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WOOD-BALANCE STUDY IN KERALA AND MARKET SURVEY

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ABSTRACT

The wood-balance situation in Kerala was assessed for the first time in the year 1988. Since then, changes in the wood utilisation pattern and liberalised trade have altered the scenario. This is the second wood-balance study which presents the wood-balance position during 2001. Wood refers to both timber and fuelwood. In this study, all timber and industrial wood including poles were classified as timber and all woody materials used as fuel, including charcoal, as fuelwood. The data used in this study were mostly primary data collected through a series of statistically designed sample surveys spread throughout Kerala. All sectors of the wood using economy were covered. The sectors are household, industries, service sector and export. Wood supply from forests, home gardens including estates and through import was assessed. In this study, import and export refer to the trade with other States in India and other countries. Time series data on import and export of timber were also examined to understand the market trends.

The effective demand for wood during 2000-01 was 122,61,000 m^3 roundwood equivalent. Of the total demand, fuelwood accounted for 83 per cent and timber 17 per cent. Home gardens and private estates produced 87 per cent of the total fuelwood supply of 101,96,000 m^3 roundwood equivalent . Forests produced around 11 per cent and fuelwood import in the form of charcoal accounted for two per cent. In the case of timber, contribution of forests was only four per cent and import 15 per cent of the total timber supply of 20,65,000 m^3 roundwood. Rubber estates contributed 40 per cent, home gardens and other estates, the remaining 41 per cent. The analysis of wood-balance revealed an export surplus of 2,63,000 m^3 of timber. Rubber wood contributed to an export of 4,55,000 m^3 roundwood. Production and consumption of teak wood matched, with only a small deficit of 667 m^3. Consumption of all other timbers exceeded production, showing a deficit of 1,91,000 m^3. The fuelwood scenario was generally comfortable with a deficit only for charcoal of 2,36,000 m^3 roundwood equivalent. The deficit of timber and charcoal was met by the import.

Changes in the demand for timber and fuelwood between 1988 and 2001 have been analysed. There is an overall decline in the demand for timber from 24,93,000 to 20,65,000 m^3. The decline in demand is substantial in the household sector where the shift has been from 11,33,000 to 6,16,000 m^3. In the service sector, the decline is more dramatic from 2,24,000 to 10,000 m^3 during this period. In the industries and export sectors, there is an increase in the demand for timber. Utilisation of timber in the industries sector increased from 7,42,000 to 8,65,000 m^3 due to the increased import of timber. During 1988 to 2001, import of timber increased from 1,90,000 to 3,10,000 m^3. Export of timber, including packing cases, increased from 3,94,000 to 5,74,000 m^3 during this period due to the increased availability of rubber wood. In the case of fuelwood, there is a noticeable decline in demand due to the shift to LPG.

The study reveals that Kerala is a net exporter of timber with a surplus of 2,63,000 m^3. About 80 per cent of the timber export during 2000-01 was contributed by rubber wood. Jack wood was the most important timber in both production and consumption in Kerala. There was demand for cheap timbers which was met by the imported silver oak and eucalypt wood which may be replacing, to a certain extent, the abundantly available coconut wood. There is a clear declining trend in teak wood export from Kerala to other States due to the increased availability of imported teak wood there. The international export of teak wood from Kerala has also declined considerably mainly due to the non-availability of logs in larger girth classes. The market survey of NWFPs cultivated in home gardens indicates that the output was negligible in the NWFPs trade in Kerala. Lack of an organised market and proper grading rules for quality determination are the major problems for NWFPs producers. There is a need to promote the cultivation of NWFPs in home gardens to reduce the pressure on forests.

Contribution of forests in the total timber and fuelwood supply in Kerala is very negligible. Therefore, the remaining forests can be reserved exclusively for conservation purposes. For making available teak logs in larger girth classes, the growing stock in forest teak plantations can be conserved by extending the rotation age. As home gardens are the major source of wood supply in Kerala, the growing stock of trees in home gardens has to be enhanced to avoid the depletion of the wood resource which has substantial environmental benefits. To reduce the dependence on fuelwood, which is a cause of environmental degradation, it is important to make LPG available throughout the State, particularly around forests, on a priority basis.

1. INTRODUCTION

Kerala, a small State in India, has a unique place in development for several reasons. It has a very high population density of 819 persons per km^2 (Census of India, 2001) and very low per capita annual income of Rs 18,000 during 2000 at current prices (Government of Kerala, 2001). Yet, its very high literacy rate (91%) and commendable indices of physical quality of life which approach the standards of developed countries for longevity and a sex ratio showing a preponderance of females are some of the features that make Kerala State an enigma within the tropical developing regions.

The geographical area of the State is 38,855 km^2. The area under forests is 10,815 km^2 which comes to about 28 per cent of the land area. Kerala pioneered teak plantations in the world since 1844 and the current area under teak plantations in forests is 780 km^2. Pulpwood plantations of eucalypt occupy nearly 380 km^2. Other species of acacia, albizia and cashew account for smaller areas. The wood production from forests comes exclusively from plantations, as harvesting of natural forests was stopped for nearly two decades following a policy favouring conservation and judicial interventions reinforcing the ban on "green felling" in forest areas.

Land use in Kerala is characterised by mixed cropping home gardens which occupy about 46 per cent of the geographical area. The home garden agriculture is often dominated by coconut palms which is a perennial source of non-wood fuel for cooking. Trees are an important component of the home garden system with multiple uses. Jack (*Artocarpus heterophyllus*), mango (*Mangifera indica*), cashew (*Anacardium occidentale*), tamarind (*Tamarindus indica*) are more prominent. Other commonly found important trees are *anjily* (*Artocarpus hirsutus*), teak (*Tectona grandis*), *matty* (*Ailanthus triphysa*), *vatta* (*Macaranca peltala*), etc. The area under coconut palms alone is 8,800 km^2. Different varieties of banana and a range of fruit trees such as guava and papaya, tuber crops such as cassava, yam and spices such as ginger and turmeric, form a mixture of uneven aged multi-storeyed crops. Land and labour saving technology is adopted as both are scarce and expensive. Over 74.4 per cent of the home gardens have an area of 0.02 ha to 0.5 ha only. Home gardens with less than 0.02 ha account for about 11.9 per cent of the number of home gardens. Home gardens with size of 0.5 to 1 ha account for 7.7 per cent. Home gardens between l and 2 ha area account for 4.2 per cent and that above 2 ha is only 1.8 per cent (Government of Kerala, 2001). The acute pressure on land is evident from the size distribution of home gardens. The bright sunshine and high annual rainfall (3,000 mm) provide a good environment for plant growth. The undulating terrain of the midlands and the hills on the eastern side provide a conducive environment for tree growing. These natural advantages contribute to a high volume of growing stock of trees and relatively high level of wood production from home gardens or areas outside the forests. Extensive monoculture plantations of rubber (4,700 km^2) provide an abundant quantity of rubber wood during each cycle of replanting after around 25 years. Cardamom and coffee plantations are raised under the natural canopy of forest trees. Timber and fuelwood are also available from these plantations. Silver oak, an exotic shade tree in tea plantations, is a popular species in home gardens in the high range regions.

Wood is used as fuel for cooking as well as in certain traditional industries and as timber for construction,

furniture and as raw material in wood-based industries. A wood-balance study is intended to assess the quantities of wood supply, demand and the net balