumption projections. One can arrive at per capita consumption by dividing total consumption by the population. Thus, population as a factor in influencing consumption is accounted for to some degree. The relationship between per capita income and per capita consumption can be used to project the consumption at the future per capita income levels. The apparent relationship between income and consumption has implicit within it the substitution effect caused by the availability of new and relatively new

products. The income-consumption relationship also reflects the strong correlation between income on the one hand and level of literacy, cultural changes and such other non-income factors on the other.

Many studies carried out on the consumption of wood products have indicated that there is a clear relationship between per capita consumption and per capita income. It has also been shown that at high income levels consumption is likely to grow at a slower rate in relation to economic growth (Arnold 1968, Westoby 1968).

The rate of change in per capita consumption relative to the rate of change in per capita income is termed as income elasticity of consumption. Therefore, the slope of the line obtained by plotting the data on per capita consumption against per capita income in a double log paper measures income elasticity of consumption. A plotted straight line graph indicates that during the period under consideration the income elasticity of consumption was constant.

But, as indicated earlier, experience has shown that in normal situations the elasticity coefficient decreases with rising incomes. It is therefore assumed that with rising incomes elasticity coefficient will decrease sharply, and of the several inverse relationships the following one was found to be very suitable.

$$z = 1/bI^3$$

where z is the income elasticity of consumption,
I is the per capita income and
b is a constant.

The above mathematical model can be solved to get the relationship of Y (the per capita consumption) on I (the per capita income).

By definition of income elasticity of consumption:

$$z = -I/Y \; . \; dY/dI$$

By assumption:

$$z = 1/bI^3$$

Therefore,

$$1/bI^3 = -I/Y \; . \; dY/dI$$

Simplifying:

$$dY/dI = 1/bI^3 \; . \; (-Y/I)$$
$$= -Y/bI^4$$
$$1/Y \; . \; dY/dI = -Y/YbI^4$$
$$= -1/bI^4$$
$$dY/Y = -dI/bI^4$$

Integrating both sides:

$$\ln Y = 1/3bI^3 + C$$
$$= 1/3b \; . \; I^{-3} + C$$
$$= BI^{-3} + C$$

where B is a constant equal to 1/3b and
C is an arbitrary constant

Taking antilogarithms:

$$Y = e^{BI^{-3}} + C$$

The relationship $Y = e^{BI^{-3}} + C$ represents the model to predict the per capita consumption (Y) for assumed values of per capita income (I), B and C being constants. Values of B and C can be estimated using empirical data by fitting a straight line for $\ln Y$ of the form $\ln Y = BI^{-3} + C$, by the method of least squares.

Projections using this model are based on explicit assumptions concerning economic and demographic trends. Once the per capita consumption is estimated for a future year, based on the assumptions regarding per capita income, it will then be possible to work out the total consumption for any assumed population.

The relationship as depicted in this model would result in a fairly sharp decrease in elasticity with increase in income. A numerical example, using per capita income and the corresponding per capita consumption of plywood, has been worked out here to illustrate the point.

Per capita income (I) --rupees--	Per capita consumption of plywood (Y) --square meters--
248.95	0.061
263.63	0.078
276.30	0.114
284.40	0.152
297.10	0.168

To estimate the values of the constants B and C, consider that $\ln Y = Y$ and $I^{-3} = X$ and fit a straight line for $Y = BX + C$. X and Y corresponding to the per capita income and the per capita consumption are as follows:

$X = I^{-3}$	$Y = \ln Y$
648×10^{-10}	-2.79688
546×10^{-10}	-2.55105
474×10^{-10}	-2.17156
435×10^{-10}	-1.88387
381×10^{-10}	-1.78379
$\Sigma X_i = 2484 \times 10^{-10}$	$\Sigma Y_i = -11.18715$
$\bar{X} = 496.8 \times 10^{-10}$	$\bar{Y} = -2.23743$

$$\Sigma X_i^2 = 1{,}277{,}082 \times 10^{-20}$$

$$(\Sigma X_i)^2/n = 1{,}234{,}051 \times 10^{-20}$$

$$(\Sigma X_i \cdot \Sigma Y_i)/n = -555{,}777 \times 10^{-12}$$

$$\Sigma(X_i \cdot Y_i) = -573{,}367 \times 10^{-12}$$

$$SP_{XY} = -17{,}590 \times 10^{-12}$$

$$SS_X = 43{,}031 \times 10^{-20}$$

Values of the constants B and C are:

$$B = -.408775 \times 10^8$$

$$C = -.20664$$

The model for predicting per capita consumption of plywood is:

$$Y = e^{(-.408775 \times 10^8) I^{-3} - .20664}$$

Based on this model, if the per capita income is assumed for the years 1980, 1990 and 2000 as 404 rupees, 545 rupees and 770 rupees respectively, the per capita

consumption of plywood will be 0.437 square meters, 0.631 square meters and 0.743 square meters. The consumption of plywood in the years 1980, 1990 and 2000 for the assumed population of 26 millions, 30 millions and 33 millions will, therefore, be 11.36 million square meters, 18.93 million square meters and 24.52 million square meters respectively.

Assumptions

The projections of future consumption have been made for particular years, namely 1980, 1990 and 2000, based on explicit assumptions about economic parameters for the models adopted. The assumptions are these:

(i) Assumption on demographic trends. The population as projected in Chapter 2 is given in the following tabulation and will be used for estimating the future consumption of wood and wood products in Kerala.

Year	Population --millions--
1980	26
1990	30
2000	33

(ii) Assumptions about income growth. Based on the goals in respect to economic growth specified by the National Planning Commission, the target per capita income has been worked out in Chapter 2. The targets are viewed as ambitious and several experts and agencies (e.g., LeCacheux 1966, FAO 1970) have adopted a much lower level of per capita income. The listing below gives two alternative levels of per capita income for Kerala to cover the likely upper and lower limits.

Year	Per capita income	
	Alternative projection (I_1)	Income target (I_2)
	------------1961 rupees------------	
1980	404	492
1990	545	880
2000	770	1,735

<u>(iii) General assumptions</u>. The static nature of the models makes it necessary to adopt general assumptions to fix the factors on which no data are available and to qualify the estimates made for the target years. The assumptions are:

(a) There will be no significant change in the relationship between the prices of wood products and the prices of their nearest substitutes.

(b) Technological progress in the wood-using industries will keep level with industries producing competitive products.

Base Year

The year 1965 has been chosen as the base year because it is the latest year upto which all the informations are available. It also marks the completion of three five year plans in India.

Consumption Estimates Reduced to Two Levels

The different models and the related assumptions give four different estimates for each of the wood products. The models used for estimating consumption are:

1. Official targets.

2. $Y = e^{a + bt}$

   where Y is the annual consumption of the product,

   t is the time period in years between the target year and 1950, and

   a, b are constants.

3. $Y = e^{BI_1^{-3}} + C$

4. $Y = e^{BI_2^{-3}} + C$

   where Y is the per capita consumption of the product,

   I_1 and I_2 are alternative per capita income assumptions and

   B, C are constants.

The different estimates clearly indicate that it is not possible to give one precise figure for future consumption, but rather that it is possible to give only rough orders of magnitude of the consumption under the different possible situations that may be encountered. In order to reduce the number of alternatives, two levels are used to show the range of estimated values.

Export Consumption

The attainment of higher levels of consumption of wood products in the other Indian states deficient in forest resources must, of course, depend on production for export in the states which are better placed in respect of forest resources. Mere self-sufficiency is, therefore, too modest a production goal for a highly timber dependant state like Kerala. The future export of wood products also must be considered. Therefore, export consumption has also been included in the estimates of consumption outlook.

The Consumption Outlook for Wood Products

The consumption outlook (including export consumption) for wood products has been estimated, considering the production-consumption relationships in the past and the indications available about the establishment of new industrial units.

Characteristics of the Future Wood Processing Plants.

Once the consumption outlook for a product has been estimated, the next step is to estimate the raw material, capital investment and labor required. This has to be done based on the characteristics of the mix of plants likely to exist in the future.

The wood processing plants which are likely to be established in the future can be expected to be more efficient as a result of general technological improvements and economic development of the country. The characteristics of the new plants in respect to raw material use per unit of output, capital investment required for additional wood processing capacity per unit of output, and employment per unit of output have been developed based on the expected technological changes in the respective industries in the State. These are dealt with separately under the different wood products or product groups (Appendix C).

CONSUMPTION OUTLOOK FOR WOOD

Detailed projections by product are to be found in Appendix C. These projection results are summarized in Table 4.2.

The total wood requirement to meet the projected consumption of wood products is given in Table 4.3 and Figure 4.2. The table also indicates the estimated change in the consumption of wood, considering the 1965 consumption as the base.

The total wood requirement in Kerala will range from 7.9 to 9.2 million cubic meters in 1980, from 9.2 to 11.8 million cubic meters in 1990, and from 10.2 to 14.8 million cubic meters in 2000. Compared to the 1965 consumption level, the wood consumption would almost double by 2000 even under the low assumption.

Table 4.2 Consumption Outlook for Wood Products in Kerala

Product	Unit of output	Alternative estimates of consumption outlook					
		Low			High		
		1980	1990	2000	1980	1990	2000
Sawnwood	Thousands of cubic meters (sawn)	672	820	938	798	1,043	1,302
Plywood	Thousands of square meters (4 mm basis)	8,700	15,750	26,250	16,950	34,050	66,750
Fiberboard	Thousands of metric tons	7	10	12.2	20	60	80
Particle-board	Thousands of metric tons	1.2	2	2.6	8.8	28	40
Pulp and paper*	Thousands of metric tons	170	220	265	285	420	510
Matches	Millions of boxes	1,635	2,010	2,445	2,025	2,730	3,510
Other wood products	Thousands of cubic meters (round)	230	246	260	250	310	380
Fuelwood	Millions of cubic meters	5.75	6.75	7.4	6.2	7.8	10

*Production outlook based on the possibility of expansion of the existing units and establishment of new ones.

Table 4.3 Consumption Outlook for Wood in Kerala

Wood product	Alternative estimates of consumption outlook					
	Low			High		
	1980	1990	2000	1980	1990	2000
	------millions of cubic meters (round)*-----					
Sawnwood	1.035 (127)	1.173 (144)	1.248 (155)	1.229 (151)	1.491 (183)	1.732 (213)
Plywood	0.070 (152)	0.115 (250)	0.175 (380)	0.136 (296)	0.248 (539)	0.445 (967)
Fiberboard and particleboard	0.024 (141)	0.033 (194)	0.037 (218)	0.085 (500)	0.235 (1382)	0.296 (1741)
Pulp and paper	0.757 (189)	0.860 (215)	0.975 (244)	1.236 (309)	1.597 (395)	1.840 (460)
Matches	0.056 (128)	0.064 (146)	0.076 (173)	0.069 (157)	0.089 (198)	0.109 (248)
Industrial roundwood	0.230 (116)	0.246 (124)	0.260 (131)	0.250 (126)	0.310 (156)	0.380 (191)
Total industrial wood	2.172 (143)	2.491 (164)	2.771 (182)	3.005 (198)	3.968 (261)	4.802 (316)
Fuelwood	5.750 (136)	6.750 (160)	7.400 (175)	6.200 (147)	7.800 (185)	10.000 (237)
Total wood	7.922 (138)	9.241 (161)	10.171 (178)	9.205 (160)	11.768 (205)	14.802 (258)

*The figures in bracket give the index of change in the consumption of wood. Index: 1965 = 100.

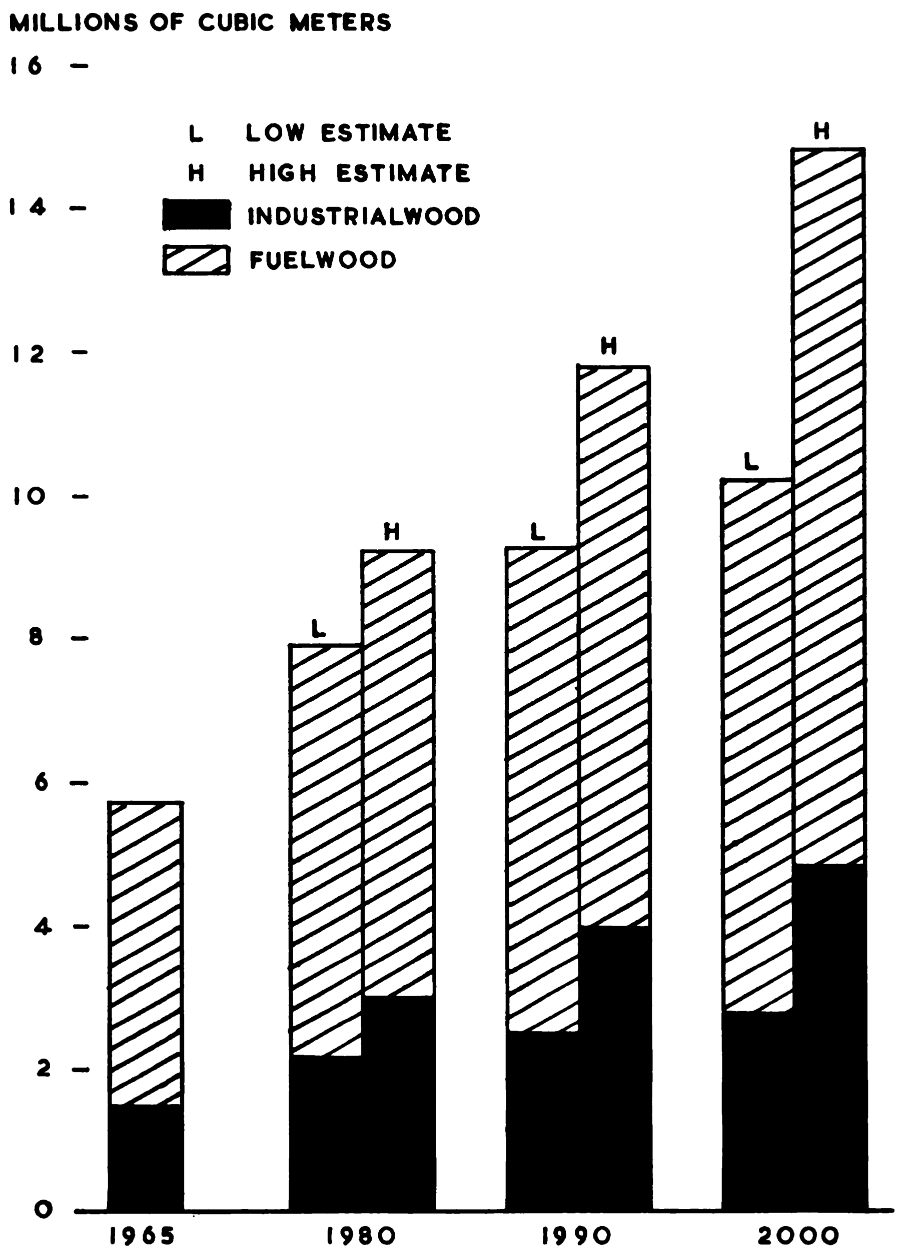

FIGURE 4.2
COMPARISON OF THE ESTIMATES OF CONSUMPTION OUTLOOK FOR WOOD IN KERALA

ECONOMIC IMPLICATIONS OF THE CONSUMPTION OUTLOOK FOR WOOD

Consumption outlook for wood and wood products has its implications for employment of labor, capital investment and value added by manufacturing.

Employment of Labor

While the requirement for labor per unit of wood processed will decline, the total labor requirement in the wood-using industries will increase considerably as can be seen from the following tabulation.

Year	Alternative estimates of consumption outlook	
	Low	High
	--number of employees*--	
1980	29,310 (109)	41,030 (153)
1990	31,350 (117)	50,820 (189)
2000	34,760 (129)	64,100 (239)

*The figures in bracket give the index of change in employment. Index: 1965 = 100.

While sawmilling, among the wood-using industries, provided the largest percentage of employment in 1965, the plywood and match industries will emerge as the major employers in the coming years.

Investment

The following tabulated statement gives the estimated requirement of capital investment to achieve the alternative estimates of consumption outlook.

Period	Alternative estimates of consumption outlook	
	Low	High
	--millions of 1961 rupees--	
1965 - 1980	358.58	805.51
1981 - 1990	213.92	643.32
1991 - 2000	221.66	565.42
Total	794.16	2,014.25

Of the total estimated investment, about 76 percent is required for the development of pulp and paper industry.

Value Added by Manufacturing

Assuming an Incremental Capital-Output Ratio (ICOR) of 6.5 for pulp and paper and 3.0 for other wood-using industries, the value added by manufacturing of the wood-using industries in Kerala will register a considerable increase, as the result of additional investment.[1] The estimates of value added by manufacturing in the wood-using industries by 2000 is given in the following tabulation.

[1] Incremental Capital-Output Ratio is the ratio between the amount of capital invested and the resulting change in the gross value added.

Alternative estimates of consumption outlook	Value added by manufacturing in 2000	Index of change 1965 = 100
	--millions of 1961 rupees--	
Low	228.56	277
High	479.33	582

SUMMARY

The total wood requirement in Kerala will range from 7.9 to 9.2 million cubic meters in 1980, from 9.2 to 11.8 million cubic meters in 1990, and from 10.2 to 14.8 million cubic meters in 2000.

Kerala burns a large quantity of wood annually as fuel. In 1965, fuelwood constituted about 74 percent of the total wood consumption in the State. Fuelwood consumption will continue to dominate all other wood uses in Kerala during the period under consideration. Fuelwood consumption in Kerala will range from 5.7 to 6.2 million cubic meters in 1980, from 6.7 to 7.8 million cubic meters in 1990, and from 7.4 to 10.0 million cubic meters in 2000.

The industrial wood requirement in Kerala will range from 2.2 to 3.0 million cubic meters in 1980, from 2.5 to 4.0 million cubic meters in 1990, and from 2.8 to 4.8 million cubic meters in 2000.

The projected employment of labor in the wood industry sector will range from 29 thousand to 41 thousand in 1980, from 31 thousand to 51 thousand in 1990, and from 35 thousand to 64 thousand in 2000.

The capital requirement during the period 1965 - 2000, corresponding to the alternative estimates of consumption outlook for wood products, will range between 794 and 2,014 million rupees. The projected capital investments in the wood industry sector will result in value added by manufacturing ranging between 229 million rupees and 479 million rupees by 2000.

Chapter 5

THE SUPPLY OUTLOOK FOR WOOD IN KERALA STATE

Estimates of the future requirements for wood were made in the previous chapter. An assessment is now to be made of the future availability of wood resources so that it will be possible to determine whether a balance between requirement and supply is feasible.

The physical quantity of wood available in the future depends to a considerable extent on the available area of forest land and its potential productivity. But the economic supply of wood is probably determined as much by social and economic factors as by changes in the size of the wood inventory.

The requirement for wood itself is an important factor in generating supply. The pace of technological advance in recent years has been such that most wood-processing industries are technically capable of using a wide range of woods of varying quality. Theoretically industry can now utilize most of what the forest has to offer in the way of roundwood, and the choice of the pattern of the wood-using industries is also a wide one.

THE TOTAL WOOD SUPPLY

The total supply of wood from forest and non-forest sources in Kerala by 2000 will range between 5.6 and 12.3 million cubic meters.

The estimates of wood supply are summarized in the following tabulation (Figure 5.1).

Year	Alternative estimates of wood supply*	
	Low	High
	--millions of cubic meters--	
1980	6.7	9.0
1990	6.0	10.7
2000	5.6	12.3

*The estimates are inclusive of the supply of bamboo and reeds.

ESTIMATION OF THE TOTAL WOOD SUPPLY

The factors influencing wood supply are the extent of forest land, productivity of the forest land, and the intensity of forest management. The extent of forest land in turn depends on the pressure for alternate land use which is controlled by the land use policy of the Government. Different estimates of the wood supply outlook have been drawn up for different sets of assumptions about the factors. Future wood supply from forest and non-forest sources has been considered separately in

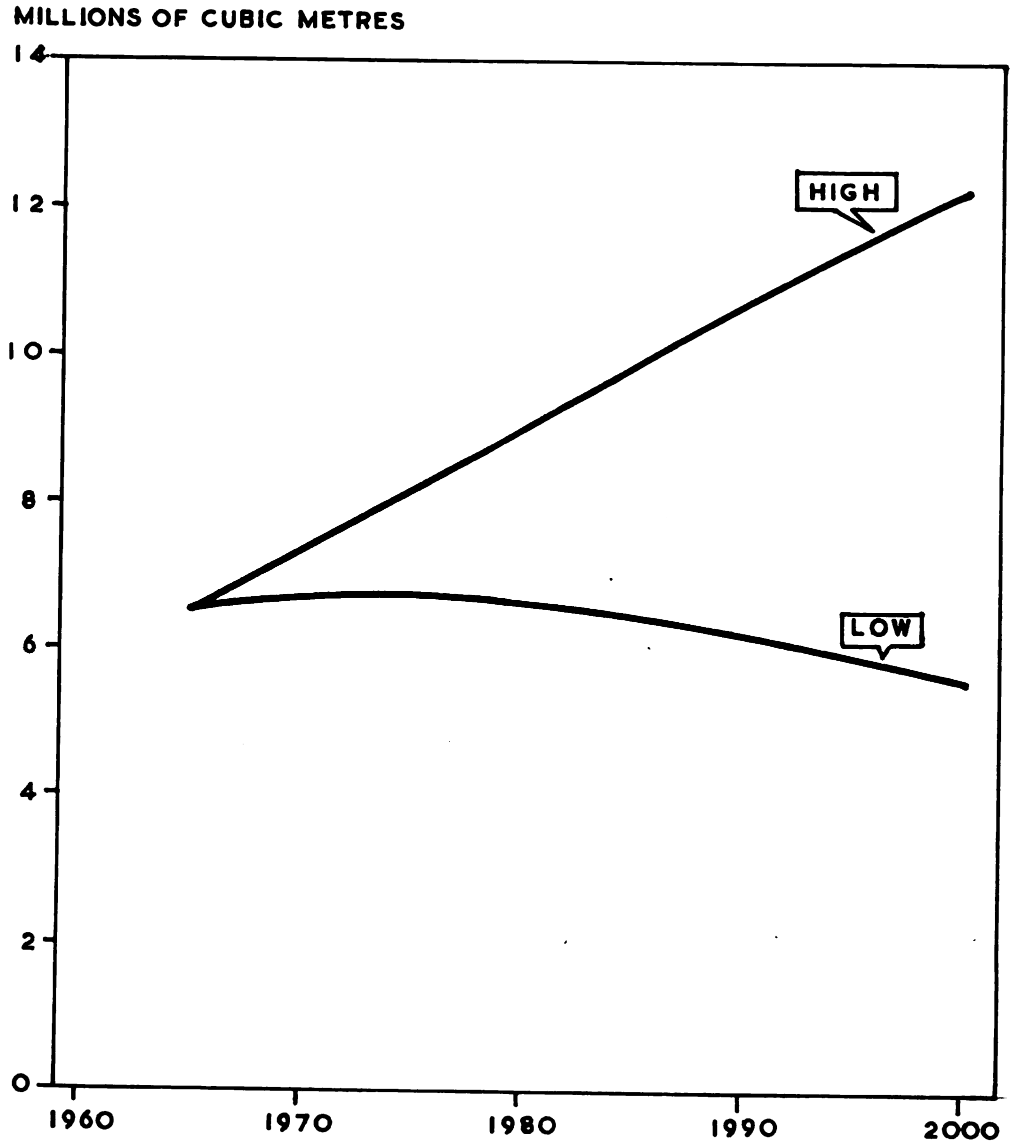

FIGURE 5.1
ESTIMATES OF TOTAL WOOD SUPPLY IN KERALA

making estimates of wood supply outlook.

WOOD SUPPLY FROM FOREST LAND

The future wood supply situation depends on the forest land outlook and on the technological developments in forest management.

Changes in the Extent of Forest Land

Changes in the area of forest land in Kerala has been as indicated in the following tabulation and in Figure 5.2.

Year	Area of forest land	Annual rate of change in forest land area	Forest land per capita
	--square kilometers--	--percent--	--hectares--
1940	12,850		0.113
		-0.75	
1950	11,910		0.089
		-1.30	
1960	10,420		0.063
		-1.25	
1965	9,770		0.053
		-0.75	
1970	9,400		0.045

Source: Kerala Forest Department.

Methods of Estimating Future Availability of Forest Land

Presented here are five different methods used in this study for estimating the future availability of forest

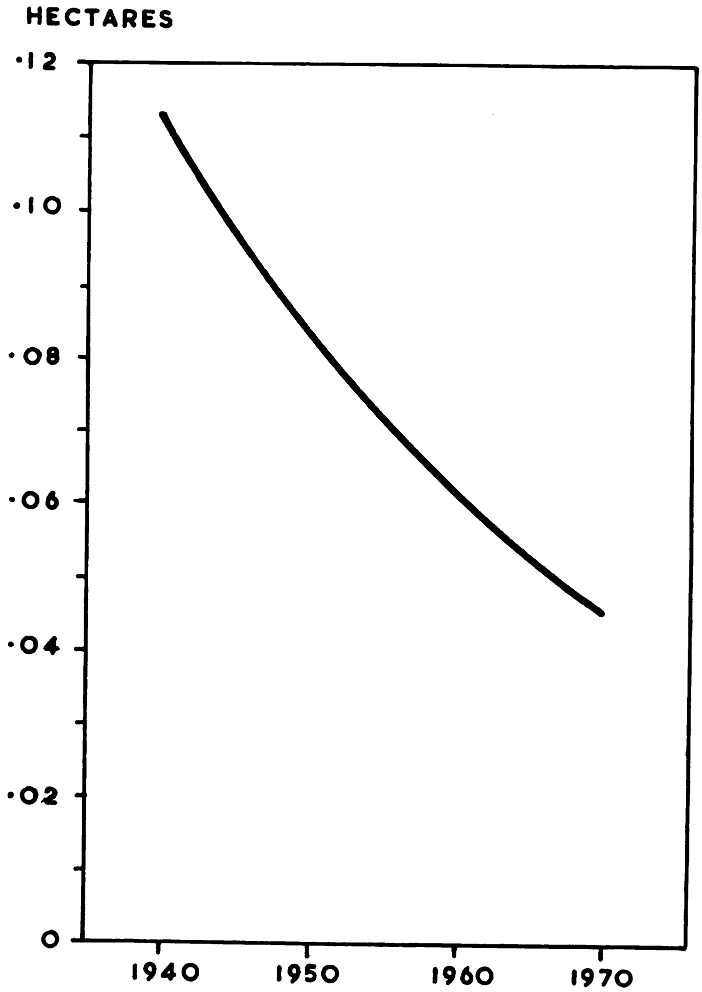

FIGURE 5·2

CHANGE IN PER CAPITA FOREST AREA IN KERALA DURING 1940—1970 land in Kerala, based on certain specified assumptions.

(i) Forest land area in 1970. One of the estimates is based on the assumption that the forest land that was available in 1970 will continue in that land use.

(ii) Extention of time trend. In this method all factors influencing the extent of forest land are aggregated as an annual compound rate factor on the assumption that the area under forest is a function of time, such that:

$$dy/dt = C$$

where C is a constant.

This would give a linear relationship for the trend line of the form:

$$y = a + bt$$

where y is the area of forest land in year t_n,

t is the time period in number of years between t_n and 1930, t_n being any year in the time period, and

a, b are constants.

Values for the constants a and b can be estimated by fitting a straight line for the above equation based on past data.

(iii) Relationship between population and area of forest land. Population has a direct impact on the availability of forest land because of the forest land withdrawals made to meet the various needs of a larger

population.

It is assumed that:

$dy/dx = C$

where C is a constant,

so that the relationship between the population and the area of forest land is linear, and of the form:

$$y = a + bx$$

where y is the area of forest land,
x is the population, and
a, b are constants.

Values for the constants a and b can be estimated by fitting a straight line for the above equation based on past data.

<u>(iv) Per capita forest land as a function of time</u>. The per capita forest land is assumed to be a function of time. The per capita forest land expressed in relation to time shows a non-linear relationship in the form of a hyperbola when plotted graphically (Figure 5.2).

This relationship can be expressed by the formula:

$$R = t^{a} \cdot e^{b}$$

where R is the area of forest land per capita in year t_n,
t is the time period in number of years between t_n and 1930, t_n being any year in the time period, and
a, b are constants.

The above relationship means that $R \cdot t^{-a}$ is a constant equal to e^{b}. The constants a and b can be derived by fitting a straight line for:

$$\ln R = a \ln t + b,$$

the $\ln R$, $\ln t$ relationship being linear.

As $R = A/P$, where A is the area of forest land and P the population, the prediction equation to find the area of forest land in a particular year will be:

$$A/P = t^a \cdot e^b$$

or

$$A = Pt^a \cdot e^b$$

The hyperbolic trend of the curve of per capita forest land is explained by two factors.

(a) As population increases there is an increasing pressure on land for increased food production, and for other uses.

(b) Offsetting (a) are the technological developments (for example, the green revolution) which cause the productivity of agricultural lands to increase considerably, thus easing the pressure on forest land to some extent.

(v) Official target. The targetted "area under forest", as pronounced by the National Planning Commission and government agencies is accepted as one of the estimates. These targets are fixed arbitrarily, employing certain assumptions on possible land use adjustments and based on the desirable path of land use. This arbitrary target has taken many factors, which are important for the overall development of the country, into consideration.

(a) The necessity of providing subsistance farming to landless and unemployed labor and the necessity of being self sufficient in food supplies.

(b) The necessity of providing land for roads, buildings, irrigation canals, reservoirs and other developmental projects.

(c) The necessity of providing land for cultivation of major cash crops like rubber, sugarcane, etc.

(d) The possibility of reversion of marginal agricultural lands to forestry as a result of the green revolution and improvements in agricultural technology.

(e) The possibility of increasing the contribution made by forestry to the overall growth of the economy, especially for providing employment and increasing state income.

(f) The consideration about the desirable extent of forest land to be dedicated permanently to forestry, in view of the accepted forest policy of the country.

<u>Assumptions</u>

Estimates of future availability of forest land and wood supply have been made based on explicit assumptions about economic parameters.

<u>(i) Assumption about demographic trend</u>. The assumption about demographic trends is that the population of Kerala in the years 1980, 1990 and 2000 will be 26 million, 30 million and 33 million respectively.

<u>(ii) General assumptions</u>. There are few general assumptions, implicit in the static nature of the models for projecting future supply of wood.

(a) There will be no substantial change in the price of wood relative to other commodities.

(b) The structure of population will not substantially affect the demand for wood.

Estimates of Future Availability of Forest Land

The five different estimates of future availability of forest land are given in Table 5.1.

Estimates (2) and (3) indicate a steady decrease in the extent of forest land, whereas estimates (4) and (5) indicate an increase. These estimated figures have been plotted against the year to which they pertain and smooth curves drawn to indicate the possible upper and lower limits of the possible future availability of forest land. The high estimate of the future availability of forest land has been arrived at on the assumption that large changes in forest land area are unlikely (Figure 5.3).

Large changes in forest land area seem unrealistic for these reasons:

(a) A downward sloping curve for forest land outlook is not realistic, as it would ultimately reach the zero point. Such a situation is not likely to happen and a minimum limit on forest land would be fixed at least at some stage in the future, below which it will not be allowed to fall, depending on the conditions prevailing.

(b) Considering the pressure of population and the rate at which the forest land area has been decreasing, the projections indicating an increase in the extent of forest land are also unrealistic. Estimate (4) indicates that if the per capita forest land falls at the same rate as in the past, larger total area of forest land still would be needed for the assumed population in the target years. The land area being

Table 5.1 Estimates of Future Availability of Forest Land in Kerala

Projection procedure	1980	1990	2000
	------square kilometers------		
1	9,400	9,400	9,400
2	8,087	6,877	5,667
3	7,084	5,557	4,412
4	11,116	11,394	11,325
5	9,000	9,500	10,000

1. Forest land area in 1970.

2. Extention of time trend. The prediction equation used to estimate the availability of forest land is:

$$y = 14137 - 121t$$

where y is the area of forest land in square kilometers, and

t is the time period in years between the target year and 1930.

3. Relationship between population and area of forest land. The prediction equation used to estimate the availability of forest land is:

$$y = 17010 - 381.76x$$

where y is the area of forest land in square kilometers, and

x is the population in millions.

4. Per capita forest land as a function of time. The prediction equation used to estimate the availability of forest land is:

$$A = Pt^{-0.652} \cdot e^{-0.602}$$

where A is the area of forest land in hectares,

P is the population, and

t is the time period in years between the target year and 1930.

5. Official target.

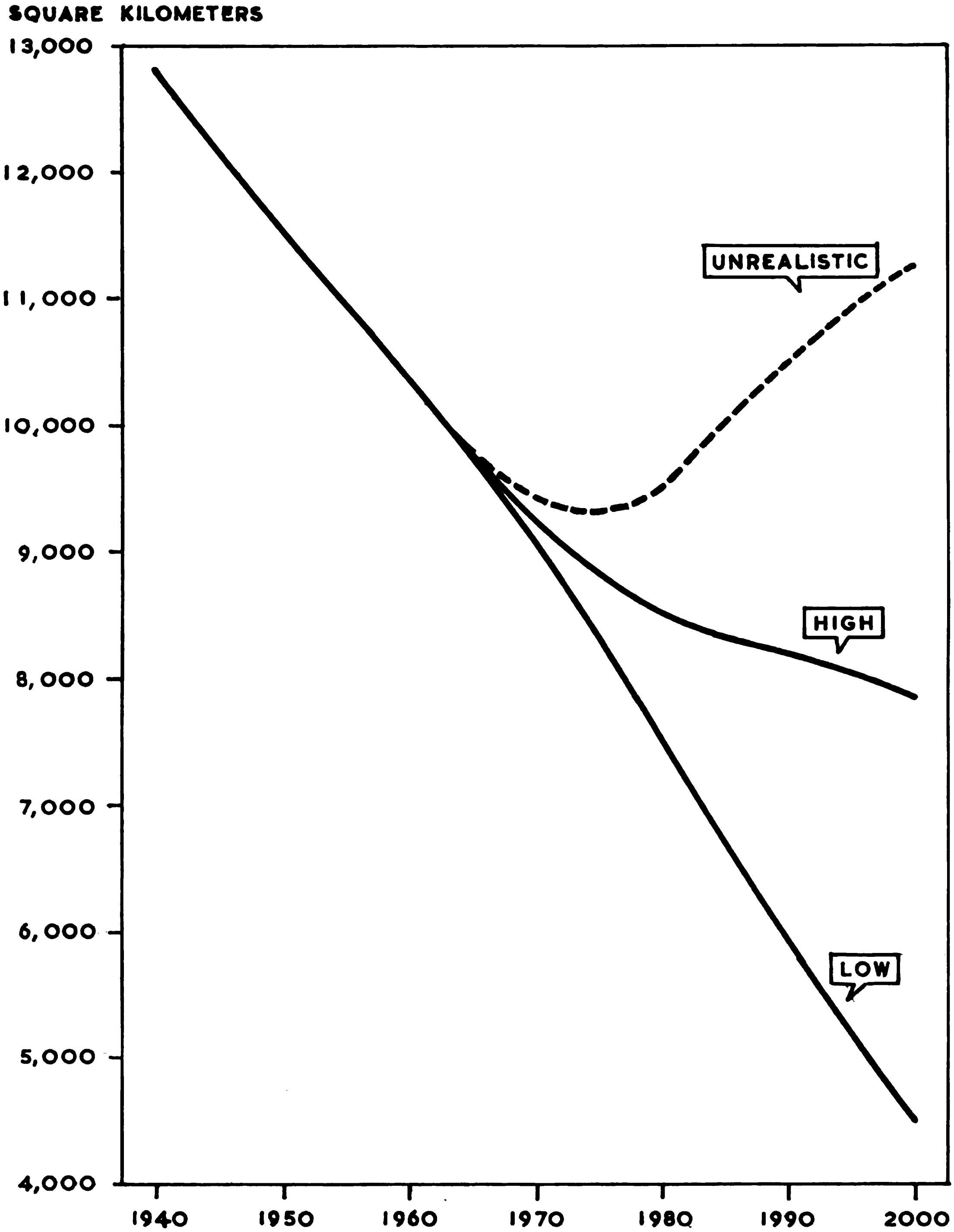

FIGURE 5 · 3
PROJECTIONS OF FOREST LAND
OUTLOOK IN KERALA

fixed, and considering the increasing demand for land for development of agriculture, dairy, industrial estates and so on, this becomes unrealistic. For the same reason, the assumptions leading to the estimate (5) also appear unrealistic.

Considering these the assumption regarding the high alternative of forest land outlook is that the forest land withdrawals would take place at a much reduced rate than in the past, while the low alternative assumes a high rate of forest land withdrawals. Even though the trend of the low alternative of forest land outlook has been found to be unrealistic, it is the worst situation the State may have to face, and this can be used as a basis to identify the policy issues, namely whether the worst situation can be allowed to happen or whether and where it has to be checked, taking the expenditure for it into consideration.

The two levels of forest land availability. The assumptions regarding the two levels of forest land availability are given in the following statement.

Year	Alternative levels of forest land availability	
	Low	High
	-----square kilometers-----	
1980	7,500	8,500
1990	5,900	8,200
2000	4,500	7,850

Future Productivity of Forest Land

The current situation regarding the productivity of forest land and the intensity of forest management have been dealt with in Chapter 3. As indicated there, the forests of Kerala are in a state of serious under-productivity.

Assumptions about future productivity of the forests are made on the basis of the intensity of investment in forestry. The important considerations taken into account in making these assumptions are:

(a) The estimate of allowable cut from the forests of Kerala in 1965 was 2.5 cubic meters per hectare per year. But due to large scale deforestation (as could be seen from the rate at which the forest area has been depleted), timber extraction in Kerala has been heavy during the last few years, and the yield of wood has amounted to about 4.5 cubic meters per hectare per year.

(b) The potential productivity of the natural forests of Kerala, according to Paterson's Index, is between 11 to 12 cubic meters per hectare per year, while the maximum potential that can be expected under intensive management is about 23 cubic meters per hectare per year. With technological improvements, and when proper exotics of wide adaptability are used, it is possible to realize, on normal soils, a productivity of about four times that indicated by Paterson's Index (Kulkarni and Seth 1968).

(c) Large scale plantations of fast growing species are being raised in Kerala, to build up the wood resource as fast as possible. By the end of 1965 Kerala had 736 square kilometers of man-made forests (and 1,018 square kilometers by the end of 1970). The expectation is that the extent of man-made forests will be increased at an accelerated pace in the coming years. Of the total man-made forests, the bulk is formed of quick growing species.[1]

(d) Man-made forests formed 10.8 percent of the total forest area in Kerala, in 1970. With the increased tempo of creating man-made forests, this percentage is expected to go up rapidly. The assumption about the area under man-made forests in future is as follows:

Year	Area under man-made forests
	-----square kilometers-----
1980	1,500
1990	2,400
2000	3,500

(e) The yield from natural forests will be increased by intensified and improved forest management and by improved harvesting methods and practices.

(f) The quantity of wood extracted per unit area (especially of natural forests) also depends on the utilization pattern, efficiency of logging, and the infrastructural pattern. It has been indicated that the average yield per unit area can be increased considerably by reducing the logging waste, accelerated road construction, and by increasing the share of small-sized wood used as industrial wood (Government of India 1968).[2]

(g) Intensive management and accelerated capital investment are required to increase the growing stock and production capacity of the forest land, in terms of volume of wood per unit area. Technological improvements in forestry also require adequate investment for research and development.

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[1]As a general guide, quick growing species have been defined as those producing a mean annual increment of not less than ten cubic meters per hectare per year.

[2]Logging is done mainly using axes and cross-cut saws. Elephants are used for skidding. A recent assessment by the Food and Agricultural Organization of the United Nations has revealed that timber output could be increased considerably, merely by adopting improved tools and methods in logging operations.

Estimates of the Future Supply of Wood

The future supply of wood has been differentiated into a short-run period and a long-run period, corresponding to the periods 1965 - 1980 and 1981 - 2000 respectively.

In the short-run, intensified investment for forest management will have very little effect. Investment on improved logging and utilization, however, can increase the supply. Estimates for the short-run have been made, based on two alternative assumptions regarding logging and utilization.

(a) Logging and utilization will be maintained at the same standard as in 1965.

(b) Logging and utilization will be improved.

It is assumed that as a result of improved logging and utilization the average yield of wood from the natural forests will increase from 4.5 cubic meters per hectare per year to 6.0 cubic meters per hectare per year. It has also been assumed that in the short-run excess fellings from the natural forests, to the extent of ten percent, will be resorted to along with the improved logging and utilization.

A considerable amount of infrastructural facilities are provided during the creation of man-made forests, and forestation also presupposes a definite demand for wood. Since new forests can be located near consuming centers better utilization is assured. Therefore, it is assumed

that improved logging and utilization will be practised in the man-made forests without any extra investments.

In the long-run, the supply of wood can be influenced considerably by acceleration of investment in timber growing (in man-made forests) as well as by improved logging and utilization. Investment for timber growing will have to be initiated now. Estimates for the long-run have been made based on three alternative assumptions regarding the level of productivity in man-made forests corresponding to three different intensities of investment, namely:

(i) Productivity maintained at the 1965 level.

(ii)
(iii) } Productivity increased by progressive increments in investment.

The assumptions regarding the average annual yield of wood from man-made forests per hectare for the three levels of productivity are eight cubic meters, 16 cubic meters and 22 cubic meters respectively.

Withdrawals of forest land contribute to the wood supply by extraction of tree growth from the area withdrawn; and the withdrawals influence both the short-run and the long-run. This aspect has also been considered estimating the future supply of wood.

To summarize, the assumptions for estimating the future supply of wood are:

Regarding availability of forest land:

Assumptions	1980	1990	2000
	---square kilometers---		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

Regarding average annual wood yield per hectare of natural forest as a result of short-run measures:

Assumptions	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

Regarding average annual wood yield per hectare of man-made forest as a result of long-run measures:

Assumptions	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

Thus, there are twelve different estimates of future supply of wood corresponding to the combinations of forest land availability, standards of logging and utilization, and productivity (Table 5.2). That is, each of the two assumptions regarding forest land availability has six sets of estimates, the lowest for each being the supply resulting at the current level of effort and the highest being the supply resulting at the assumed

Table 5.2 Estimates of Future Supply of Wood from the Forests of Kerala

Assumptions regarding forest land availability*	Assumptions regarding wood yield as a result of short-run measures**	Assumptions regarding wood yield as a result of long-run measures@	Wood supply 1980	1990	2000
			--millions of cubic meters--		
Low	(a)	(i)	5.0	4.4	4.0
		(ii)	5.3	6.3	6.7
		(iii)	5.6	7.7	8.9
	(b)	(i)	6.3	4.9	4.1
		(ii)	6.6	6.8	6.9
		(iii)	6.9	8.3	9.0
High	(a)	(i)	5.3	4.8	5.2
		(ii)	5.6	6.8	8.0
		(iii)	5.9	8.1	10.1
	(b)	(i)	6.7	5.7	5.8
		(ii)	7.0	8.0	8.6
		(iii)	7.3	9.1	10.7

*Assumptions regarding availability of forest land:

	1980	1990	2000
	---square kilometers----		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

**Assumptions regarding average annual wood yield er hectare of natural forest as a result of short-run easures:

	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

@Assumptions regarding average annual wood yield hectare of man-made forest as a result of long-run sures:

	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

maximum increase in the effort. The lowest estimate of future wood supply is for the combination of the low alternative of forest land availability with current levels of effort in logging and utilization and in man-made forests. The highest estimate is for the combination of the high alternative of forest land availability with maximum effort in logging and utilization and in man-made forests.

The low estimate of future wood supply indicates a decreasing trend with a supply of 5.0 million cubic meters, 4.4 million cubic meters and 4.0 million cubic meters respectively by the years 1980, 1990 and 2000. The high estimate shows an increasing trend with 7.3 million cubic meters, 9.1 million cubic meters and 10.7 million cubic meters respectively.

WOOD SUPPLY FROM NON-FOREST SOURCES

Wood supply will be augmented to some extent by the availability of wood from non-forest sources. Non-forest sources of wood include plantations of rubber and ashew, farms and residential compounds, and wood wastes rom sawmills and plywood mills.

Availability of wood from non-forest sources has en estimated to be 1.7 million cubic meters by 1980, 1.6 llion cubic meters by 1990 and 1.6 million cubic meters 2000 (Table 5.3).

Table 5.3 Future Availability of Wood from Non-forest Sources in Kerala

Source	1980	1990	2000
	--thousands of cubic meters--		
Rubber plantations[a]	650	700	750
Cashew plantations[a]	230	240	250
Other non-forest land[b]	570	450	340
Wood wastes from sawmills and plywood mills[c]	240	250	240
Total	1,690	1,640	1,580

[a] Based on the assumed targets for planting.

[b] Based on the past trend.

[c] Based on the low assumption about the consumption outlook for sawnwood and plywood.

EXPORT DRAINS

347 thousand cubic meters of industrial roundwood and 368 thousand cubic meters of fuelwood were exported from Kerala, during 1965. It is assumed that in the future the export of unprocessed wood will be curtailed considerably, in the interest of industrial development in the State; and the export of wood will mostly be matched by imports, in terms of quantity.

SUPPLY OUTLOOK FOR WOOD

The total estimated supply of wood from forest and non-forest sources for the different combinations of assumptions is given in Table 5.4. From the range of estimated values, two levels have been chosen to cover the upper and lower limits of the future wood supply. The change in the estimated supply of wood in comparison with the 1965 wood supply position is given in the following tabulated statement (Figure 5.4).

Year	Index of change in wood supply for alternative estimates of supply outlook (Index: 1965 = 100)	
	Low	High
1980	103	138
1990	92	165
2000	86	189

Table 5.4 Estimates of Total Supply of Wood from Forest and Non-forest Sources in Kerala

Assumptions regarding forest land availability*	Assumptions regarding wood yield as a result of short-run measures**	Assumptions regarding wood yield as a result of long-run measures@	Wood supply 1980	1990	2000
			--millions of cubic meters--		
Low	(a)	(i)	6.7	6.0	5.6
		(ii)	7.0	7.9	8.3
		(iii)	7.3	9.3	10.5
	(b)	(i)	8.0	6.5	5.7
		(ii)	8.3	8.4	8.5
		(iii)	8.6	9.9	10.6
High	(a)	(i)	7.0	6.4	6.8
		(ii)	7.3	8.4	9.6
		(iii)	7.6	9.7	11.7
	(b)	(i)	8.4	7.3	7.4
		(ii)	8.7	9.2	10.2
		(iii)	9.0	10.7	12.3

*Assumptions regarding availability of forest land:

	1980	1990	2000
	---square kilometers---		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

**Assumptions regarding average annual wood yield per hectare of natural forest as a result of short-run measures:

	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

@Assumptions regarding average annual wood yield per hectare of man-made forest as a result of long-run measures:

	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

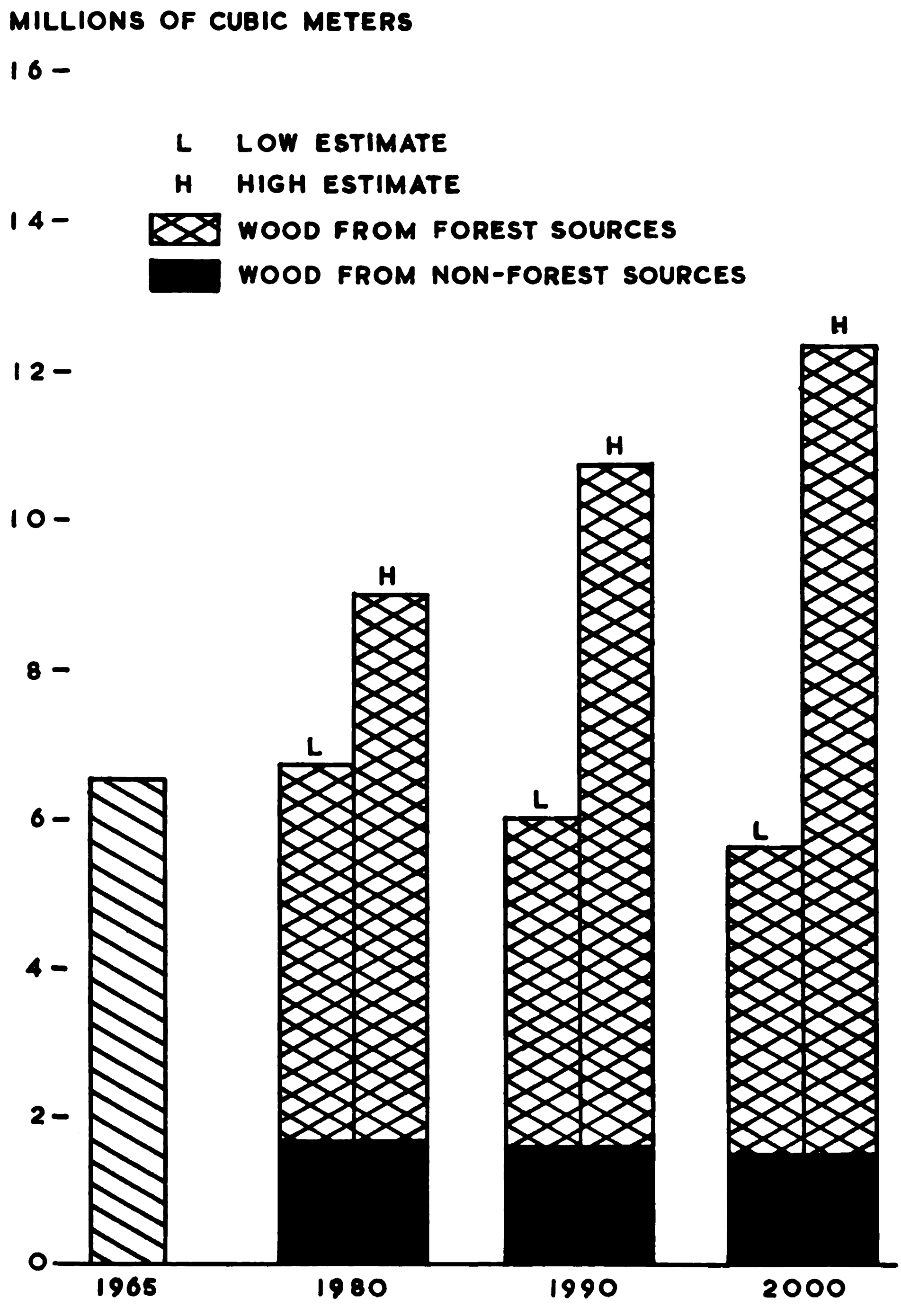

FIGURE 5·4
COMPARISON OF THE ESTIMATES OF SUPPLY OUTLOOK FOR WOOD IN KERALA

ECONOMIC IMPLICATIONS OF THE SUPPLY OUTLOOK FOR WOOD

A low level of wood supply has been estimated for the assumed low availability of forest land in combination with current level of effort on forest management. To achieve higher levels of wood supply, it is necessary to employ labor and capital on a large scale. Higher levels of wood supply also imply indirect costs to prevent forest land withdrawals.

Employment of Labor

Forest management and timber extraction are labor intensive activities. And, in a country where the social opportunity cost of labor is close to zero, it will be advantageous to adopt labor intensive techniques, wherever feasible.

The employment of labor under the various supply projections is given in Table 5.5. It clearly indicates that even to keep up the 1965 level of employment in forestry, intensification of forest management is essential. The change in the estimated employment of labor in forest management and timber extraction, compared to the 1965 position, is as follows:

Table 5.5 Employment of Labor under the Various Wood Supply Projections in Kerala

Assumptions regarding forest land availability*	Assumptions regarding wood yield as a result of short-run measures**	Assumptions regarding wood yield as a result of long-run measures@	Employment of labor 1980	1990	2000
			--number of employees--		
Low	(a)	(i)	15,500	15,940	15,900
		(ii)	17,530	23,130	25,920
		(iii)	19,060	28,120	33,040
	(b)	(i)	25,480	19,170	16,720
		(ii)	27,510	26,360	26,740
		(iii)	29,040	31,610	33,850
High	(a)	(i)	16,280	16,980	19,980
		(ii)	18,310	24,430	29,050
		(iii)	19,840	29,160	36,160
	(b)	(i)	27,620	22,510	22,970
		(ii)	29,650	29,700	33,000
		(iii)	31,180	34,950	40,110

*Assumptions regarding availability of forest land:

	1980	1990	2000
	---square kilometers---		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

**Assumptions regarding average annual wood yield per hectare of natural forest as a result of short-run measures:

	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

@Assumptions regarding average annual wood yield per hectare of man-made forest as a result of long-run measures:

	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

Year	Index of change in employment of labor for alternative estimates of wood supply outlook (Index: 1965 = 100)	
	Low	High
1980	77	154
1990	79	173
2000	79	199

Investment

Intensification of forest management involves capital investment for timber growing and improving harvesting methods and practices; and the productivity of forest land depends on the investment in preparation of land, fertilization, etc. The estimated requirements for capital investment for the various projections of wood supply are given in Table 5.6. In calculating the requirements for capital investment, wood supply from forest land alone has been taken into consideration. Since the availability of wood from non-forest sources is incidental,(as they are primarily raised for non-wood products like latex, flower, fruits, leaves and so on), no capital investment is assumed for the wood supply from such sources.

Table 5.6 indicates that forestry sector needs heavy investment, if the management is to be intensified. The requirements for capital investment during the period

Table 5.6 Requirements for Capital Investment for the Various Wood Supply Projections in Kerala

Assumptions regarding forest land availability*	Assumptions regarding wood yield as a result of short-run measures**	Assumptions regarding wood yield as a result of long-run measures@	Requirements for capital investment 1965 to 1980	1981 to 1990	1991 to 2000
			--millions of 1961 rupees--		
Low	(a)	(i)	256	165	173
		(ii)	291	228	277
		(iii)	361	328	414
	(b)	(i)	354	206	190
		(ii)	384	270	293
		(iii)	462	369	430
High	(a)	(i)	263	183	204
		(ii)	300	284	308
		(iii)	372	345	445
	(b)	(i)	370	238	243
		(ii)	406	302	346
		(iii)	478	401	485

*Assumptions regarding availability of forest land:

	1980	1990	2000
	---square kilometers---		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

**Assumptions regarding average annual wood yield per hectare of natural forest as a result of short-run measures:

	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

@Assumptions regarding average annual wood yield per hectare of man-made forest as a result of long-run measures:

	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

1965 - 2000, corresponding to the alternative estimates of future wood supply will range between 594 and 1,364 million rupees.

Period	Requirements of capital investment for alternative estimates of future wood supply	
	Low	High
	--millions of 1961 rupees--	
1965 - 1980	256	478
1981 - 1990	165	401
1991 - 2000	173	485
Total	594	1,364

Other Costs

Cost for prevention of forest land withdrawals. The capital investment estimated in the previous section is for the production of wood. In addition to these costs there are indirect costs to prevent unauthorized use. Since the low alternative of forest land outlook is the situation that is likely to occur if forest land withdrawals are allowed to proceed unchecked, the expenditure necessary to control forest land withdrawals will have to be considered as an added cost for the high alternative. The estimated expenditure to prevent unauthorized forest land withdrawals and to insure the availability of the amount of forest land assumed under the high alternative is given in the following tabulation.

Period	Added cost to insure the availability of forest land assumed under the high alternative
	--millions of 1961 rupees--
1965 - 1980	200
1981 - 1990	260
1991 - 2000	210
Total	670

Working capital. Working capital required for cutting and collection of wood and for overhead expenses will also have to be considered while estimating the supply cost of wood. The requirement for working capital will depend on the quantity of wood and it is assumed that on an average the cost of cutting and collection of wood will be eight rupees per cubic meter and the overhead expenses will be two rupees per cubic meter.

SUMMARY

The 1980 wood supply in Kerala has been estimated to vary between 6.7 and 9.0 million cubic meters, the 1990 wood supply between 6.0 and 10.7 million cubic meters, and the 2000 wood supply between 5.6 and 12.3 million cubic meters. The investment required during the period 1965 - 2000 to achieve the estimated levels of wood supply will range between 594 million rupees and 1,364 million rupees. The range in the employment of labor will be between 15 thousand and 31 thousand in 1980, between 16 thousand and 35 thousand in 1990, and between 16 thousand and 40 thousand in 2000.

Chapter 6

POLICY IMPLICATIONS OF WOOD SUPPLY AND REQUIREMENTS PROJECTIONS

In seeking to determine how much wood should be grown for a particular period, concern is all too often directed solely toward determining future requirements and these requirements are then held to be synonymous with the wood supply goal. However, wood supply and wood requirements have to be considered together to determine the likely course of future events.

POLICY ISSUES AND IMPLICATIONS

The projections of wood supply based on various combinations of assumptions give a clear indication regarding the range of future possibilities.

The actual wood supply will, however, depend on certain policy decisions by the Government. While a production goal is a useful way to express a forest policy, it has to take the economic realities into consideration. In this connection, the question as to what extent the growing of wood is an efficient use of the State's resources becomes important. The answer to the question depends on the cost of production and value of wood, as well as on the benefits of wood supply.

The policy issues pertaining to wood supply can be broadly divided into two, namely the land use policy and the forest management policy.

THE LAND USE POLICY

Wood supply depends considerably on the availability of forest land. Therefore, the land use policy of the Government will greatly influence the future wood supply.

Policy Issue

There has been a steady decline in the extent of forest land in Kerala. The policy issue regarding the land use in the future is this:

> To what extent will the Government control forest land withdrawals?

Two different assumptions have been made to cover the range of forest land availability in the future. One is that there will be continued withdrawals of forest land, and the alternative assumption is that the withdrawals will be controlled.

Influence on wood supply. Forest land withdrawals have influence on wood supply, both in the short and the long-run. In the short-run, forest land withdrawals contribute to the wood supply. Continued withdrawals will have continued influence on the wood supply because of the extraction of wood from the forest areas withdrawn. In the long-run, effect of the withdrawals will be adverse on the wood supply due to the reduction in the area available for forestry purposes. The combined effect of the short and the long-run aspects of forest land withdrawals has been estimated to be a progressive reduction in the total wood supply, all other factors remaining constant.

Assuming that all the other factors remain constant at the current (1965) level, the future wood supply under the two assumptions regarding forest land availability will be as given in the following tabulation (Table 5.4).

Year	Alternative assumptions regarding forest land availability	
	Low	High
	--millions of cubic meters--	
1980	6.7	7.0
2000	5.6	6.8

The tabulation indicates that the wood supply will vary within a range, depending on the policy decision regarding forest land withdrawal, and the range widens as the withdrawals continue under the low assumption regarding forest land availability.

Forest land withdrawals can be made up for by creation of more plantations, subject to the availability of suitable land for plantations to the required extent. But, as forestry in Kerala is plantation oriented and as the assumption regarding the area to be converted into man-made forests in Kerala is based on the perspective plan for forestry development in the State, such a trade off (by introducing different assumptions regarding the area under man-made forests) is not considered in this study. However, the aspect of trade off between withdrawals and intensification of management has been covered by the introduction of different assumptions about the short-run and the long-run measures.

THE FOREST MANAGEMENT POLICY

The intensity of forest management has a considerable influence on wood supply.

The policy issues involved in forest management have short-run and long-run aspects. The outcomes of the management decisions have to be assessed by taking the land use policy also into consideration, because the outcomes depend on the extent of land on which forest management will be practised.

In order to analyse the issues involved and to assess their implications, the projection period is divided into two - 1965 to 1980 and 1981 to 2000 - corresponding to the short-run and the long-run nature of the measures to be adopted for increasing wood supply.

Short-run Measures

Short-run measures are meant to give results within a short period of time, and such measures can be adopted continuously or from time to time. While the adoption of short-run measures is a regular and continuing aspect of forest management, it is expected that increased investment in short-run programs will be the main strategy for increasing wood supply during 1965 - 1980. During this period better utilization and improved harvesting practices can increase wood supply per unit area. The actual wood supply will depend on the extent of forest land under management.

Policy issue. The policy issue regarding the short-run measures to increase wood supply is this:

> To what extent will the Government pay the costs for increasing output by improving harvesting methods and practices?

Two different assumptions have been made regarding the short-run measures. One is that logging and utilization will be maintained at the same standard as in 1965. The alternative assumption is that logging and utilization will be improved.

Influence on wood supply. The estimates of wood supply with logging and utilization (as well as other factors) maintained at the same standard as in 1965 has been given for the two levels of forest land availability under the land use policy. The wood supply reasonably attainable in the future by improving the logging and utilization standards, other factors remaining constant, is given in the following tabulation for the two different assumptions regarding forest land availability (Table 5.4).

Year	Alternative assumptions regarding forest land availability	
	Low	High
	--millions of cubic meters--	
1980	8.0	8.4
2000	5.7	7.4

The range of wood supply for the different combinations of policy decisions regarding forest land use and short-run management measures will be between 6.7 and 8.4 million cubic meters in 1980 and between 5.6 and 7.4 million cubic meters in 2000, indicating a decreasing supply trend.

The additions to wood supply that can reasonably be expected as a result of improved logging and utilization are as follows:

Year	Alternative assumptions regarding forest land availability	
	Low	High
	--millions of cubic meters--	
1980	1.3	1.4
2000	0.1	0.6

From the above listing it is seen that the addition to wood supply resulting from improved logging and utilization decreases along with the decrease in the extent of forest land.

Long-run Measures

The results of long-run measures are obtained some years after its initiation, and long-run measures are meant to give more effective and lasting results. Intensification of forest management results in increase of productivity. In the long-run supply can be increased considerably by intensification of investment in timber growing. It is expected that increased investments in long-run measures will influence wood supply in the period 1981 - 2000.

Policy issue. The policy issue regarding the long-run measures to increase wood supply is this:

To what extent will the Government invest in timber growing?

Three different assumptions have been made regarding the investment in timber growing per unit area of man-made forest. One is that the investment intensity per hectare of man-made forest will be maintained at the 1965 level. The other two assume increased investments in timber growing.

It is assumed that the growth in the extent of plantations will follow the trend indicated in Chapter 5 and no alternative assumptions have been made regarding the extent of plantations.

Influence on wood supply. Policy decisions about long-run measures have to be implemented in combination with other policy decisions concerning land use and short-run measures. Even though the full impact of the long-run measures is expected only during 1981 - 2000, there will be a small increase in the annual wood production even in the short-run.

Of the three alternatives the one which assumes the investment intensity to remain constant at the 1965 level has already been dealt with under the two policy issues discussed earlier. Therefore, the annual production of wood reasonably attainable in the future as a result of the two increased intensities of investment alone is listed here (Table 5.4). In the listing each of the higher investment intensities (namely, intensified investment and highly intensified investment) are separately shown. The intensified investment and the highly intensified investment have four combinations each, corresponding to the two levels of forest land availability and the two alternative assumptions regarding short-run measures.

Year	Assumptions regarding short-run measures (Logging and utilization)	Assumptions regarding forest land availability	
		Low	High
		-----millions of cubic meters-----	
Intensified investment			
1980	1965 standard	7.0	7.3
2000		8.3	9.6
1980	Improved standard	8.3	8.7
2000		8.5	10.2
Highly intensified investment			
1980	1965 standard	7.3	7.6
2000		10.5	11.7
1980	Improved standard	8.6	9.0
2000		10.6	12.3

When the different assumptions about the intensity of investment in timber growing are also introduced the range of estimated annual wood production under the various combinations of assumptions will be between 6.7 and 9.0 million cubic meters by 1980 and between 5.6 and 12.3 million cubic meters by 2000. While the combinations of policy alternatives with the investment intensity at the

1965 level indicated a decreasing supply trend, all the combinations of alternative assumptions with increased investment in timber growing indicate an increasing supply trend. In other words, intensification of investment is necessary to obtain an increased wood supply. Even though about a same level of wood supply can be obtained under more than one combination of policy alternatives, supply beyond the level of 8.6 million cubic meters in 1980 and beyond 10.6 million cubic meters in 2000 can be obtained only with the high level of forest land availability, in spite of highly intensified investment in timber growing.

The projected increase in wood supply as a result of intensification of investment in timber growing is as follows:

Assumptions regarding investment	Increase in wood supply	
	1980	2000
	-----millions of cubic meters-----	
Intensified investment	0.3	2.8
Highly intensified investment	0.6	4.9

Linking of the Short-run and the Long-run Measures

There are strong linkages between the short-run and the long-run measures, and they together form a package for the different levels of forest land availability. Intensive forest management involves heavy investment and to get long-run benefits by timber growing, investments must be initiated now.

The actual wood supply in the future will depend on the mix or combination of the policy decisions regarding the increases in current effort and the changes in the extent of forest land. The operational question, therefore, is how much effort the State will devote to timber production. Knowledge about the cost of wood supply and the related economic aspects will help to take decisions on policy issues.

COST OF WOOD SUPPLY

Annual Budget Cost

Estimates of annual budget cost corresponding to the estimates of annual wood production and the average (budget) cost per cubic meter of wood under the various combinations of assumptions have been made for 1980 and 2000 (Table 6.1). The component items included in the annual budget are: (i) the annual cost for control of forest land withdrawals, (ii) the annual requirements for new capital for timber growing and harvesting, and (iii) the cost of cutting and collection of timber and the overhead costs. In estimating the annual budget cost, no expenditure is assumed for wood from non-forest sources, except the cost of cutting and collection. The

Table 6.1 Estimates of Annual Budget Cost for the Estimated Wood Supply in 1980 and 2000

Assumptions: Forest land availability*	Assumptions: Short-run measures**	Assumptions: Long-run measures@	Total budget cost: 1980	Total budget cost: 2000	Average budget cost per cubic meter of wood: 1980	Average budget cost per cubic meter of wood: 2000
			--millions of 1961 rupees--		--1961 rupees--	
Low	(a)	(i)	80.6	70.1	13.42	14.37
		(ii)	86.0	108.5	13.68	14.10
		(iii)	93.7	143.2	14.32	14.67
	(b)	(i)	100.2	72.8	13.76	14.68
		(ii)	105.2	111.1	13.90	14.27
		(iii)	113.4	145.8	14.48	14.80
High	(a)	(i)	97.4	106.2	15.83	18.00
		(ii)	102.9	144.6	15.96	16.50
		(iii)	110.7	179.3	16.47	16.51
	(b)	(i)	118.6	116.1	15.68	17.85
		(ii)	123.9	154.4	15.77	16.49
		(iii)	131.8	189.3	16.20	16.51

*Assumptions regarding availability of forest land:

	1980	1990	2000
	---square kilometers---		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

**Assumptions regarding average annual wood yield per hectare of natural forest as a result of short-run measures:

	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

@Assumptions regarding average annual wood yield per hectare of man-made forest as a result of long-run measures:

	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

average cost per unit of wood has been worked out, taking only the estimated supply of wood from forest land into consideration, as the availability of wood from non-forest sources is incidental.

For the estimated wood supply in 1980, ranging between 6.7 and 9.0 million cubic meters, the annual budget cost will range from 80.6 to 131.8 million rupees. Based on the annual budget cost, the average cost per cubic meter of wood in 1980 will range from 13.42 to 16.47 rupees.

In 2000, for the estimated wood supply ranging between 5.6 and 12.3 million cubic meters, the annual budget cost is estimated to range from 70.1 million rupees to 189.3 million rupees. The corresponding average cost per cubic meter of wood will range from 14.10 to 18.00 rupees.

An analysis of the projected annual budget cost reveals the following.

(a) Both in the short and the long-run, all the alternative combinations under the assumption of low availability of forest land will provide wood supplies at a cheaper average budget cost per unit of wood than any of the alternatives under the high assumption about forest land availability. This is due to two factors:

(i) Additional cost involved in preventing forest land withdrawals to insure the availability of forest land assumed under the high alternative.

(ii) Additional contribution to wood supply obtainable for all the alternatives under the low assumption about forest land outlook as a result of withdrawals, for which no investment is involved.

(b) In the short-run (1980), intensification of investment in man-made forests results in an increase in the average budget cost per unit of wood for all its combinations with other policy alternatives. This is so because the full outcome of the investment can be obtained only in the long-run.

(c) In the long-run (2000), intensified investment results in a decrease in the average budget cost per unit of wood for all its combinations with other policy alternatives. But the average budget cost per unit of wood rises again when the investment is 'highly intensified.'

(d) The average budget cost per unit of wood in 1980 is generally lower for all the alternatives (compared to 2000), because of the larger proportion of wood from the forest lands withdrawn, in the total wood supply.

(e) For supply levels upto 8.6 million cubic meters in 1980 and 10.6 million cubic meters in 2000, it is cheaper to adopt increased investments on man-made forests without incurring any cost to control forest land withdrawals.

(f) Supply levels of above 8.6 million cubic meters in 1980 and 10.6 million cubic meters in 2000 can be attained only by a combination of increased investments in man-made forests, improved logging and utilization, and control of forest land withdrawals. Therefore, wood supply at these levels costs more per cubic meter.

Cost for Additional Wood Supply

The average cost per unit of additional wood supply is a more meaningful indicator than the average for the total wood supply. This is obtained by dividing the increase in the budget cost by the additional supplies obtained as a result of the added cost. The listing below shows the average annual budget cost per cubic meter of additional wood supply obtained as a result of the increase in the current (1965) level of effort on logging and utilization, and man-made forests.

Details of the increases in current effort	Average annual budget cost per cubic meter of additional output	
	1980	2000
	-------1961 rupees--------	
Improvement in logging and utilization*	15.10	21.75
Intensified investment in man-made forests**	18.15	13.95
Highly intensified investment in man-made forests**	22.00	14.90
Improvement in logging and utilization plus intensified investment in man-made forests**	15.45	14.15
Improvement in logging and utilization plus highly intensified investment in man-made forests**	17.25	15.15

*This is a short-run measure and therefore is not very important for costing in the long-run.

**These are long-run measures and tend to increase the average budget cost per unit of wood in the short-run.

The annual budget cost consists of the costs incurred during the year on the short-run and the long-run measures and therefore, it is not a true representation of the actual cost of wood. While in the short-run the average cost per unit of additional wood supply resulting from short-run measures can be taken to represent the true cost, in the long-run the relevant cost will be the compounded cost per unit of output from man-made forests.

Cost of Production

A direct implication of man-made forests is heavy investment. As intensive investment in timber growing is a policy alternative, the cost of interest in the long-run is the future value of all costs occasioned by management. Therefore, the compounded cost per unit of output for plantations is the relevant cost. And, the cost of production for the additional units of wood by more expensive increments of investments is an important and useful measure for fixing the price of wood and/or for fixing the optimum level of production at a given price.

The compounded cost per unit of output for the three levels of investment on man-made forests at an interest rate of six percent is given in the following tabulation.

Alternative levels of investment	Compounded cost per cubic meter of output	Cost per cubic meter of additional output
	-------------1961	rupees--------------
(i)	16.64	..
(ii)	12.89	9.15
(iii)	16.27	25.28

To summarize:

The average budget cost per cubic meter of wood varies between 13.42 and 16.47 rupees in 1980 and between 14.10 and 18.00 rupees in 2000.

When additional budget cost for increased effort on wood production is considered, the average cost per additional cubic meter of output will vary from 15.10 to 22.00 rupees in 1980 and from 13.95 to 21.75 rupees in 2000.

The relevant cost is the compounded cost per unit of output for plantations and it varies between 12.89 and 16.64 rupees per cubic meter.

The compounded cost for additional output from plantations by 'highly intensified investment' has been estimated as 25.28 rupees per cubic meter, and this cost is important for pricing of wood.

PRICE OF WOOD AND WOOD SUPPLY

The primary justification for investment in wood production is the value of wood. Supply levels are influenced by price. An adverse gap between the requirements and supply normally exists only for short periods. Unmet requirements would result in an increase in the price of wood, and when price increases it may become advantageous to supply additional quantities.

The price of wood (average for all classes) in 1965 was 16 rupees per cubic meter. At the 1965 price level it would be possible to produce some additional units of wood, increasing the 1980 output from 6.7 to 8.7 million cubic meters. With a small price increase the wood supply can be increased further to the maximum feasible level of 9.0 million cubic meters.

If the average budget cost per cubic meter of wood is considered, it will not be advantageous to produce more than 10.6 cubic meters of wood in 2000, at the 1965 price level, even though the average cost for additional output to reach those higher supply levels is less than the 1965 price. This happens because the average cost per unit of wood under the high assumption of forest land availability is pushed up due to the cost involved for preventing the withdrawals.

As mentioned, the relevant cost in the long-run is the compounded cost (future compounded value of all costs) per cubic meter of wood for plantations. But when the average budget cost per unit of wood is higher, it will have to be given due consideration in deciding the supply goal. Thus, if the average annual budget cost and the compounded cost per unit of output is considered together, the 2000 wood supply will have to be limited to 8.5 million cubic meters at the 1965 price level.

If the compounded cost for the additional units of output from plantations is considered, wood supply can be increased to the maximum feasible level only at a price of 25.28 rupees or more per cubic meter.

For making assumptions regarding price, the cost per unit of additional output for plantations is taken into consideration, and the future wood price has been assumed to be 26 rupees per cubic meter. At the assumed price, it will be highly advantageous and justifiable to produce the maximum feasible quantity of wood.

THE BENEFITS OF WOOD SUPPLY

The benefits of wood supply is reflected in the annual profit, contribution to the employment of labor, contribution to the gross state product, and the development of wood-using industries. The extent of benefits will depend on policy decisions. The projected benefits of future wood supply will serve to compare the overall attractiveness of the various policy options and as an additional aid to take policy decisions.

Profit from Wood Supply

The annual profit from wood supply has been estimated by taking the difference between the estimated budget cost for the year and the estimated value of the projected wood supply. Wood value has been estimated for two different price levels, namely the 1965 price (16 rupees per cubic meter) and the assumed future price (26 rupees per cubic meter).

For the range of annual budget varying between 80.6 and 131.8 million rupees in 1980, the profit will be between 10.9 and 27.8 million rupees at the 1965 price level, and between 84.6 and 110.6 million rupees at the assumed future price. In terms of percentages, the range of estimated profit is between 9.2 and 33.0 at the 1965 price level and between 77.5 and 116.1 at the assumed future price (Table 6.2).

Table 6.2 Estimates of Annual Profit from Wood Supply in 1980

Assumptions			Profit at the 1965 price level		Profit at the assumed future price	
Forest land availability*	Short-run measures**	Long-run measures@	In millions of 1961 rupees	In percentages	In millions of 1961 rupees	In percentages
Low	(a)	(i)	26.6	33.0	93.6	116.1
		(ii)	26.0	30.2	96.0	109.1
		(iii)	23.1	24.6	96.1	102.6
	(b)	(i)	27.8	27.7	107.8	107.6
		(ii)	27.6	26.2	110.6	105.1
		(iii)	24.2	21.3	110.2	97.2
High	(a)	(i)	14.6	15.0	84.6	86.8
		(ii)	13.9	13.5	86.9	84.4
		(iii)	10.9	9.8	86.9	78.5
	(b)	(i)	15.8	13.3	99.8	84.1
		(ii)	15.3	12.3	102.3	82.6
		(iii)	12.2	9.2	102.2	77.5

*Assumptions regarding availability of forest land:

	1980	1990	2000
	---square kilometers---		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

**Assumptions regarding average annual wood yield per hectare of natural forest as a result of short-run measures:

	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

@Assumptions regarding average annual wood yield per hectare of man-made forest as a result of long-run measures:

	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

Similarly, for an annual budget varying between 70.1 and 189.3 million rupees in 2000, the profit will vary between 2.3 and 24.9 million rupees at the 1965 price level, and between 70.6 and 130.5 million rupees at the assumed future price. When expressed in terms of percentage, the range of estimated profit will be from 2.0 to 27.8 at the 1965 price level and from 65.7 to 107.7 at the assumed future price (Table 6.3).

Contribution to the Employment of Labor

Estimates of employment under the various policy alternatives are given in Table 5.5. Depending on the policy decisions, employment of labor will range between 15 thousand and 31 thousand in 1980, and between 16 thousand and 40 thousand in 2000. Considering the 1965 employment to be 100, the index of change in employment will range between 77 and 154 in 1980, and between 79 and 199 in 2000.

Forestry provides some relief to rural unemployment; but in terms of employment per hectare, forestry does not produce more 'jobs' than subsistance agriculture. Therefore, employment of labor cannot be a major consideration for making decisions about wood supply.

Contribution to the Gross State Product

Contribution to the gross state product is represented by the value added. The components of the value

Table 6.3 Estimates of Annual Profit from Wood Supply in 2000

Assumptions			Profit at the 1965 price level		Profit at the assumed future price	
Forest land availability*	Short-run measures**	Long-run measures@	In millions of 1961 rupees	In percentages	In millions of 1961 rupees	In percentages
Low	(a)	(i)	19.5	27.8	75.5	107.7
		(ii)	24.3	22.4	107.3	98.9
		(iii)	24.8	17.3	129.8	90.6
	(b)	(i)	18.4	25.3	75.4	103.6
		(ii)	24.9	22.4	109.9	98.9
		(iii)	23.8	16.3	129.8	89.0
High	(a)	(i)	2.6	2.4	70.6	66.5
		(ii)	9.0	6.2	105.0	72.6
		(iii)	7.9	4.4	124.9	69.6
	(b)	(i)	2.3	2.0	76.3	65.7
		(ii)	8.8	5.7	110.8	71.8
		(iii)	7.5	4.0	130.5	68.9

*Assumptions regarding availability of forest land:

	1980	1990	2000
	---square kilometers---		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

**Assumptions regarding average annual wood yield per hectare of natural forest as a result of short-run measures:

	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

@Assumptions regarding average annual wood yield per hectare of man-made forest as a result of long-run measures:

	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

added are the wages and salaries and the profit.

For the different policy outcomes depending on the government decisions, the contribution to the gross state product is estimated to range between 154 and 189 million rupees in 1980, and between 128 and 227 million rupees in 2000, at an assumed wood price of 26 rupees per cubic meter (Table 6.4).

Development of Wood-using Industries

The development of wood-using industries requires an increasing supply of wood. The most important benefit of increased wood supply is the development of wood-using industries resulting in increased output of wood products and more employment and income from the wood industry sector.

The projections have indicated that bulk of the future wood consumption will continue to be as fuelwood. The wood classified as fuelwood is also utilizable as industrial wood, if it can be made available for that purpose. But, fuel needs will have to be met with priority. In the absence of sufficient quantities of substitute fuels to replace wood, it will not be possible to reduce the fuelwood consumption to any considerable extent and to divert it to meet the demand for industrial wood. The development of wood-using industries will therefore depend on the increase in the total wood supply, and it requires to be co-ordinated with the programs for

Table 6.4 Estimates of the Contribution of Wood Supply to the Gross State Product of Kerala

Forest land availability*	Short-run measures**	Long-run measures@	Contribution to the gross state product 1980	2000
			--millions of 1961 rupees--	
Low	(a)	(i)	153.8	128.1
		(ii)	157.3	184.3
		(iii)	168.1	216.0
	(b)	(i)	182.9	128.4
		(ii)	187.0	187.8
		(iii)	189.3	217.8
High	(a)	(i)	157.4	147.5
		(ii)	162.8	192.7
		(iii)	165.6	220.0
	(b)	(i)	180.1	155.3
		(ii)	183.3	204.9
		(iii)	185.1	227.5

*Assumptions regarding availability of forest land:

	1980	1990	2000
	---square kilometers---		
Low	7,500	5,900	4,500
High	8,500	8,200	7,850

**Assumptions regarding average annual wood yield per hectare of natural forest as a result of short-run measures:

	1980	1990	2000
	-----cubic meters-----		
(a)	4.5	4.5	4.5
(b)	6.6	6.0	6.0

@Assumptions regarding average annual wood yield per hectare of man-made forest as a result of long-run measures:

	1980	1990	2000
	-----cubic meters-----		
(i)	8	8	8
(ii)	10	16	16
(iii)	12	22	22

wood production. Thus, the policy decisions affecting wood production have far-reaching implications.

COMPARISON OF THE WOOD SUPPLY AND REQUIREMENTS PROJECTIONS

The estimated wood supply in Kerala in 1980 ranges from 6.7 to 9.0 million cubic meters as against the estimated requirements ranging from 7.9 to 9.2 million cubic meters. The wood supply in 2000 will range from 5.6 to 12.3 million cubic meters as against the requirements ranging from 10.2 to 14.8 million cubic meters.

A comparison of these projections indicates a wood supply-requirements gap. Theoretically, the supply-requirements gap can range from the difference between the high estimate of wood requirement and low estimate of supply on the one side to the difference between the high estimate of wood supply and low estimate of requirements on the other. Thus, the theoretical gap (supply minus requirements) will be between -2.5 and +1.1 million cubic meters in 1980, and between -9.2 and +2.1 million cubic meters in 2000.

For the purpose of indicating the impact of policy decisions, two different situations are assumed regarding the wood supply-requirements gap. The assumed situations are these:

(1) Wide supply-requirements gap. The theoretical supply-requirements gap is only an expression to

cover the extremes. The activity in the wood industry sector will be controlled by the wood supply. Therefore, the range of wood supply will be the meaningful range for the development of wood-using industries. On that consideration the maximum wood supply-requirements gap is assumed to be the difference between the low and high levels of estimated wood supply.

(2) Narrow supply-requirements gap. The gap gets narrowed if the range of overlap of the estimated wood supply and requirements is considered to be the realistic range for the purpose of planning the development of forestry and wood-using industries (Figure 6.1).

IMPACT OF WOOD SUPPLY ON THE WOOD INDUSTRY SECTOR

The level of activity in the wood industry sector is decided by the level of wood supply. The impact of wood supply on the wood industry sector can be assessed from the employment of labor, the capital investment and the value added by manufacturing in that sector.

Employment of Labor

The expected range of employment in the wood industry sector is given for the two assumed situations of the supply-requirements gap in the following tabulation.

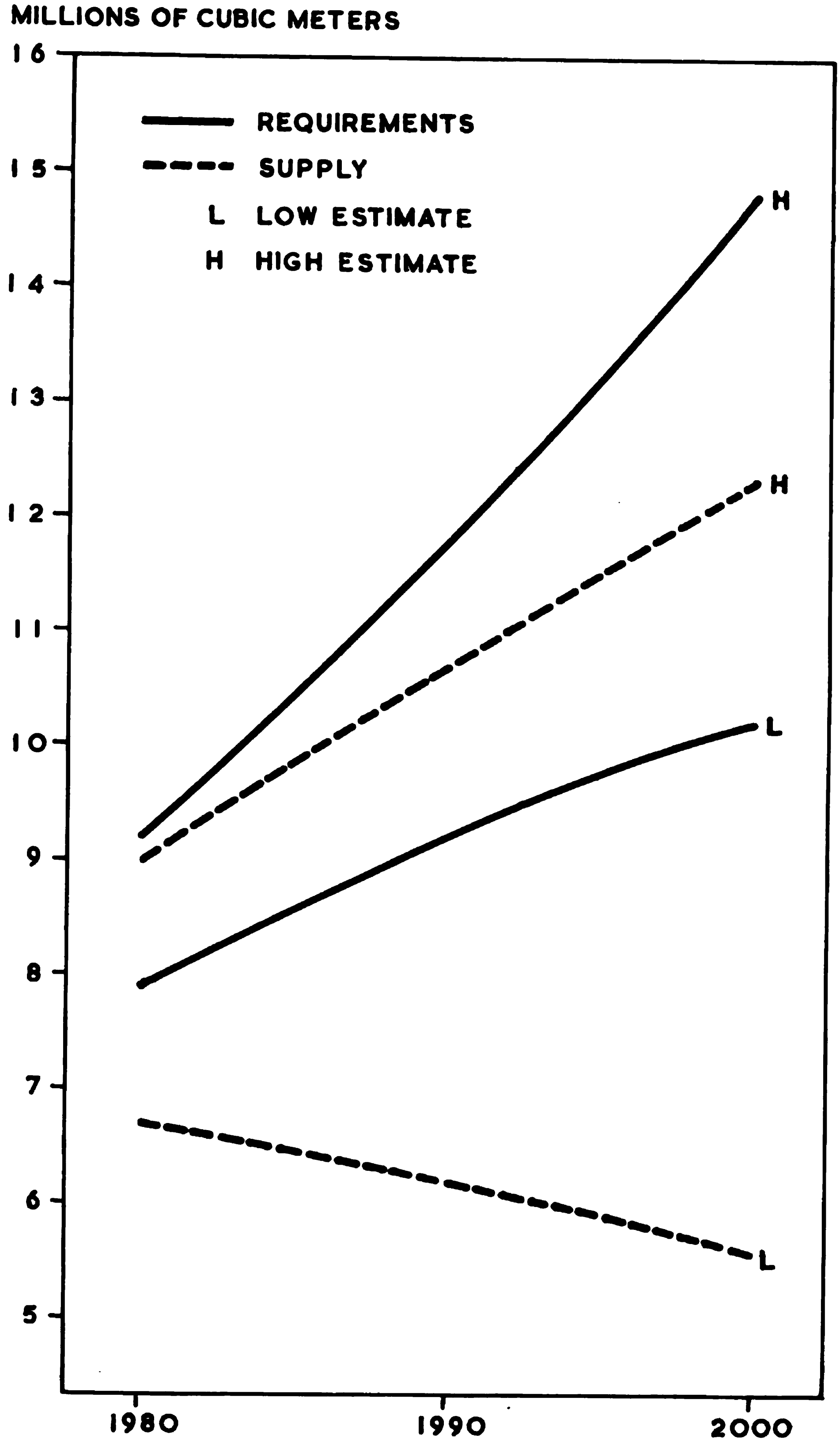

FIGURE 6.1

COMPARISON OF THE SUPPLY AND REQUIREMENTS PROJECTIONS FOR WOOD IN KERALA

Year	Range of employment	
	From	To
	--number of employees*--	
Wide supply-requirements gap		
1980	24,860 (92)	40,140 (149)
2000	20,780 (77)	53,270 (198)
Narrow supply-requirements gap		
1980	29,310 (109)	40,140 (149)
2000	34,760 (129)	53,270 (198)

*The figures in bracket give the index of change in employment. Index: 1965 = 100.

Investment

The range of the requirements for capital investment in the wood industry sector for the two assumed situations of supply-requirements gap will be as follows:

Period	Range of requirements for investment	
	From	To
	--millions of 1961 rupees--	
Wide supply-requirements gap		
1965 - 1980	162.9	759.3
1981 - 2000	nil	748.6
Total	162.9	1,507.9
Narrow supply-requirements gap		
1965 - 1980	358.6	759.3
1981 - 2000	435.6	748.6
Total	794.2	1,507.9

Value Added by Manufacturing

The estimates of value added by manufacturing in the wood-using industries of Kerala by 2000, for the two assumed situations of supply-requirements gap, vary within the range shown in the following tabulation.

Supply-requirements gap	Range of the value added by manufacturing	
	From	To
	--millions of 1961 rupees*--	
Wide	98.8 (120)	397.6 (482)
Narrow	228.6 (277)	397.6 (482)

*The figures in bracket give the index of change in value added by manufacturing. Index: 1965 = 100.

THE TOTAL EFFECT OF POLICY DECISIONS

The effect of the various policy decisions affecting wood supply on forestry sector and the effect of the outcomes of those decisions on wood industry sector can be combined to get the range of the total effect of the policy decisions.

Employment in Forestry and Wood-using Industries

The total effect of the various policy alternatives on the employment of labor is summarized in the following tabulation.

Year	Range of total employment	
	From	To
	--number of employees*--	
Wide supply-requirements gap		
1980	40,360 (86)	71,320 (151)
2000	36,680 (78)	93,380 (198)
Narrow supply-requirements gap		
1980	54,780 (116)	71,320 (151)
2000	63,800 (135)	93,380 (198)

*The figures in bracket give the index of change in total employment. Index: 1965 = 100.

Investment in Forestry and Wood-using Industries

The range in the estimated total requirements for capital investment in forestry and wood-using industries will be as follows:

Period	Range of total requirements for investment	
	From	To
	--millions of 1961 rupees--	
Wide supply-requirements gap		
1965 - 1980	418.9	1,237.3
1981 - 2000	338.0	1,634.6
Total	756.9	2,871.9
Narrow supply-requirements gap		
1965 - 1980	712.6	1,237.3
1981 - 2000	1,103.6	1,634.6
Total	1,816.2	2,871.9

Contribution of Forestry and Wood-using Industries to the Gross State Product

Depending on the government decisions, the total contribution of forestry and wood-using industries to the gross state product will range within the limits shown in the following tabulation.

Supply-requirements gap	Range of the total contribution to the gross state product by 2000	
	From	To
	--millions of 1961 rupees*--	
Wide	226.9 (132)	625.1 (364)
Narrow	434.5 (253)	625.1 (364)

*The figures in bracket give the index of change in the total contribution to the gross state product. Index: 1965 = 100.

SUMMARY

With regard to wood supply, the policy issues on which the Government must make decisions are: (i) to what extent to control forest land withdrawals, (ii) to what extent to invest in improving harvesting methods and practices, and (iii) to what extent to invest in timber growing. Based on the options under each of the issues, 12 different policy alternatives have been considered. The cost to the Government for each of the alternatives and their result on wood supply, employment and contribution to the gross state product have been estimated.

Depending on the policy decisions, the 1980 wood supply has been estimated to range from 6.7 to 9.0 million cubic meters. The 2000 wood supply will range from 5.6 to 12.3 million cubic meters.

The requirements for capital investment in forestry during the 1965 - 2000 period, to attain the projected supply levels, will range from 594 to 1,364 million rupees. The annual budget cost has been estimated to be within the range of 80.6 to 131.8 million rupees in 1980 and between 70.1 and 189.3 million rupees in 2000. The range of annual profit from wood supply is expected to be between 84.6 and 110.6 million rupees in 1980 and between 70.6 and 130.5 million rupees in 2000, at the assumed future price of 26 rupees per cubic meter.

For the various policy options, the employment in forestry is expected to range between 15 thousand and 31 thousand in 1980 and between 16 thousand and 40 thousand in 2000. Likewise, the contribution to the gross state product is expected to range from 154 to 189 million rupees in 1980 and from 128 to 227 million rupees in 2000.

The level of activity in the wood industry sector depends entirely on the wood supply. For the range of estimated wood supply, the employment of labor in the wood industry sector of Kerala has been projected to vary between 25 thousand and 40 thousand in 1980, and between 21 thousand and 53 thousand in 2000.

The requirements for capital investment in the wood industry sector during the 1965 - 2000 period will be between 163 and 1,508 million rupees, for a development commensurate with the wood supply. The value added by manufacturing in the wood industry sector of Kerala is then expected to range from 99 to 398 million rupees by 2000.

Together, forestry and wood industry sectors will require a total investment ranging between 757 and 2,872 million rupees during the 1965 - 2000 period. The total labor requirement will range from 40 thousand to 71 thousand by 1980 and from 37 thousand to 93 thousand by 2000. The total contribution to the gross state product by 2000 from forestry and wood industry sectors will range from 227 to 625 million rupees.

Appendix A

MAJOR GROUPS AND SUB-GROUPS OF WOOD-USING INDUSTRIES

Appendix A

MAJOR GROUPS AND SUB-GROUPS OF WOOD-USING INDUSTRIES

Major group	Group	Sub-group	Name of the industry as given in the Indian Standard Industrial classification
25	251	..	Sawmills, Planing mills and other wood-based mills
		251 - 1	Sawmilling
		251 - 2	Plywood
	252	..	Wooden and cane containers and cane small-ware
	259	..	Manufacture of wood and cork products not elsewhere classified
		259 - 1	Joinery and general wood working
		259 - 2	Others
26	260	260 - 1	Manufacture of wooden furniture and fixtures
27	271	271 - 1	Pulp - wood pulp, mechanical and chemical including dissolving pulp
		271 - 2	Paper - writing, printing and wrapping
		271 - 3	Newsprint
		271 - 4	Paperboard and strawboard
		271 - 5	Paper for packaging (corrugated paper, kraft paper, paper bags, paper containers etc.)
		271 - 6	Hardboard including fiberboard and chipboard
		271 - 7	Others
31	319	319 - 8	Matches
36	360	360 - 8	Agricultural implements
38	381	381 - 2	Boat building
39	399	399 - 1	Brooms and brushes
		399 - 4	Pencil making
		399 -11	Games and sports goods
		399 -12	Toy manufacturing
		399 -14	Wrapping, packing, filling etc. of articles

Appendix B

GROUPING OF WOOD-USING INDUSTRIES ADOPTED IN THIS STUDY

Appendix B

GROUPING OF WOOD-USING INDUSTRIES ADOPTED IN THIS STUDY

Wood-using industry	Group or sub-group	Name of the industry as given in the Indian Standard Industrial classification
Sawnwood	251 - 1	Sawmilling
Plywood	251 - 2	Plywood
Fiberboard and particleboard	271 - 6	Hardboard including fiber-board and chipboard
Pulp and paper	271 - 1	Pulp - wood pulp, mechanical and chemical including dissolving pulp
	271 - 2	Papers - writing, printing and wrapping
	271 - 3	Newsprint
	271 - 4	Paperboard and strawboard
	271 - 5	Paper for packaging (corrugated paper, kraft paper, paper bags, paper containers etc.)
	271 - 7	Others
Matches	319 - 8	Matches
Other wood-using industries	252	Wood and cane containers and cane small-ware
	259	Manufacturing of wood and cork products not elsewhere classified
	260	Manufacture of wooden furniture and fixtures
	360 - 8	Agricultural implements
	381 - 2	Boat building
	399 - 1	Brooms and brushes
	399 - 4	Pencil making
	399 -11	Games and sports goods
	399 -12	Toy manufacturing
	399 -14	Wrapping, packing, filling etc. of articles

Appendix C

PROJECTIONS OF WOOD CONSUMPTION IN KERALA BY PRODUCT AND THEIR ECONOMIC IMPLICATIONS

CONTENTS

Appendix C

PROJECTIONS OF WOOD CONSUMPTION IN KERALA BY PRODUCT AND THEIR ECONOMIC IMPLICATIONS

SAWNWOOD

Sawnwood is used for a variety of uses and in terms of roundwood equivalent it accounts for about half of all the wood products consumed.

Consumption Trend

The total consumption of sawnwood registered sharp increase between 1950 and 1967. The annual rate of increase was 2.75 percent in Kerala as against 4.75 percent in India.

The sawnwood consumption figures for Kerala are given in the following tabulated statement.

Year	Total consumption	Per capita consumption
	--thousands of cubic meters (sawn)--	--cubic meters (sawn)--
1950	231	0.0170
1955	260	0.0178
1960	299	0.0180
1965	355	0.0193
1967	367	0.0201

Source: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

<u>End uses of sawnwood.</u> The most significant end use of sawnwood has been for construction (Table C.1). Construction includes the erection, maintenance and repairs of immovable structures and utilities (eg. buildings, railways, tunnels, wharfs, electrical installations, transmission lines, telephone and telegraph lines etc.) together with the integral service facilities.

Construction use accounted for 87.5 percent of total sawnwood use in Kerala as against 71.4 percent in India in 1965.

Construction of residential buildings was the most important of the construction activities. Use of wood in residential constructions is influenced to a great deal by relative abundance of wood in the locality and by climatic conditions and habit. Compared to some of the western countries, wood use in residential construction in India is very low and the main items for which wood is used are doors and windows.

Official Consumption Targets

Consumption targets for sawnwood are 471 thousand cubic meters (sawn) by 1980, 586 thousand cubic meters (sawn) by 1990 and 645 thousand cubic meters (sawn) by 2000 (Table C.2). Construction industry will continue to consume the largest percentage of sawnwood. Some of the important assumptions and considerations which have weighed in fixing the official consumption targets for

Table C.1 Consumption of Sawnwood in Kerala, 1965

Uses	Consumption of sawnwood
	--cubic meters (sawn)--
Constructional uses	
Residential buildings	228,200
Non-residential buildings	50,200
Railways, bridges, tunnels, wharfs etc.	14,400
Other construction	7,200
Sub total	300,000
Other uses	
Mining and quarrying	600
Transport equipments	10,200
Wood works including furniture, sports goods etc.	18,000
Packaging	12,600
Agricultural implements	1,800
Miscellaneous	12,000
Sub total	55,200
Grand total	355,200

Sources: Kerala Forest Department.

Kerala Public Works Department.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

Table C.2 Consumption Targets of Sawnwood for Different End Uses in Kerala

End use	1980	1990	2000
	-----thousands of cubic meters (sawn)-----		
Residential buildings	298	356	368
Non-residential buildings	75	107	129
Railways, bridges, tunnels, wharfs etc. and other constructions	20	25	30
Mining and quarrying	1	1	1
Transport equipments	10	10	10
Wood works including furniture, sports goods etc.	20	25	30
Packaging	25	35	45
Agricultural implements	2	2	2
Miscellaneous	20	25	30
Total	471	586	645

Sources: Government of India, National Building Organization, New Delhi.

Government of India, Directorate General of Technical Development, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

residential and non-residential buildings are listed.

(a) The average number of persons per household in Kerala was 5.6 in 1941, 6.2 in 1951, 6.1 in 1961 and 6.2 in 1971 as recorded in the decennial census. With the increase in income and urbanization and with the growing social favour for single family system (as against the extended or joint family system), the average number of persons per household is expected to be reduced to 6.0 by 1980, 5.5 by 1990 and 5.0 by 2000.

(b) It has been assumed that the construction of new households will be evenly spread over time and that the replacement of old, overaged and obsolescent houses will require additional sawnwood to the extent of five percent of the sawnwood use in building new residential houses. An additional five percent is assumed to be the requirement for repairs and maintenance work.

(c) The average quantity of sawnwood consumed in Kerala for construction of residential buildings in 1965 was 2.9 cubic meters per unit. Considering the possibility of substitution of sawnwood by other materials, and substitution of other materials by sawnwood, it is assumed that there will be no increase in the sawnwood use and that the present level of consumption will be maintained.

(d) It has been assumed that the use of wood in non-residential buildings will be proportionately low compared to the investment involved and that the sawnwood use expressed as a percentage of sawnwood use for residential buildings will be about 25 in 1980, 30 in 1990 and 35 in 2000.

The requirement of sawnwood for other uses has been fixed arbitrarily, based on past experience and expected future developments.

Estimates of Future Consumption

Four different estimates of future consumption of sawnwood have been made, as explained in Chapter 4 (Table C.3). The consumption estimates have been reduced

Table C.3 Estimates of Future Consumption of Sawnwood in Kerala

Projection procedure	1980	1990	2000
	--thousands of cubic meters (sawn)--		
1	471	586	645
2	532	706	935
3	593	720	815
4	619	741	825

1. Official target.

2. Extention of consumption time trend. The prediction equation used to estimate consumption of sawnwood is:

$$Y = e^{5.4314 + .02817t}$$

where Y is the consumption in thousands of cubic meters (sawn) and

t is the time period in years between the target year and 1950.

3. 4. Income-consumption relationship. The prediction equations used to estimate per capita consumption of sawnwood are:

$$Y = e^{(-.061049 \times 10^{8})I_1^{-3} - 3.69187}$$

and

$$Y = e^{(-.061049 \times 10^{8})I_2^{-3} - 3.69187}$$

where Y is the consumption per capita in cubic meters (sawn) and

I_1 and I_2 are alternative per capita income assumptions.

to two alternative levels (low and high) after plotting the estimate figures against the year to which it pertains (Figure C.1). The two levels of future consumption are given in the following tabulation.

Year	Alternative levels of future consumption	
	Low	High
	--thousands of cubic meters (sawn)--	
1980	480	570
1990	586	745
2000	670	930

<u>Export Consumption</u>

Kerala has been producing sawnwood, much more than its requirement for consumption (Table C.4). It is also in national interest that Kerala should produce for export consumption, to meet the requirements of the neighbouring states, national railways, defence industries and so on.

A large quantity of round logs are now being exported from Kerala annually. Considering that the export of unprocessed wood will be reduced in the future, it is assumed that Kerala will maintain a production-consumption ratio of 1.4 for sawnwood during the period under consideration.

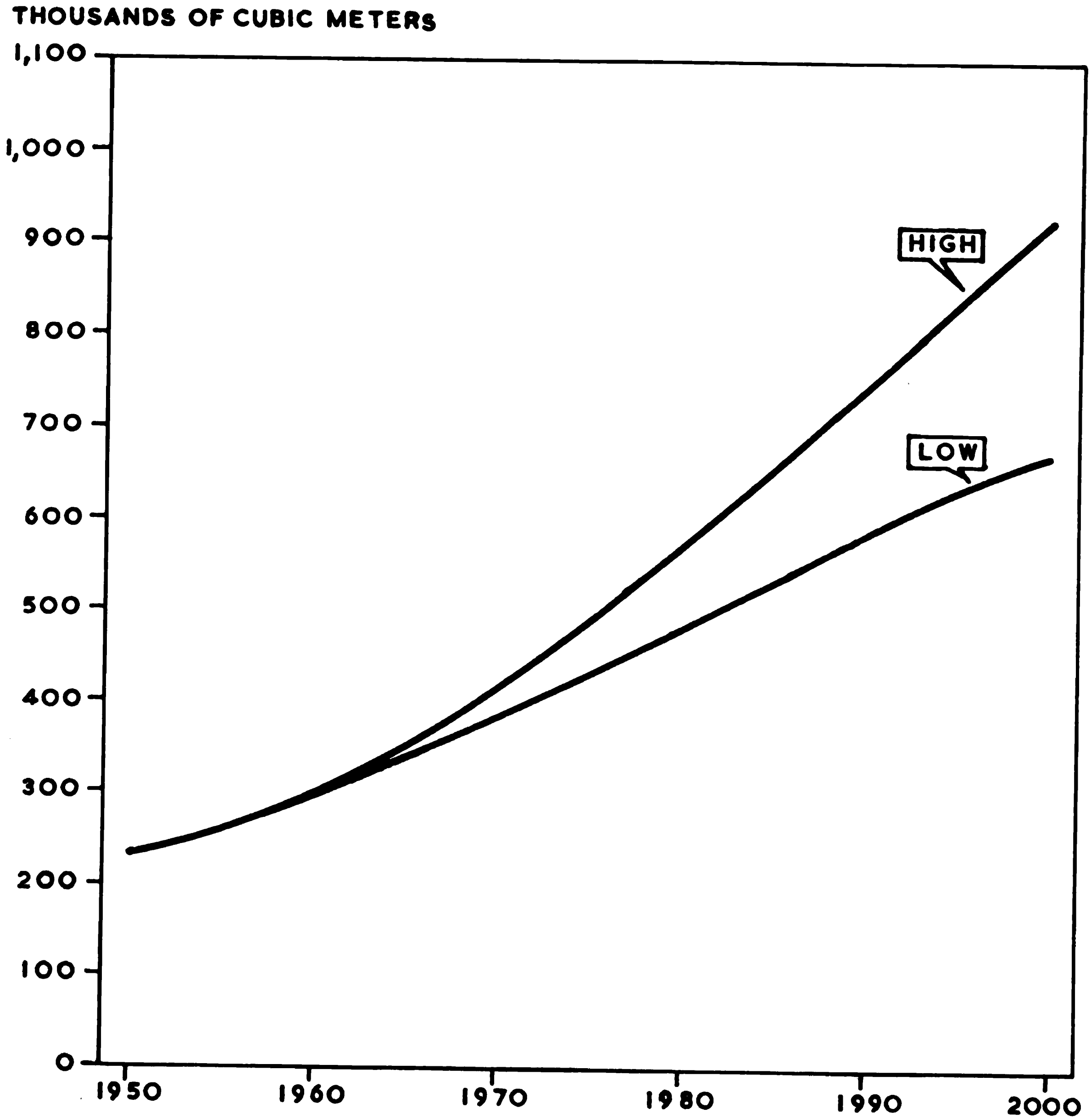

FIGURE C·1
CONSUMPTION PROJECTIONS FOR SAWNWOOD IN KERALA

Table C.4 Production-Consumption Ratio for Sawnwood in Kerala

Year	Production	Consumption	Production-consumption ratio
	--thousands of cubic meters (sawn)--		
1947	301	210	1.43
1950	379	231	1.64
1955	410	260	1.58
1960	478	299	1.60
1965	490	355	1.38
1967	527	367	1.44

Source: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

The Consumption Outlook

The alternative estimates of consumption outlook are given in the following tabulation.

Year	Alternative estimates of consumption outlook	
	Low	High
	--thousands of cubic meters (sawn)--	
1980	672	798
1990	820	1,043
2000	938	1,302

Characteristics of the Future Sawmill Units

Assumptions about future unit characteristics are made on the basis of considerations discussed below.

(a) In order to improve productivity it will be necessary for pit-saw teams and non-factory units to give way to organized industrial units. Improved layout and equipments (eg. multiple band saws, circular saws etc.) will increase the efficiency of sawmills.

(b) Apart from the type of the saw and thickness of the saw blades, log length, log diameter, quality and grade of logs, market and end use requirements are factors influencing sawnwood recovery. Thus, improvement of logging specifications would help to get better percentage of recovery.

(c) Modern timber engineering (and the development of edge and end jointing) has made it possible to use short length, small dimensioned timber. This has resulted in great saving in wood and has increased the outturn of sawn sizes in terms of effective usable materials, by extracting small sizes from slabs and edgings.

(d) Integration of sawmills with other industrial units like that of furniture, fiberboard and particleboard will lead to maximum utilization of roundwood.

(e) Considering the large scale unemployment and availability of cheap labor, it is not realistic to expect Kerala to go for high level mechanization for labor saving. It is also not likely that Kerala will go for very large sawmill units in spite of the economy of scale. It is expected that small high-production sawmills and medium sized sawmills will dominate the scene of sawmilling industry.

The following are the assumptions about unit characteristics of sawmilling industry in Kerala.

Characteristics	Unit	1980	1990	2000
Average requirement of sawlogs per cubic meter of sawnwood	Cubic meters	1.54	1.43	1.33
Average requirement of labor per cubic meter of sawnwood	Man-days	2.0	1.5	1.2
Average requirement of capital investment per cubic meter of additional capacity to be generated*	1961 rupees	75	105	120

*The investment per unit of output depends on the number of shifts worked. There are only few sawmills which work two shifts at present. It is assumed that at least 50 pércent of the units will work on a two shift basis, in the future.

Wood Requirement

The requirement of sawlogs has been estimated, based on the assumed unit characteristics for the two alternative levels of estimated future consumption of sawnwood.

Year	Alternative estimates of consumption outlook	
	Low	High
	--thousands of cubic meters (round)--	
1980	1,035	1,229
1990	1,173	1,491
2000	1,248	1,732

Employment of Labor

Labor requirement has been calculated assuming an operation of 300 days per year. The labor requirement to meet the production target indicates that employment in sawmilling industry will register a decrease between 1965 and 2000, in spite of the increase in production and that to keep up the employment production has to increase very considerably.

Year	Alternative estimates of consumption outlook	
	Low	High
	--number of employees--	
1980	4,480	5,320
1990	3,960	5,215
2000	3,752	5,208

Investment

Requirement of capital investment has been worked out on the assumption of an operating ratio of 0.9.

Period	Alternative estimates of consumption outlook	
	Low	High
	--millions of 1961 rupees--	
1965 - 1980	19.13	29.77
1981 - 1990	17.22	28.56
1991 - 2000	15.72	34.56
Total	52.07	92.89

PLYWOOD

Plywood is one of the wood-based panel products, the others being fiberboard and particleboard. These products are interchangeable for most of the end uses - in building construction, furniture, packaging and so on.

Consumption Trend

On a per capita basis the consumption of plywood (including veneers) in Kerala has been about three times the average of India. Over the period 1950 to 1967 the consumption of plywood increased at an annual rate of 8.5 percent in Kerala.

Consumption trend of plywood (including veneers) in Kerala is given in the following tabulation.

Year	Total consumption	Per capita consumption
	--thousands of square meters (4 mm basis)--	--square meters (4 mm basis)--
1950	805	0.061
1955	1,150	0.078
1960	1,760	0.114
1965	2,800	0.152
1967	3,240	0.168

<u>Sources</u>: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

The Federation of Plywood Industry, New Delhi.

<u>End uses of plywood</u>. Plywood is popular for diverse uses. But, its most prominant use has been as tea-chests. The use pattern of plywood during 1965 has been as follows.

Uses	Consumption of plywood
	--thousands of square meters (4 mm basis)--
Residential buildings	200
Non-residential buildings	400
Other construction	100
Transport equipments	600
Wood works including furniture	200
Packaging	1,300
Total	2,800

<u>Source</u>: The Federation of Plywood Industry, New Delhi.

<u>Official Consumption Targets</u>

Consumption targets for plywood are 5.6 million square meters by 1980, 10.5 million square meters by 1990

and 16.7 million square meters by 2000 on 4 mm basis (Table C.5). Important assumptions and considerations which have weighed in fixing official consumption targets are the following.

(a) Plywood goes into packaging industry mainly as plywood chests for packing tea leaves. As the scope for expansion of tea industry in India is limited, there cannot be any great increase in the consumption of tea-chest plywood. There is, of course, possibility of increase in the consumption of plywood as a general packaging material. As a packaging material plywood will have to face competition from plastic bags, paper bags and boxes, light wooden chests and wire bound folding chests.

(b) The average use of plywood in residential building construction in 1965 was three square meters per unit in Kerala. The corresponding figure for non-residential buildings was 17.5 square meters.

(c) The assumption regarding the use of plywood in building construction is that there will be progressively increasing use of plywood for flush doors, partition walls, ceiling and wall panelling, cabinets and so on. Upkeep and improvements of buildings are also expected to register increased use of plywood.

(d) Use of plywood in other constructions, transport equipments and wood works is also expected to increase steadily.

Estimates of Future Consumption

The four different estimates of future consumption of plywood in Kerala are given in Table C.6. The consumption estimates have been reduced to two alternative levels (low and high) after plotting the estimated figures against the target year to which it pertains (Figure C.2). The two levels of consumption estimates for plywood are

Table C.5 Consumption Targets of Plywood for Different End Uses in Kerala

End use	1980	1990	2000
	--thousands of square meters (4 mm basis)--		
Residential buildings	804	2,706	3,949
Non-residential buildings	1,420	3,470	7,520
Other constructions	300	500	700
Transport equipments	800	900	1,000
Wood works including furniture	500	700	900
Packaging	1,800	2,200	2,600
Total	5,624	10,476	16,669

Sources: Government of India, National Building Organization, New Delhi.

Government of India, Directorate of Technical Development, New Delhi.

National Planning Commission, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

Table C.6 Estimates of Future Consumption of Plywood in Kerala

Projection procedure	1980	1990	2000
	----thousands of square meters (4 mm basis)----		
1	5,624	10,476	16,669
2	9,510	22,026	50,620
3	11,362	18,930	24,519
4	15,002	22,950	26,631

1. Official target.

2. Extention of consumption time trend. The prediction equation used to estimate consumption of plywood is:

$$Y = e^{6.66237 + .08341t}$$

where Y is the consumption in thousands of square meters (4 mm basis) and

t is the time period in years between the target year and 1950.

3. 4. Income-consumption relationship. The prediction equations used to estimate per capita consumption of plywood are:

$$Y = e^{(-.408775 \times 10^8)I_1^{-3} - .20664}$$

and

$$Y = e^{(-.408775 \times 10^8)I_2^{-3} - .20664}$$

where Y is the consumption per capita in square meters (4 mm basis) and

I_1 and I_2 are alternative per capita income assumptions.

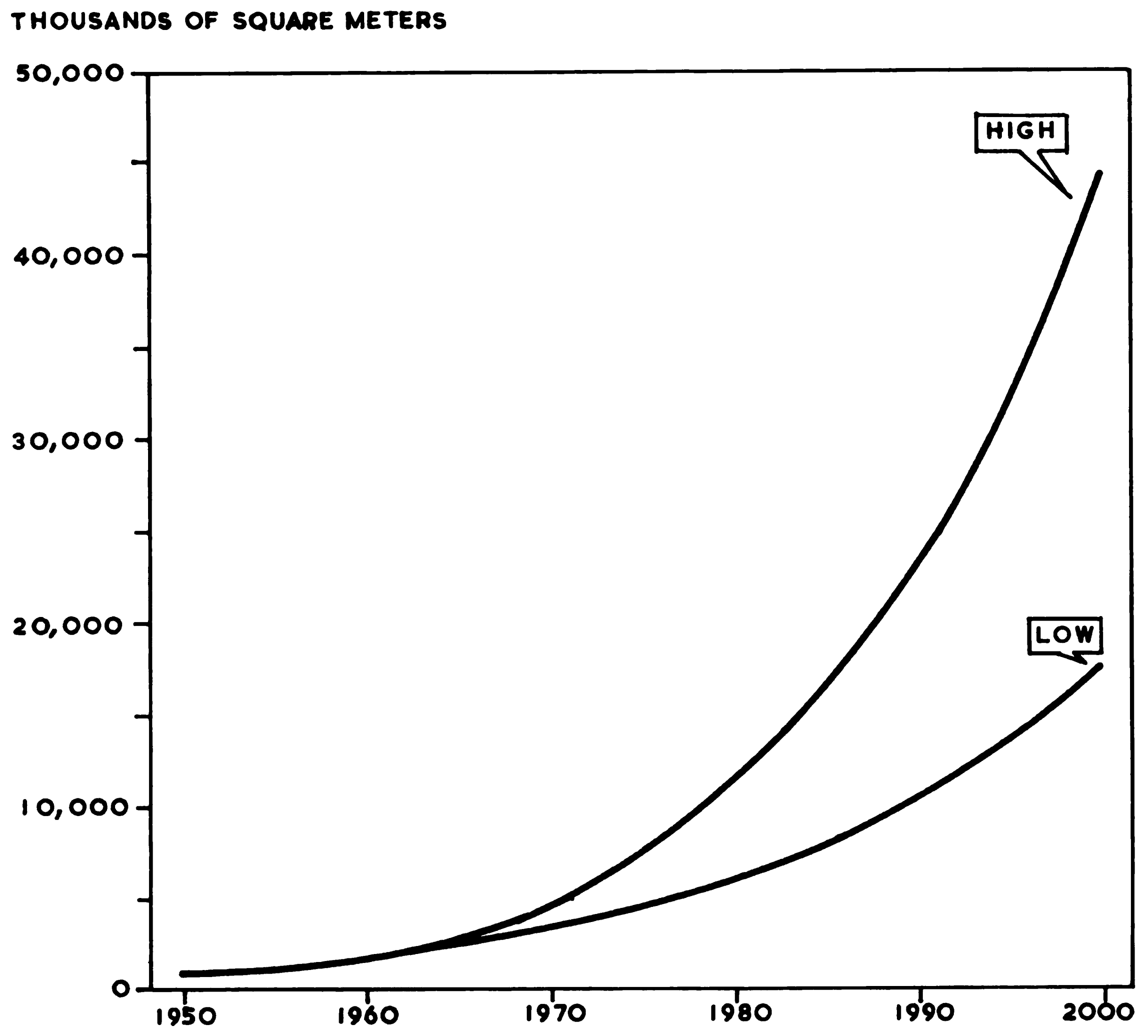

FIGURE C·2

CONSUMPTION PROJECTIONS FOR PLYWOOD IN KERALA given in the following tabulation.

Year	Alternative levels of future consumption	
	Low	High
	--thousands of square meters (4 mm basis)--	
1980	5,800	11,300
1990	10,500	22,700
2000	17,500	44,500

Export Consumption

Kerala has been a net exporter of plywood and has been maintaining a production-consumption ratio of over 1.50 (Table C.7).

Kerala is expected to keep up its lead in plywood production and its market outside the State, by improving the quality of production. The scarcity of plylogs in most parts of India, makes it incumbent that states like Kerala which are better placed in this respect should produce more than its own requirements.

The Consumption Outlook

For the purpose of estimating consumption outlook for plywood, it is assumed that the production-consumption ratio for plywood in Kerala will be 1.50. The consumption outlook, corresponding to the two levels are given in the following tabulation.

Table C.7 Production-Consumption Ratio for Plywood in Kerala

Year	Production	Consumption	Production-consumption ratio
	----thousands of square meters (4 mm basis)----		
1947	1,248	640	1.95
1950	1,449	805	1.80
1955	1,840	1,150	1.60
1960	2,728	1,760	1.55
1965	4,616	2,800	1.65
1967	4,860	3,240	1.50

<u>**Sources**</u>: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

The Federation of Plywood Industry, New Delhi.

Year	Alternative estimates of consumption outlook	
	Low	High
	----thousands of square meters (4 mm basis)----	
1980	8,700	16,950
1990	15,750	34,050
2000	26,250	66,750

Characteristics of the Future Plywood Units

The productivity and manufacturing economics of plywood industry are being improved. With the improvement in the processing technology and equipment the conversion factor for plywood is also expected to increase.

In assuming the unit characteristics of plywood industry the following aspects have been taken into consideration.

(a) The actual production of plywood is only 47 percent of the rated capacity in Kerala as against 70 percent in India. Therefore, part of the expansion of output can be achieved, initially, by operating the mills to full capacity.

(b) The percentage of outturn of plywood depends on log size, log form and log quality. It also depends on the end use for which the plywood will be required. For example, for furniture and other purposes where appearance is important, there will be more waste compared to those required for construction, containers and utility purposes.

(c) With the growing popularity of commercial (decorative and massgrade) plywood, a greater number of species which could not be used for tea-chests due to smell or color will be used. The great differences in the physical characteristics of the logs would also affect the conversion factor for plywood.

(d) Improvement in the layout of the mill, increase in speed of veneer cutters, reduction in the dimention of residual core etc. would help to increase the percentage of outturn.

(e) It is not advantageous to go in for labor saving devices and high level of automation, considering the un-employment in the State. Therefore, the future units, while adopting modern technology, would refrain from deliberately introducing labor saving devices.

The assumptions on the unit characteristics of plywood industry are as follows.

Characteristics	Unit	1980	1990	2000
Average requirement of plylogs per thousand square meter of plywood (4 mm basis)	Cubic meters	8.00	7.27	6.66
Average requirement of labor per thousand square meter of plywood (4 mm basis)	Man-days	110	95	85
Average requirement of capital investment per thousand square meter of plywood (4 mm basis) of additional capacity to be generated*	1961 rupees	2,250	2,750	2,900

*The investment requirement has been worked out assuming a two shift operation.

Wood Requirement

The requirement of plylogs has been estimated, based on the assumed unit characteristics for the two alternative levels of estimated future consumption of plywood.

Year	Alternative estimates of consumption outlook	
	Low	High
	--thousands of cubic meters (round)--	
1980	69.60	135.60
1990	114.50	247.54
2000	174.83	444.56

Employment of Labor

Labor requirement has been worked out on the basis of 300 working days per year. Even under the low estimate, the employment by 2000 will be more than three times that of 1965.

Year	Alternative estimates of consumption outlook	
	Low	High
	--number of employees--	
1980	3,190	6,215
1990	4,987	10,782
2000	7,437	19,912

Investment

Plywood is a moderately capital intensive industry. The investment needs have been estimated assuming an operating ratio of 0.9.

Period	Alternative estimates of consumption outlook	
	Low	High
	--millions of 1961 rupees--	
1965 - 1980	2.25	22.73
1981 - 1990	21.45	52.25
1991 - 2000	33.93	105.56
Total	57.63	180.54

FIBERBOARD AND PARTICLEBOARD

Fiberboard and particleboard are interchangeable for many end uses.

Fiberboard and particleboard are amenable for re-manufacturing, special processing, mechanical treatments and chemical treatments. The greatest outlet for fiberboard and particleboard in India is in construction, mainly for sound insulation and for interior uses such as panel material, partition walls, wall sheaths, doors and windows, cabinets, flooring and frame work. The boards are used as corestock for veneer and other overlaid furniture and for sandwich panels. Fiberboard and particleboard also find uses for advertisement displays (especially as perforated boards), fixtures and packaging.

Consumption Trend

Fiberboard and particleboard are relatively new products. Consumption details are available only from 1960. Over the period 1960 to 1968 the consumption of fiberboard increased at an annual rate of about 8.5 percent in Kerala. During the same period the increase in consumption of fiberboard was at a rate of 11.5 percent.

The details of past consumption of fiberboard and particleboard in Kerala are given in the following tabulation.

Year	Fiberboard		Particleboard	
	Total consumption	Per capita consumption	Total consumption	Per capita consumption
	--metric tons--	--kilo-grams--	--metric tons--	--kilo-grams--
1960	790	0.048	92	0.006
1965	2,050	0.111	168	0.009
1967	1,400	0.073	160	0.008
1968	1,530	0.078	220	0.011

Sources: The Federation of Plywood Industry, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

The consumption of fiberboard and particleboard has remained so far at a very low level due to the fact that there has been hardly any price advantage in going for these products.

End uses of fiberboard and particleboard. The significant end uses of fiberboard and particleboard are for construction and furniture and the use of it for these purposes is expected to increase due to its special advantages. During 1965, construction industry accounted for 44 percent of the total use of fiberboard and particleboard. Furniture making accounted for 39.5 percent.

Official Consumption Targets

Consumption targets for fiberboard and particleboard are 34 thousand metric tons by 1980, 51.7 thousand metric tons by 1990 and 73.5 thousand metric tons by 2000 (Table C.8). The major considerations in fixing the official targets are the following.

(a) Apart from the overall expansion of consumption of wood products that accompanies economic development, it is expected that

(i) the need to find substitutes for solid wood which has become relatively scarce and

(ii) the possibility to turn the logging residues and the residues arising in the wood-using industries to profitable account, by utilizing it for boards

would lead to the rapid growth of consumption of fiberboard and particleboard.

(b) New use practices for fiberboard and particleboard, promotional activities by the industry, relaxation of construction codes and standards etc. would also help to increase the consumption of these products.

(c) The boards have advantages like lightness, ease of erection and ease of removal. When boards are substituted for sawnwood there is also a reduction in total volume consumed. The boards have continuing advantage over sawnwood because

Table C.8 Consumption Targets of Fiberboard and Particleboard for Different End Uses in Kerala

End use	Fiberboard			Particleboard		
	1980	1990	2000	1980	1990	2000
	--------thousands of metric tons----------					
Construction	12.0	20.0	30.0	10.0	15.0	22.0
Furniture	4.0	6.0	8.0	3.5	4.0	5.0
Transport equipments	1.5	2.5	3.0	1.0	1.5	2.0
Others	1.0	1.5	2.0	1.0	1.2	1.5
Total	18.5	30.0	43.0	15.5	21.7	30.5

Sources: Government of India, National Building Organization, New Delhi.

Government of India, Directorate of Technical Development, New Delhi.

National Planning Commission, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

of more flexible sources of raw materials and greater possibilities for improvements in processing techniques (FAO 1966).

(d) Fiberboard and particleboard have to compete with non-wood materials like brick, stone, plaster, steel, concrete, aluminium, asbestos, plastics, ceramic tiles, rubber and linoleum. Due to the possibility to give special surface finishes and overlays, it is expected that the fiberboard and particleboard will be used in larger quantities in the future.

Estimates of Future Consumption

The different estimates of future consumption of fiberboard and particleboard are given in Table C.9.

A perusal of the table indicates that the estimate according to the projection procedure (1), which gives the official target, is very ambitious and much higher than the other estimates. This aspect has been considered and given due weight, while reducing the estimates to two alternative levels (Figures C.3 and C.4). The two levels of future consumption are as follows.

Year	Alternative levels of future consumption			
	Fiberboard		Particleboard	
	Low	High	Low	High
	---------thousands of metric tons---------			
1980	3.50	10.00	0.60	4.40
1990	5.00	30.00	1.00	14.00
2000	6.10	40.00	1.30	20.00

Table C.9 Estimates of Future Consumption of Fiberboard and Particleboard in Kerala

Projection procedure	Fiberboard			Particleboard		
	1980	1990	2000	1980	1990	2000
	---------thousands of metric tons---------					
1	18.5	30.0	43.0	15.5	21.7	30.5
2	4.7	10.7	24.3	0.7	1.8	4.7
3	3.5	5.0	6.0	0.6	0.9	1.2
4	4.1	5.6	6.3	0.8	1.1	1.3

1. Official target.

2. Extention of consumption time trend. The prediction equation used to estimate consumption is:

$Y = e^{5.98422 + .0823t}$ for fiberboard and

$Y = e^{3.55939 + .09795t}$ for particleboard

where Y is the consumption in metric tons and

t is the time period in years between the target year and 1950.

3. 4. Income-consumption relationship. The prediction equations used to estimate per capita consumption are:

$$Y = e^{(-.23142 \times 10^8)I_1^{-3} - 1.64964}$$

and

$$Y = e^{(-.23142 \times 10^8)I_2^{-3} - 1.64964}$$ for fiberboard and

$$Y = e^{(-.38038 \times 10^8)I_1^{-3} - 3.22632}$$

and

$$Y = e^{(-.38038 \times 10^8)I_2^{-3} - 3.22632}$$ for particleboard

where Y is the consumption per capita in kilograms and

I_1 and I_2 are alternative per capita income assumptions.

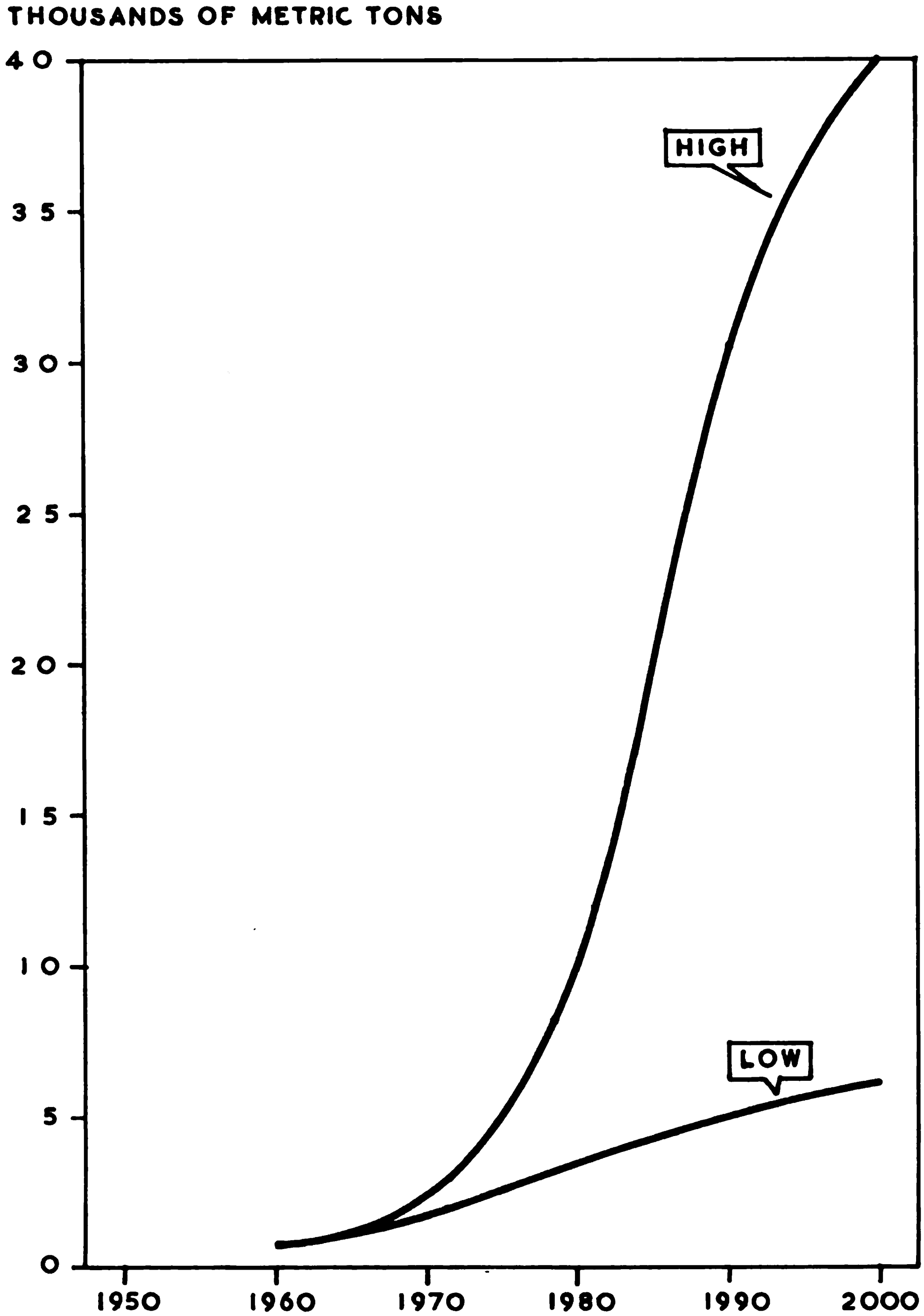

FIGURE C.3
CONSUMPTION PROJECTIONS FOR FIBERBOARD IN KERALA

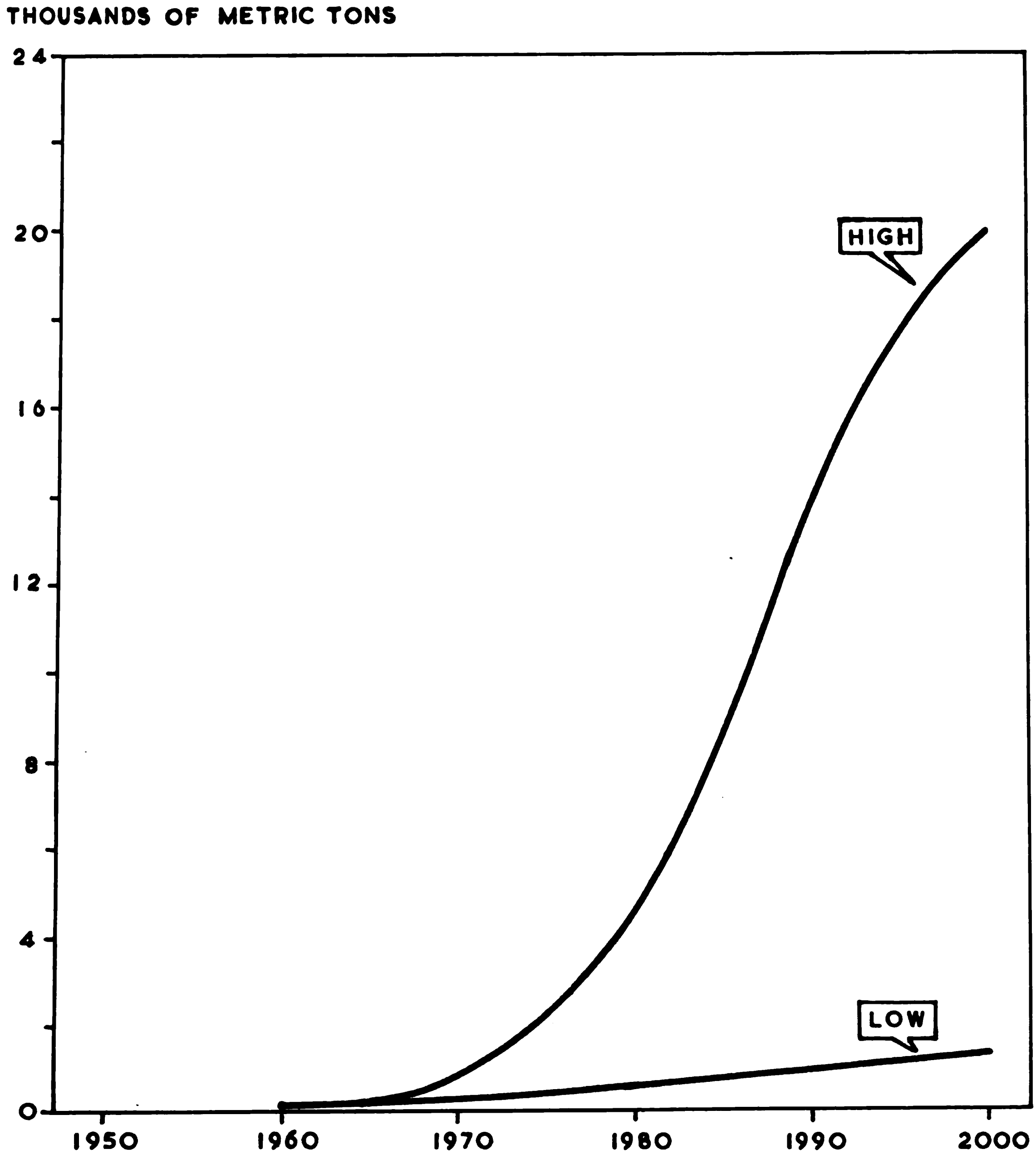

FIGURE C·4

CONSUMPTION PROJECTIONS FOR PARTICLEBOARD IN KERALA

Export Consumption

Kerala has been maintaining a production-consumption ratio of over two (Table C.10). It is assumed that the State will have a production-consumption ratio of at least two, considering the comparative advantage enjoyed by it.

The Consumption Outlook

The consumption outlook corresponding to the two levels of future consumption are given in the following tabulated statement.

Year	Alternative estimates of consumption outlook			
	Fiberboard		Particleboard	
	Low	High	Low	High
	----------thousands of metric tons----------			
1980	7.0	20.0	1.2	8.8
1990	10.0	60.0	2.0	28.0
2000	12.2	80.0	2.6	40.0

Characteristics of the Future Fiberboard and Particleboard Units

The unit characteristics of the future fiberboard and particleboard units have been assumed on the basis of the following considerations.

(a) As the production capacity of fiberboard and particleboard industry is much higher than the present consumption of the products, the existing units will be able to meet the increase in

Table C.10 Production-Consumption Ratio for Fiberboard and Particleboard in Kerala

Year	Production	Consumption	Production-consumption ratio
	-------metric	tons-------	
Fiberboard			
1960	1,620	790	2.05
1965	4,810	2,050	2.35
1967	3,270	1,400	2.34
1968	4,400	1,530	2.87
Particleboard			
1960	nil	92	0
1965	340	168	2.10
1967	330	160	2.06
1968	460	220	2.10

Sources: Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

The Federation of Plywood Industry, New Delhi.

consumption, in the immediate future.

(b) Fiberboard and particleboard industry can accept wood raw material from a wide range of species, diameters and forms that hitherto could be used only as fuel. Industrial wood residues, logging and forest management residues, thinnings, cull timber, non-commercial timber from mixed hardwood forests etc. can all be used. (Success has been claimed even in the use of sawdust upto a limit, which can be about 50 percent of the total raw material requirement for the middle layer of the three layer boards).

(c) In as much as the industry can use industrial wood residues, new units can be integrated (and even be captive plants) with saw mills, plywood mills and furniture mills, using the wood residues arising in them, to produce corestock for doors, windows, overlaid furniture and so on. Such integration is good not only for the maximum utilization of forest resources, but also for reduction in capital investment and cost of production and increase in labor productivity.

(d) Availability of cheap labor would discourage the establishment of very large and automated units.

(e) Proper grading and preparation of raw material would result in higher yield per unit of raw material.

The assumptions on the unit characteristics of the fiberboard and particleboard industry are given in the following tabulated statement.

Characteristics	Unit	Product	1980	1990	2000
Average requirement of wood per metric ton of product	Cubic meters	F	3.0	2.75	2.5
		P	2.8	2.50	2.4
Average requirement of labor per metric ton of product	Man-days	F	18	12	8
		P	15	10	7
Average requirement of capital investment per metric ton of additional capacity to be generated*	1961 rupees	F	1,200	1,400	1,800
		P	1,100	1,250	1,650

F = Fiberboard.

P = Particleboard.

*The investment requirement has been worked out assuming a three shift operation.

Wood Requirement

Wood requirement in the target years for the two alternative levels of estimated future consumption of fiberboard and particleboard is given in the following tabulation.

Year	Alternative estimates of consumption outlook	
	Low	High
	--thousands of cubic meters (round)--	
1980	24.36	84.64
1990	32.50	235.00
2000	36.74	296.00

<u>Employment of Labor</u>

Labor requirement has been worked out on the basis of 300 working days per year. Considerable increase in employment has been estimated under the high alternative of consumption outlook.

Year	Alternative estimates of consumption outlook	
	Low	High
	--number of employees--	
1980	480	1,640
1990	466	3,333
2000	386	3,066

<u>Investment</u>

The investment required to attain the estimated consumption has been worked out assuming an operating ratio of 0.9.

Period	Alternative estimates of consumption outlook	
	Low	High
	--millions of 1961 rupees--	
1965 - 1980	0.24	25.67
1981 - 1990	4.76	88.79
1991 - 2000	5.16	61.91
Total	10.16	176.37

PULP AND PAPER

Pulp and paper is a major industry group which covers a wide variety of products. Pulp is the predominant raw material for manufacture of paper and cellulosic rayon.

Classification of Products

A proper classification of 'pulp and paper' is difficult due to the overlap in the processes and end uses. For purposes of this study the following simplified classification is adopted.

1. Pulp : Only high alpha cellulose (or rayon grade) pulp is included under this.
2. Cultural papers : Include (a) writing and printing papers and (b) newsprint. Pulp produced for manufacture of cultural papers is also included under this.
3. Industrial papers : Include (a) packaging and wrapping papers (b) other special varieties of papers and (c) paper boards. Pulp produced for manufacture of industrial papers is also included under this.

Pulp. All the paper and paper board mills in India are fully integrated with pulping units. A unit to produce 'market' paper pulp was established in Gujarat State in 1968 and it sells its pulp to small units for expanding their paper production. The indications are that no more of such units producing marketable pulp will be established in the near future. Therefore, under the classification of pulp, it is proposed to deal only with rayon grade pulp.

Till the beginning of this century pulp production was exclusively meant as a fiber 'furnish' for paper industry. Cross and Bevan discovered the possibility of producing regenerated cellulose fibers in 1892 utilizing wood as raw material; and the commercial development of a process to produce textile (rayon) fibers from wood pulp soon followed. Rayon grade pulp is also used for manufacture of celluphane, absorbent tissues, lacquers, smokeless powder, photographic films, plastics, tyre cord and a variety of cellulose chemicals. Rayon grade pulp is characterised by its chemical purity, with a high percentage of alpha cellulose.

Rayon pulp is not consumed as an end product and is used as a raw material for further processing. The demand for rayon grade pulp reflects the demand for the end products made out of it.

Cultural papers. Writing and printing papers and newsprint are two major categories of cultural papers. Writing and printing papers include a large variety, the important ones of which are offset paper, white and colored printing paper, typewriting paper, lithograph paper etc. Schools, colleges and offices are the major consumers of this product.

Newsprint is a special quality cheap paper used mainly for newspaper and cheap publications. As cheapness is an essential attribute of newsprint, it is manufactured from mechanical pulp with a small admixture of chemical pulp. India has to import most of its newsprint, and the use of newsprint is severely restricted due to high import tariffs and price ceilings.

Industrial papers. Industrial papers include wrapping and packaging papers (eg. kraft sack-paper, light weight tissues, greese proof paper, waxed paper), other varieties (eg. paper towells, tissues, disposable paper articles, cigarette paper), solid paper boards and corrugated boards. At present, the consumption of wrapping and packaging papers, card boards and its manifold corrugated products is very poor in India. The growth in the use of industrial papers and paper boards rests largely upon the continued success of these materials in the packaging field, where it has to compete with jute bags, plastic containers, cellophane packagings and wooden containers.

Consumption Trend

A nation's consumption of pulp and paper is said to be a measure not only of its economic but also of its social and cultural status.

Consumption trend of pulp and paper in Kerala shows conspicuous increase in the per capita consumption of writing and printing papers (Table C.11). During the period 1950 - 1967, the rate of growth of consumption of writing and printing papers was 9.12 percent as against

Table C.11 Consumption Trend of Pulp and Paper in Kerala

Year	Pulp*		Writing and printing papers**		Newsprint		Industrial papers	
	Total consumption	Per capita consumption	Total consumption	Per capita consumption	Total consumption	Per capita consumption	Total consumption	Per capita consumption
	--metric tons--	--kilograms--	--metric tons--	--kilograms--	--metric tons--	--kilograms--	--metric tons--	--kilograms--
1950	n.a.	n.a.	11,200	0.840	8,200	0.615	3,000	0.225
1955	n.a.	n.a.	19,100	1.289	9,200	0.621	5,600	0.378
1960	8,300	0.501	28,500	1.722	10,400	0.628	8,300	0.501
1965	8,600	0.467	41,300	2.242	13,000	0.706	11,800	0.641
1967	9,000	0.465	49,500	2.555	14,200	0.733	12,200	0.630
1968	13,100	0.660	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

*The consumption of rayon grade pulp represents the quantity used for further processing in the mills in Kerala and per capita consumption is the per capita share of the quantity of rayon pulp used for further processing in Kerala.

**Due to the scarcity of newsprint, some quantity of writing and printing papers has been used as substitute for newsprint.

Source: Government of India, Directorate of Technical Development, New Delhi.

8.56 percent for industrial papers and 3.28 percent for newsprint.

Consumption of cultural papers has been very high (more than 80 percent of the total consumption of paper) in Kerala. This has significance for the liquidation of illiteracy and development of cultural activities in the State. In the industrially advanced countries, the consumption of industrial papers will generally be higher.

The per capita consumption of paper (of all varieties) in 1965 was 3.589 kilograms in Kerala. This figure is low in absolute terms but is much more than can be expected by comparison with world average at the same per capita income level.

Official Consumption Targets

Consumption targets for pulp and paper are 240 thousand metric tons by 1980, 501 thousand metric tons by 1990 and 775 thousand metric tons by 2000. The targets are based on several assumptions and considerations.

(a) Considering the popularity of rayons, the consumption of rayon filament and staple fiber is expected to increase. The mixed fabrics of viscose staple fiber and cotton (and other kinds of fiber) have gained greatly in the market and therefore, it can be forecasted that there will be increased production of viscose fiber in the future. Rayon pulp can also generate a chain of industrial units and could be a means of reducing unemployment.

(b) It is expected that due to the great emphasis laid on raising the level of literacy and education, there will be increased consumption of writing and printing papers. In this regard, the targets fixed for school enrollment and level of literacy are taken into consideration.

(c) In respect of newsprint, an annual average increase of about 8.5 percent in consumption is envisaged, to keep up with the improvements in literacy and cultural standards.

(d) Use of paper and paper boards for packaging is important for India, since wood (particularly softwood) for packing cases is in short supply. Use of wood as a packaging material should therefore be confined to agricultural products from rural areas, where rough handling and storage in the open cannot be avoided. Packaging paper and boards also save on the transporting cost of goods, due to their lower weight.

(e) As the country advances industrially, the consumption of packaging papers (mainly kraft paper, fluting medium and kraft liner) would increase and it is expected to constitute a larger percentage of the total consumption of paper than writing and printing papers. Disposable paper articles such as dishware, paper towells and tissues are also expected to gain wide acceptance in the future.

Estimates of Future Consumption

The different estimates of future consumption of pulp and paper in Kerala are given in Table C.12. The consumption estimates have been reduced to two alternative levels to show the range of estimated values as given in the following tabulation (Figures C.5 to C.8 and Table C.13).

Year	Alternative levels of future consumption	
	Low	High
	---thousands of metric tons----	
1980	199	363
1990	334	767
2000	445	1,138

Table C.12 Estimates of Future Consumption of Pulp and Paper in Kerala

Projection procedure	Year	Pulp	Writing and printing papers	News-print	Indus-trial papers	Total
		--------thousands of metric tons--------				
1	1980	16.0	125.0	43.0	56.0	240.0
	1990	30.0	210.0	96.0	165.0	501.0
	2000	58.0	250.0	212.0	255.0	775.0
2	1980	17.5	152.0	21.0	39.4	229.9
	1990	26.2	357.9	29.0	89.5	502.6
	2000	39.3	837.4	40.1	203.6	1120.4
3	1980	21.1	183.5	21.6	47.5	273.7
	1990	28.5	311.7	26.4	79.4	446.0
	2000	33.7	407.3	29.9	102.9	573.8
4	1980	23.8	245.7	22.6	62.8	354.9
	1990	31.0	381.5	27.3	96.2	536.0
	2000	34.9	443.4	30.3	111.7	620.3

1. Official target.

2. Extention of consumption time trend. The prediction equation used to estimate consumption is:

$Y = e^{1.65511 + .04029t}$ for pulp,

$Y = e^{2.46623 + .08526t}$ for writing and printing papers,

$Y = e^{2.07211 + .0324t}$ for newsprint,

$Y = e^{1.20951 + .08212t}$ for industrial papers

where Y is the consumption in thousand metric tons, t is the time period in years between the target year and 1950.

3., 4. Income-consumption relationship. The prediction equations used to estimate per capita consumption are:

$Y = e^{(-.17437 \times 10^8)I_1^{-3} + .0582}$ and

$Y = e^{(-.17437 \times 10^8)I_2^{-3} + .0582}$ for pulp,

$Y = e^{(-.42941 \times 10^8)I_1^{-3} + 2.60699}$ and

$Y = e^{(-.42941 \times 10^8)I_2^{-3} + 2.60699}$ for writing and printing papers,

$Y = e^{(-.06704 \times 10^8)I_1^{-3} - .08425}$ and

$Y = e^{(-.06704 \times 10^8)I_2^{-3} - .08425}$ for newsprint,

$Y = e^{(-.41054 \times 10^8)I_1^{-3} + 1.22707}$ and

$Y = e^{(-.41054 \times 10^8)I_2^{-3} + 1.22707}$ for industrial papers

where Y is the consumption per capita in kilograms and I_1 and I_2 are alternative per capita income assumptions.

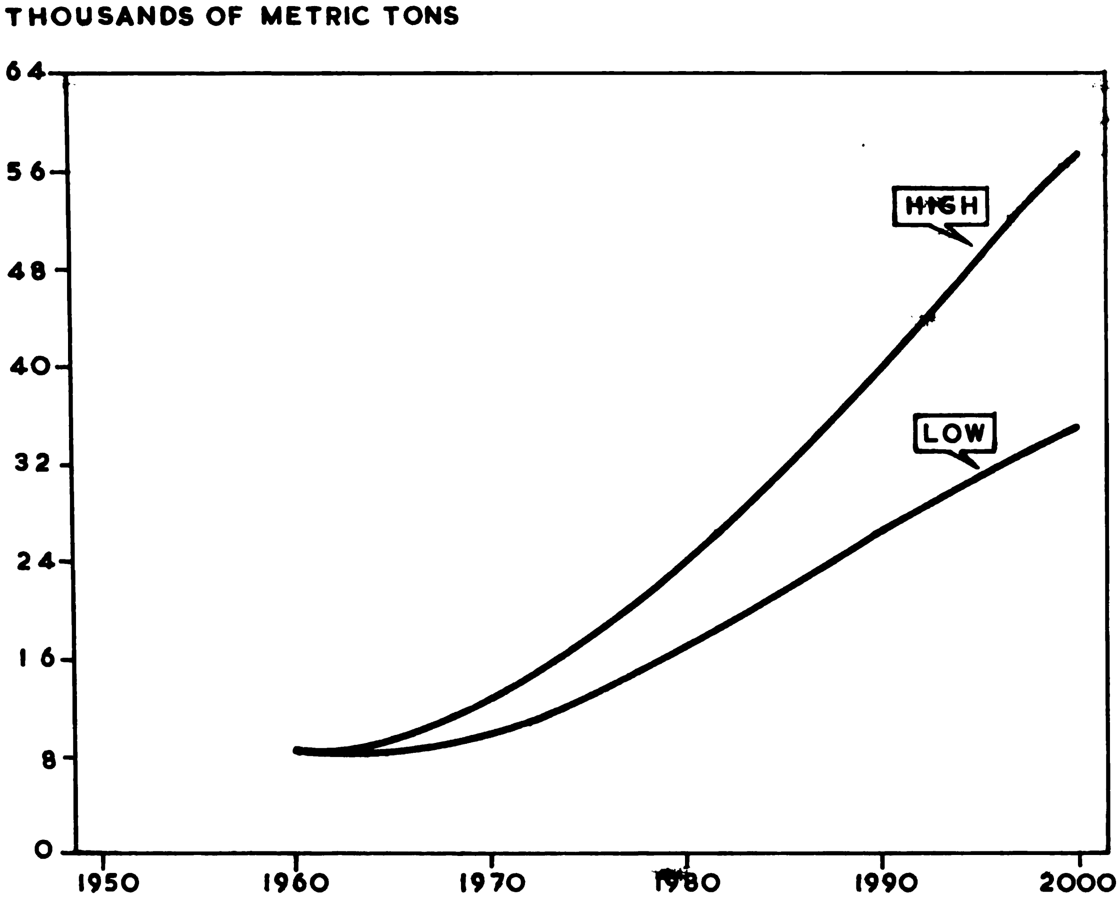

FIGURE C·5

CONSUMPTION PROJECTIONS FOR PULP IN KERALA

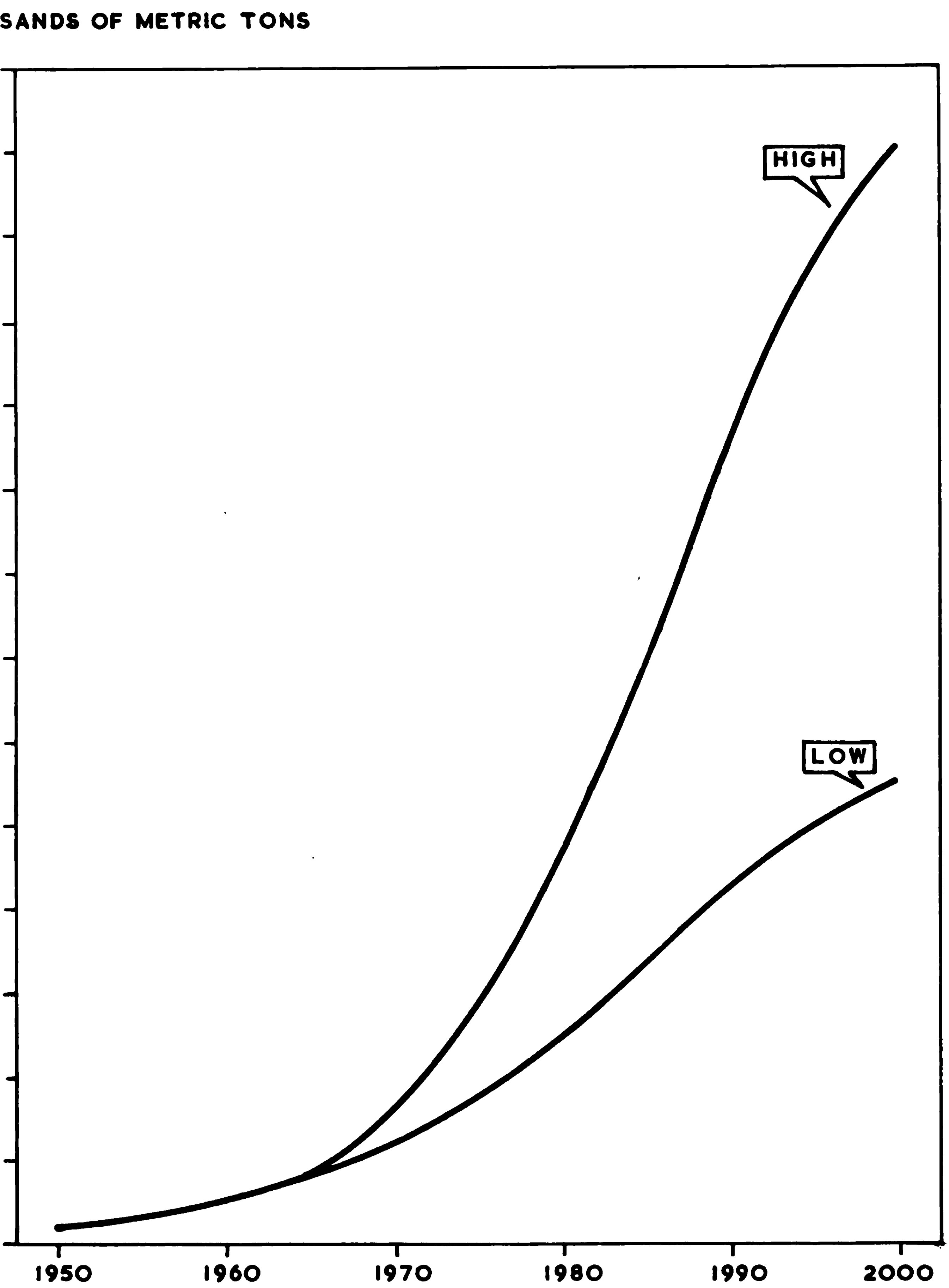

FIGURE C.6

CONSUMPTION PROJECTIONS FOR
WRITING AND PRINTING PAPERS IN KERALA

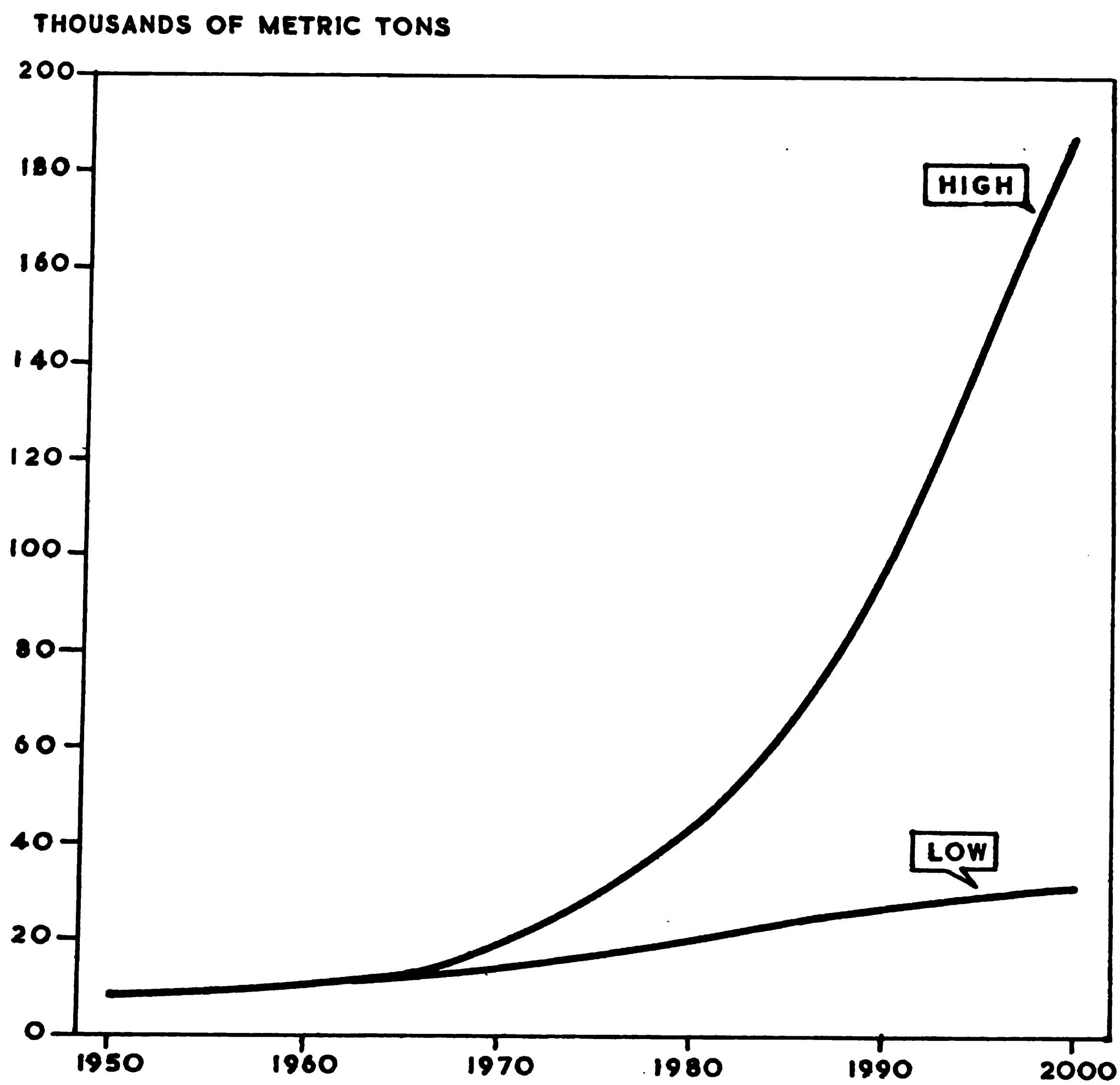

FIGURE C.7
CONSUMPTION PROJECTIONS FOR NEWSPRINT IN KERALA

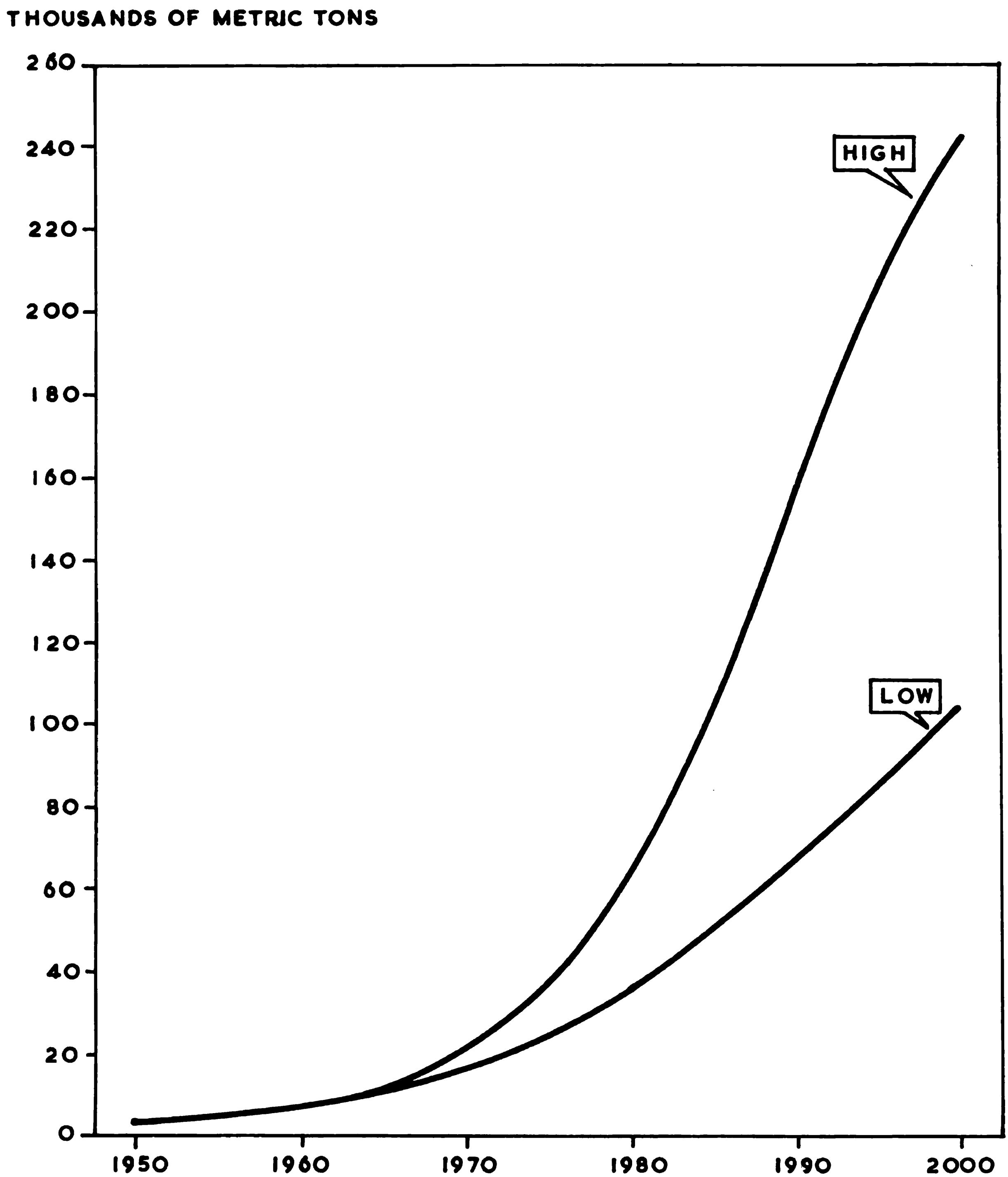

FIGURE C · 8
CONSUMPTION PROJECTIONS FOR
INDUSTRIAL PAPERS IN KERALA

Table C.13 The Alternative Levels of Future Consumption of Pulp and Paper in Kerala

Product	Alternative levels of future consumption					
	Low			High		
	1980	1990	2000	1980	1990	2000
	thousands of metric tons					
Pulp	17.0	26.5	35.0	23.0	39.0	58.0
Writing and printing papers	125.0	212.5	275.0	235.0	475.0	650.0
Newsprint	21.0	27.0	31.0	43.0	95.0	188.0
Industrial papers	36.0	68.0	104.0	62.0	158.0	242.0
Total	199.0	334.0	445.0	363.0	767.0	1,138.0

Import and Export

The total production capacity of pulp and paper industry in Kerala in 1965 was 73 thousand metric tons as against 879 thousand metric tons in India. (This has been increased to 76 thousand metric tons and 1,020 metric tons respectively, by the end of 1970). Even to meet the low estimate of future consumption, the capacity will have to be increased several fold by the end of this century.

In 1965 India imported (net of export) 64.1 percent of the total consumption of (rayon grade) pulp, 2.5 percent of the consumption of writing and printing papers, 75.7 percent of the consumption of newsprint and six percent of the consumption of industrial papers. Apart from this, six percent of the total intake of paper grade pulp also was imported.

Within India there is a considerable amount of inter-state trade, as all the regions do not produce all the required varieties of pulp and paper. Thus, in 1965 Kerala exported (net of import) 81.8 percent of the total production of (rayon grade) pulp, and imported (net of export) 71.0 percent of the requirement of writing and printing papers, 100 percent of the requirement of newsprint and 49.2 percent of the requirement of industrial papers.

The Consumption Outlook

The outlook for pulp and paper industry in Kerala, therefore, has to take the import-export possibilities into consideration. As Kerala is a suitable region for raising plantations of fast growing wood species and as Kerala is better placed in respect of suitable raw materials for newsprint and (rayon grade) pulp, the State is likely to produce proportionately a larger share of these two products. This aspect has been given due weight in estimating the future production of pulp and paper in Kerala. And the outlook for pulp and paper industry in Kerala has been drawn up based on the possibility of expansion of the existing units and establishment of new ones.

Estimates of future production of pulp and paper in Kerala, corresponding to the two levels of future consumption, are summarized in the following tabulation (Table C.14).

Year	Alternative estimates of future production	
	Low	High
	--thousands of metric tons--	
1980	170	285
1990	220	420
2000	265	510

Table C.14 The Alternative Estimates of Production of Pulp and Paper in Kerala

Product	Alternative estimates of future production					
	Low			High		
	1980	1990	2000	1980	1990	2000
	thousands of metric tons					
Pulp	60	65	75	80	100	125
Writing and printing papers	45	50	60	100	120	150
Newsprint	50	75	85	75	150	160
Industrial papers	15	30	45	30	50	75
Total	170	220	265	285	420	510

Characteristics of the Future Pulp and Paper Units

Pulp and paper industry experienced more changes during the past ten years than it did in the preceding fifty, and there is every reason to believe that the pace of progress will continue to accelerate. Changes have taken place in all aspects of pulp and paper making - in the variety of fiber raw materials, processes, efficiency of machinery, range of products, size of units and so on.

Fiber raw material. India has been producing pulp, primarily from bamboo (and reeds). This had to be so, because bamboo is a long fiber raw material and the length of fiber is of great importance in respect of paper grade pulp for forming the paper sheets. Even rayon grade pulp is made from bamboo, in spite of the fact that the fiber length of the raw material is not important for rayon grade pulp. The coniferous raw material resources of India are confined to the remote Himalayan region, which to this day remains comparatively inaccessible. And at the early beginning of the pulp and paper industry bamboo resources were also comparatively plentiful in India.

The raw material base for pulp and paper manufacture has been changing considerably throughout the development of pulp and paper technology. In the past it was generally held that the tropical hardwoods are unsuitable for pulping (especially for paper) because of the shortness of their fiber. It has been the forecast about two decades ago that "there seems to be little chance of successful pulpwood operation in the more heterogeneous types of tropical evergreen products" because there is usually a mixture of species varying widely in wood properties (Hess 1952).

Technology has progressed so fast and one of the major developments in recent times has been the expansion of the use of mixtures of broad-leaved hardwoods for pulp and paper. Utilization of hardwoods (individually and in mixture) in a big way has been adopted by many countries.

Extensive trials have been carried out with hardwoods in India (individually and in mixture) and they have been found to be suitable for making acceptable grades of most types of pulp and paper. Researches have indicated that even the spent rubberwood (which is available in large quantities in Kerala) can be used for pulping, either by removal of residual latex by modifying pulping conditions or by emulsifying the latex in order to take advantage of the special characteristics which it imparts to paper.

As the availability of long fiber raw materials such as conifers, bamboos and reeds is limited, it is necessary to make a rational allocation of resources and to utilize the long fiber raw materials only for superior grades of pulp and paper for which others are not suitable. Import of a small quantity of high quality coniferous pulp from foreign countries will, however, have to be continued for improving the quality of certain special grades of paper.

Process. Hardwoods can readily be converted into pulp by most of the present day pulping processes. But, the use of semi-chemical and chemi-mechanical processes for which these woods are practically suited is becoming of increasing importance. It has been observed that "the important factor seems to be the process and machinery rather than the structure of wood" (FAO 1969).

Yield of pulp can be increased considerably by refinement of the processes adopted. The pulping methods used in India enable only an average yield of 35 to 40 percent in terms of bleached pulp. By application of high yield pulping methods an average yield of 60 percent can be expected (LeCacheux 1966).

The fiber furnish for paper making is also very important as that ultimately decides the raw material requirement to meet the demand for paper. For example, newsprint is made in India with 60 percent hardwood mechanical pulp and 40 percent bleached bamboo chemical pulp (or with a combination of equal quantities of hardwood mechanical pulp, hardwood cold soda pulp and semi-bleached bamboo kraft). For future plants, where bamboo is not available, a hundred percent wood pulp furnish has been suggested consisting of 30 percent fully bleached kraft pulp, 40 percent bleached cold soda pulp and 30 percent unbleached chip ground pulp for newsprint (Narasimhan 1968).

It can be expected that the modern and refined methods of pulping which are suitable for the tropical hardwoods and which would give higher yields will be adopted in Kerala.

<u>Machinery</u>. Paper machine is a combination of a number of machines and due to the necessity to keep all the machines in the system in a similar order of efficiency no drastic changes in the design of machinery, in respect to its essential characteristics, can be expected in the near future. Some of the recent developments has been the introduction of high speed paper machines and conversion of chemical pulping from batch to continuous operations at increased speeds.

A recent tendency has been to go in for second hand machines from advanced western countries, where it has become obsolete due to recent developments. This makes it possible to save on the initial capital investment. For the same reason, increasing the capacity of the existing units by balancing or adding equipments is also a preferred approach.

It is expected that the future development of this industry will be based on advanced technology and modern equipments. India has already made a start to manufacture some of the equipments required for pulp and paper industry.

Size of units. Apart from the economy of scale, which in India will be different from what it is in the western countries due to availability of cheap labor, the factors affecting the size of the operation are the availability of raw materials within a reasonable distance from the mill and the problem of effluent disposal. For these reasons (and also to reduce the foreign exchange component of the capital cost on machinery) the size of new pulp and paper units is likely to be of a production capacity between 200 to 500 metric tons per day, tending mostly towards the lower limit than to the upper.

Unit characteristics. Based on the aspects discussed above, the unit characteristics of the pulp and paper industry have been assumed as follows.

Characteristics	Unit	Product	1980	1990	2000
Average requirement of pulpwood per metric ton of product	Cubic meters	P	6.0	5.5	5.3
		WP	4.2	3.6	3.2
		N	3.2	3.1	3.0
		IP	3.2	3.0	2.8
Average requirement of labor per metric ton of product	Man-days	P	4.0	3.0	2.5
		WP	16.0	10.0	8.0
		N	3.2	3.0	2.8
		IP	12.0	8.0	6.0
Average requirement of capital investment per metric ton of additional capacity to be generated	1961 rupees	P	2,800	3,000	3,100
		WP	3,600	4,200	4,800
		N	3,000	3,200	3,400
		IP	2,600	2,750	2,900

P = Pulp. WP = Writing and printing papers.
N = Newsprint. IP = Industrial papers.

Wood Requirement

The projected requirement of pulpwood for the two alternative levels of future production are given in the following tabulation.

Year	Alternative estimates of future production	
	Low	High
	--thousands of cubic meters (round)--	
1980	757	1,236
1990	860	1,597
2000	975	1,840

Employment of Labor

Labor requirement has been worked out on the basis of 300 working days per year. Under both the alternatives there will be no marked change in employment from one period to another. This situation is due to the fact that Kerala will be producing a larger share of newsprint and (rayon grade) pulp, which are not labor intensive.

Year	Alternative estimates of future production	
	Low	High
	--number of employees--	
1980	4,333	8,400
1990	3,870	7,833
2000	3,918	8,035

Investment

Pulp and paper is the most capital intensive of the wood-using industries. The investment needs to attain the estimated production have been estimated assuming an operating ratio of 0.95.

Period	Alternative estimates of future production	
	Low	High
	--millions of 1961 rupees--	
1965 - 1980	333.6	720.8
1981 - 1990	167.4	461.8
1991 - 2000	159.6	346.7
Total	660.6	1,529.3

MATCHES

Safety match is a consumption item of everyday use and its market is widely distributed.

Consumption Trend

The details of past consumption of matches in Kerala are given in the following tabulation.

Year	Total consumption	Per capita consumption
	--millions of boxes of 50 sticks each--	--number of sticks per day--
1950	260.80	2.68
1955	280.00	2.59
1960	351.60	2.91
1965	406.10	3.02
1967	424.20	3.00

Sources: National Planning Commission, Resources and Scientific Research Division, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

During the period 1950 to 1967, consumption of safety matches in Kerala increased at a rate of about 2.90 percent per year.

Official Consumption Targets

Consumption targets for matches have been fixed on the assumption that the consumption of matches will grow at an annual rate of two percent, as estimated by the Tariff Commission.

Estimates of Future
Consumption

The different consumption estimates for matches are given in Table C.15. The alternative consumption estimates have been reduced to two levels after plotting the estimated figures against the target year to which it pertains (Figure C.9).

Year	Alternative levels of future consumption	
	Low	High
	--millions of boxes of 50 sticks each--	
1980	545	675
1990	670	910
2000	815	1,170

Export Consumption

The production-consumption ratio for matches in Kerala in 1965 was three. The ratio has been fairly consistant for the period 1950 - 1965. In 1965, Kerala exported splints and veneers equivalent to 809.3 million boxes of 50 sticks each as against a domestic consumption of 406.1 million boxes.

Most of the wood species now being used for matches grow in heavy rainfall areas. Considering the advantageous position of Kerala and the scarcity for matchwood species in most part of the country, it is assumed that Kerala will maintain the same production-consumption ratio

Table C.15 Estimates of Future Consumption of Matches in Kerala

Projection procedure	1980	1990	2000
	------million of boxes of 50 sticks each------		
1	546.6	666.3	812.2
2	632.7	862.8	1,176.5
3	652.9	790.6	891.3
4	681.4	812.5	901.0

1. Official target.

2. Extention of consumption time trend. The prediction equation used to estimate consumption of matches is:

$$Y = e^{5.53593 + .0306t}$$

where Y is the consumption in millions of boxes of 50 sticks each and

t is the time period in years between the target year and 1950.

3. 4. Income-consumption relationship. The prediction equations used to estimate per capita consumption of matches are:

$$Y = e^{(-.05577 \times 10^8)I_1^{-3} + 1.31897}$$

and

$$Y = e^{(-.05577 \times 10^8)I_2^{-3} + 1.31897}$$

where Y is the consumption per capita in number of sticks per day and

I_1 and I_2 are alternative per capita income assumptions.

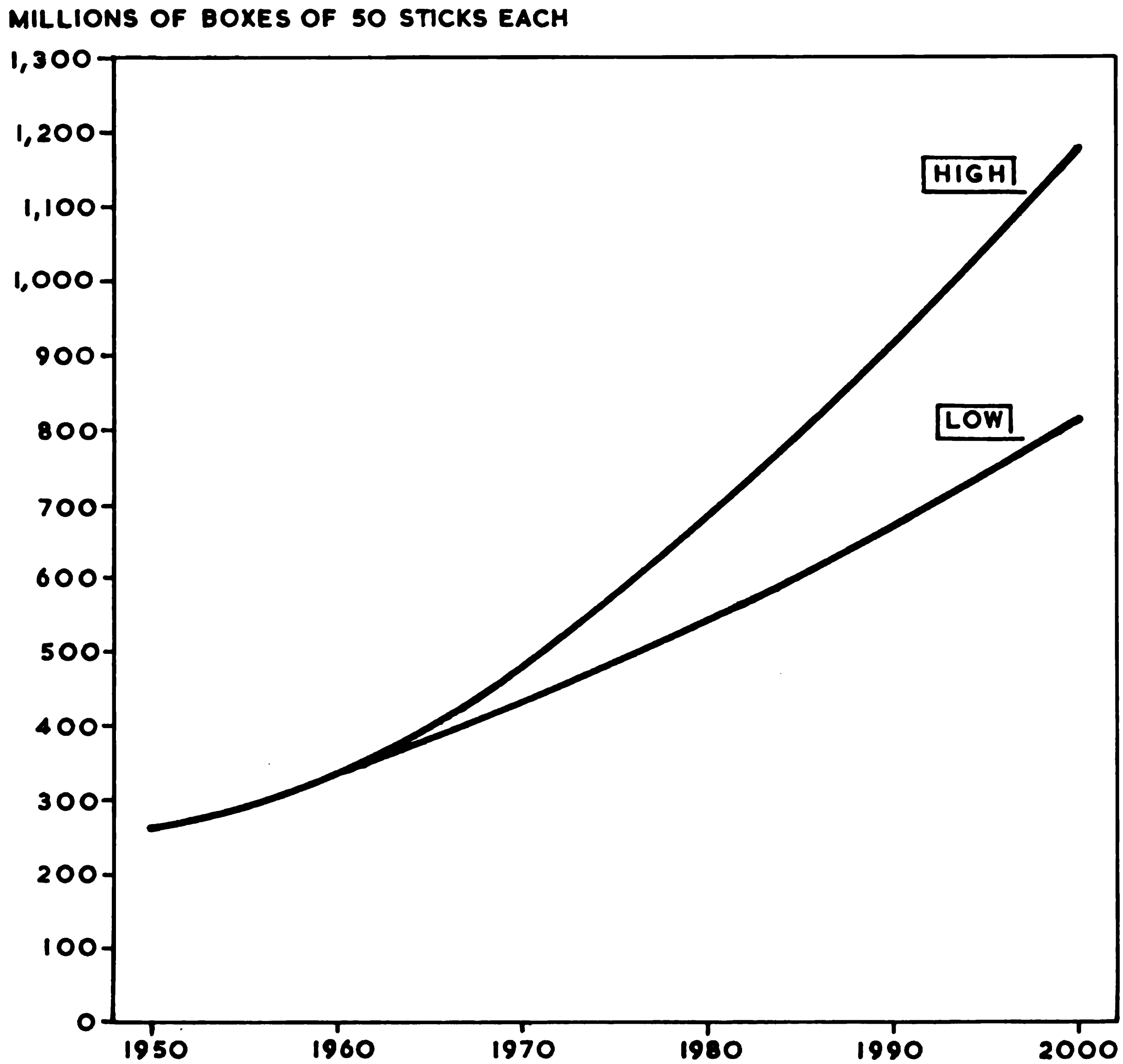

FIGURE C·9

CONSUMPTION PROJECTIONS FOR MATCHES IN KERALA in the future.

The Consumption Outlook

The consumption outlook corresponding to the two levels are given in the following tabulated statement.

Year	Alternative estimates of consumption outlook	
	Low	High
	----millions of boxes of 50 sticks each----	
1980	1,635	2,025
1990	2,010	2,730
2000	2,445	3,510

Characteristics of the Future Match Manufacturing Units

Unit characteristics of the match industry have been assumed on the basis of the following considerations.

(a) The units of match industry are mostly of cottage scale and the predominance of such units are likely to continue in the future. However, refinements in production techniques and establishment of few mechanized units are expected resulting in higher outturn per unit of wood and labor employed.

(b) At present only white colored woods are used for match splints and veneers. It is expected that colored match splints and veneers will be accepted by the market and that it will be popularized by the industry. This will help to improve the raw material position.

(c) Match sticks from cardboards (wax vestas) are not suitable for use in tropical countries due to the high atmospheric humidity during rainy season. Therefore, wax vestas are not likely to replace wooden match sticks to any considerable extent.

(d) It is expected that more dipping units will be established in the State and that larger percentage of splints and veneers produced will be utilized for dipping within the State. The dipping factories should have facilities to dry the sticks under controlled conditions to get over the difficulties caused by the heavy rainfall and high humidity in the State.

The assumptions regarding the unit characteristics of the match industry are the following:

Characteristics	Unit	1980	1990	2000
Average requirement of matchwood per million boxes of 50 sticks each	Cubic meters	34	32	31
Average requirement of labor per million boxes of 50 sticks each	Man-days	1,400	1,350	1,300
Average requirement of capital investment per million boxes of 50 sticks each of additional capacity to be generated*	1961 rupees	8,000	9,500	12,500

*The investment requirement has been worked out assuming a two shift operation.

Wood Requirement

Matchwood requirement in the target years for the two alternative levels of estimated future consumption is given in the following tabulation.

Year	Alternative estimates of consumption outlook	
	Low	High
	--thousands of cubic meters (round)--	
1980	55.59	68.85
1990	64.32	87.36
2000	78.80	108.81

Employment of Labor

Labor requirement has been worked out on the basis of 300 working days per year. There will be considerable increase in employment and even under the low estimate, employment by 2000 will almost be double that of 1965 level.

Year	Alternative estimates of consumption outlook	
	Low	High
	--number of employees--	
1980	7,630	9,450
1990	9,045	12,285
2000	10,595	15,210

Investment

Match industry is labor intensive and high mechanization is not anticipated. The investment needs to attain the alternative estimates of consumption outlook have been worked out, assuming an operation ratio of 0.9.

Period	Alternative estimates of consumption outlook	
	Low	High
	--millions of 1961 rupees--	
1965 - 1980	..	1.68
1981 - 1990	1.83	7.44
1991 - 2000	6.05	10.84
Total	7.88	19.96

INDUSTRIAL ROUNDWOOD

Industrial roundwood covers all wood not processed before use and which is not used as fuelwood. Roundwood (with or without preservative treatment) goes into constructional uses, mining, transport equipments and so on. Quantitatively the most important use of roundwood is as structural building material in simple, traditional constructions in rural areas and as posts, poles, pilings and props. It also covers the use of roundwood for specialized products and in industries which have not been separately considered, namely wooden carvings, toys, musical instruments, bobbins, battery separators, boot lasts, boats, containers, game and sports equipments, furniture, carpentry works and so on.

Consumption Trend

Consumption of industrial roundwood between 1950 and 1967 in Kerala registered an annual rate of increase of 1.12 percent.

The consumption figures of industrial roundwood in Kerala is given in the following table.

Year	Total consumption	Per capita consumption
	--thousands of cubic meters--	--cubic meters--
1950	167	.0125
1955	178	.0120
1960	189	.0114
1965	199	.0108
1967	202	.0104

Sources: Kerala Forest Department.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

End uses of roundwood. The end use pattern of roundwood in 1965 has been as indicated in the following tabulation.

Uses	Consumption of roundwood*
	--cubic meters--
Construction	136,000
Transport equipments	9,800
Woodworks including furniture	19,800
Packaging	14,000
Agricultural implements	8,000
Other	11,400
Total	199,000

*Includes bamboo and reeds used for construction of dwellings, packaging etc.

Source: Kerala Forest Department.

Official Consumption Targets

Consumption targets for roundwood have been fixed at 250 thousand cubic meters by 1980, 310 thousand cubic meters by 1990 and 380 thousand cubic meters by 2000. The targets have been fixed based on the following considerations.

(a) The future requirement of roundwood for direct use is expected to decrease steadily due to the effect of urbanization and competition from cheaper materials.

(b) Consumption of roundwood for specialized products and industries which have not been considered separately is likely to increase.

(c) The total requirement of industrial roundwood is expected to register a small increase, due to the increase in population.

Estimates of Future Consumption

The different consumption estimates for industrial roundwood in Kerala are given in Table C.16.

The consumption estimates have been reduced to two alternative levels after plotting the estimate figures against the year to which it pertains (Figure C.10). The two levels of future consumption for industrial roundwood are given in the following tabulation.

Year	Alternative levels of future consumption	
	Low	High
	--thousands of cubic meters--	
1980	230	250
1990	246	310
2000	260	380

Table C.16 Estimates of Future Consumption of Industrial Roundwood in Kerala

Projection procedure	1980	1990	2000
	--thousands of cubic meters--		
1	250	310	380
2	235	263	293
3	231	252	267
4	229	243	264

1. Official target.

2. Extention of consumption time trend. The prediction equation used to estimate consumption of industrial roundwood is:

$$Y = e^{5.12278 + .01126t}$$

where Y is the consumption in thousands of cubic meters and

t is the time period in years between the target year and 1950.

3. 4. Income-consumption relationship. The prediction equations used to estimate per capita consumption of industrial roundwood are:

$$Y = e^{(.07086 \times 10^8)I_1^{-3} - 4.82737}$$

and

$$Y = e^{(.07086 \times 10^8)I_2^{-3} - 4.82737}$$

where Y is the consumption per capita in cubic meters and

I_1 and I_2 are alternative per capita income assumptions.

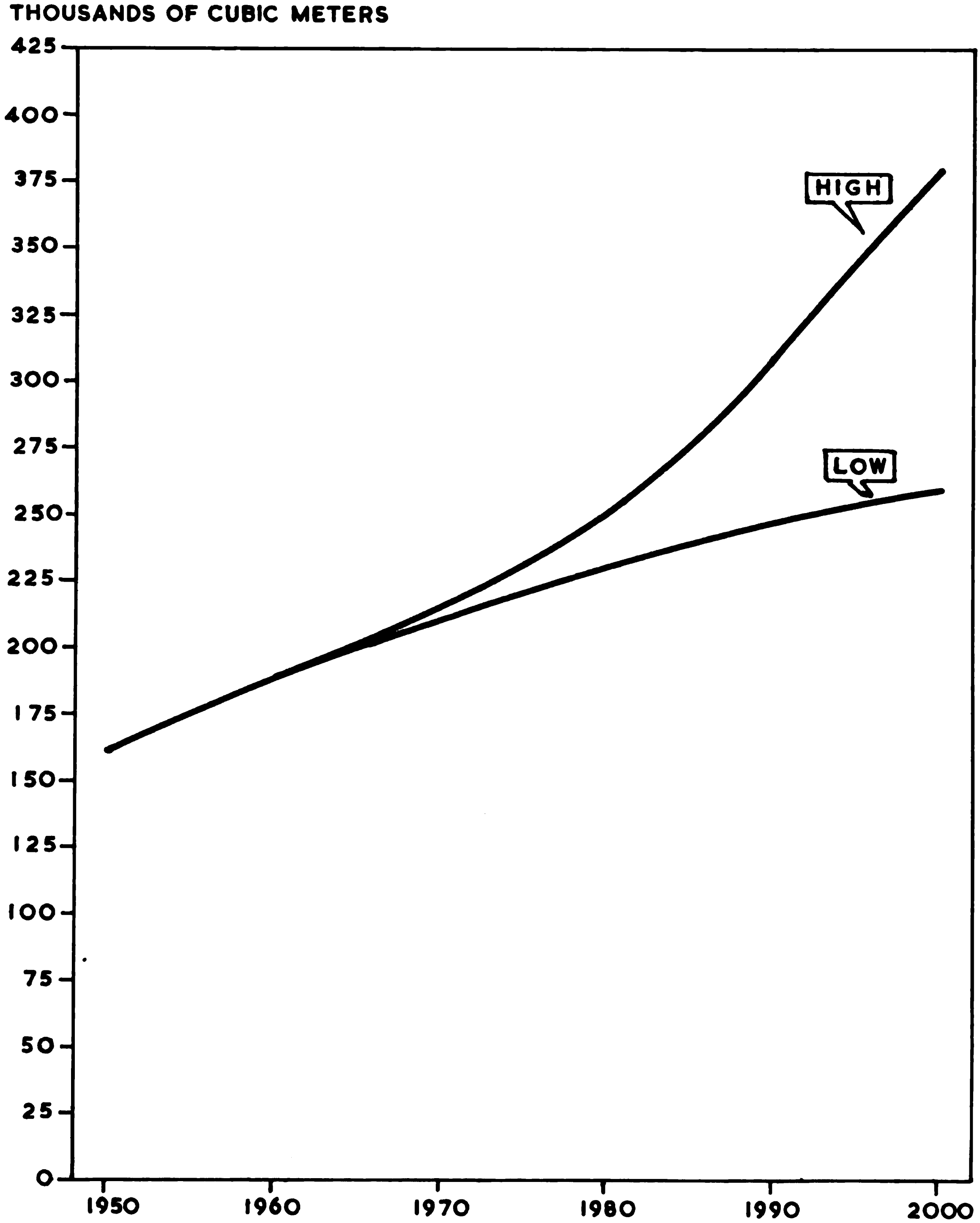

FIGURE C·10

CONSUMPTION PROJECTIONS FOR INDUSTRIAL ROUNDWOOD IN KERALA

Characteristics of the Future Units

The characteristics of units using industrial roundwood, with respect to the requirement of labor and capital investment have been assumed to be as follows:

Characteristics	Unit	1980	1990	2000
Average requirement of labor per cubic meter of industrial roundwood	Man-days	12	11	10
Average requirement of capital investment for generating additional capacity per cubic meter of industrial roundwood	1961 rupees	60	70	75

Employment of Labor

The labor requirement corresponding to the two estimates of consumption outlook is given in the following tabulation.

Year	Alternative estimates of consumption outlook	
	Low	High
	--number of employees--	
1980	9,200	10,000
1990	9,020	11,370
2000	8,670	12,670

Investment

The investment needs to meet the estimated consumption are given in the following tabulation, assuming an operating ratio of 0.9.

Period	Alternative estimates of consumption outlook	
	Low	High
	--millions of 1961 rupees--	
1965 - 1980	3.36	4.86
1981 - 1990	1.26	4.48
1991 - 2000	1.20	5.85
Total	5.82	15.19

FUELWOOD

Fuelwood is a major energy source in India and it contributes 35 to 40 percent of the total energy requirement. Other sources of energy include electricity, coal, oil, natural gas, agricultural residues, begasse and dung.

In 1965, fuelwood constituted 73.7 percent of the total wood consumption in Kerala compared to 88.8 percent in India.

Consumption Trend

Consumption of fuelwood in Kerala increased at an annual rate of 2.41 percent between 1950 and 1967.

The details of past consumption are given in the following tabulation.

Year	Total consumption	Per capita consumption
	--millions of cubic meters--	--cubic meters--
1950	2.90	0.2176
1955	3.14	0.2120
1960	3.70	0.2235
1965	4.22	0.2291
1967	4.35	0.2246

Sources: National Council of Applied Economic Research, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

Bulk of the fuelwood is used for cooking and other household uses. The consumption pattern in 1965 was as follows:

Uses	Consumption of fuelwood
	--millions of cubic meters--
Household uses	3.17
Industrial uses (including transport and other service industries)	1.05
Total	4.22

Sources: National Council of Applied Economic Research, New Delhi.

Government of Kerala, Bureau of Economics and Statistics, Trivandrum.

Official Consumption Targets

Consumption targets for fuelwood have been fixed at 5.75 million cubic meters by 1980, 6.75 million cubic meters by 1990 and 7.40 million cubic meters by 2000. The targets have been fixed based on the following considerations.

(a) Per capita consumption of fuelwood for household uses tends to decline as living standards rise and more efficient fuels become available.

(b) Industries using wood for fuel are mainly ceramics, tea and sugar. The industrial use of fuelwood is expected to go down with the availability of alternative energy sources.

(c) Technological improvements facilitating fuel economy would result in more efficient use of fuelwood.

(d) Consumption of fuelwood would also be restricted partly due to scarcity and consequent rise in price and partly due to diversion of some fuelwood for use as industrial wood.

Estimates of Future Consumption

The different consumption estimates for fuelwood in Kerala are given in Table C.17.

The consumption estimates have been reduced to two alternative levels after plotting the estimate figures against the year to which it pertains (Figure C.11). The two levels of future consumption of fuelwood are given in the following tabulation.

Table C.17 Estimates of Future Consumption of Fuelwood in Kerala

Projection procedure	1980	1990	2000
	--millions of cubic meters--		
1	5.75	6.75	7.40
2	6.09	7.83	10.08
3	6.17	7.25	8.04
4	6.26	7.32	8.07

1. Official target.

2. Extention of consumption time trend. The prediction equation used to estimate consumption of fuelwood is:

$$Y = e^{1.04811 + .02525t}$$

where Y is the consumption in millions of cubic meters and

t is the time period in years between the target year and 1950.

3.
4. Income-consumption relationship. The prediction equations used to estimate per capita consumption of fuelwood are:

$$Y = e^{(-.02033 \times 10^8)I_1^{-3} - 1.40733}$$

and

$$Y = e^{(-.02033 \times 10^8)I_2^{-3} - 1.40733}$$

where Y is the consumption per capita in cubic meters and

I_1 and I_2 are alternative per capita income assumptions.

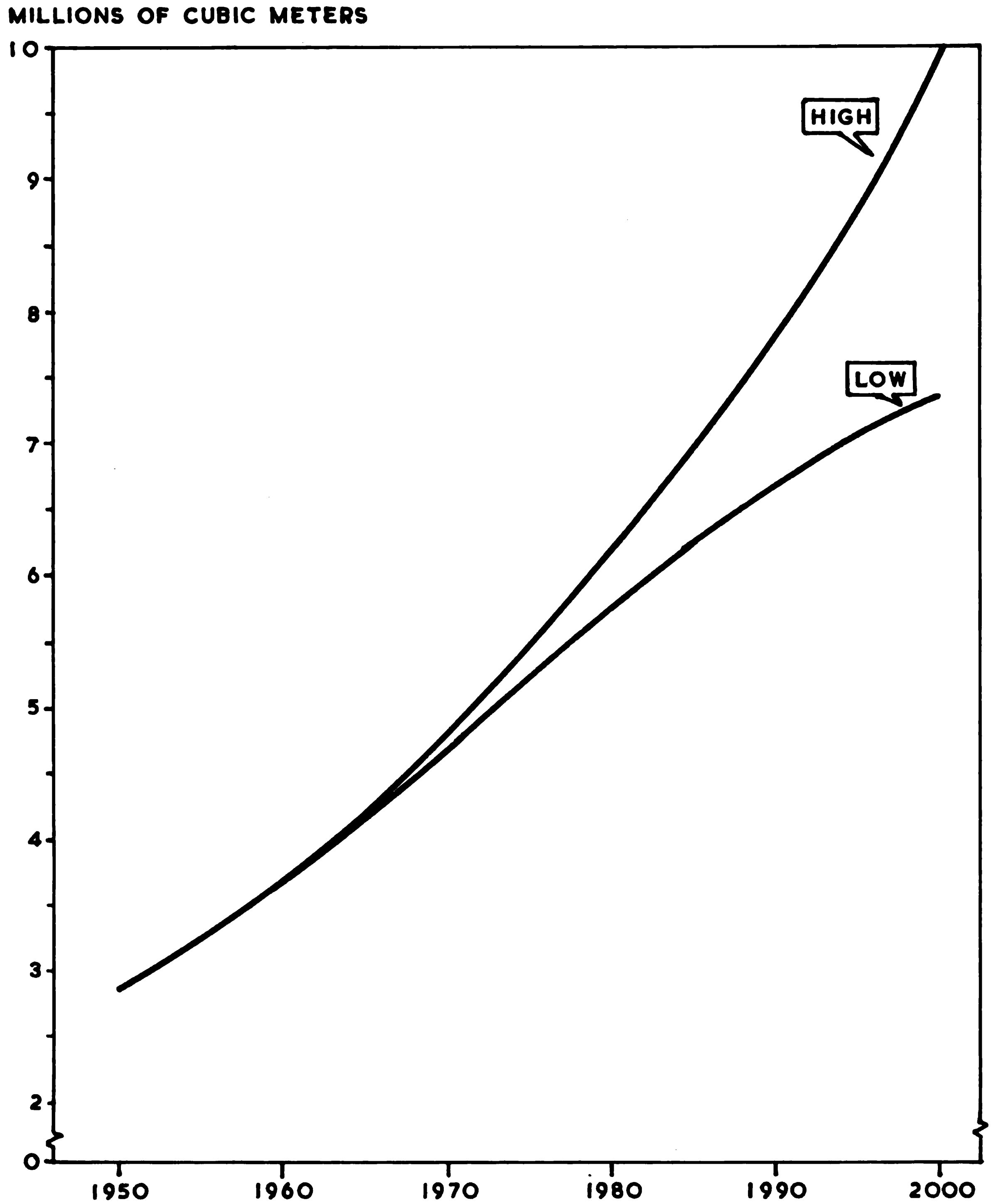

FIGURE C·11
CONSUMPTION PROJECTIONS FOR
FUELWOOD IN KERALA

Year	Alternative levels of future consumption	
	Low	High
	--millions of cubic meters--	
1980	5.75	6.20
1990	6.75	7.80
2000	7.40	10.00

It is assumed that there will be no export of fuelwood from Kerala in the future.

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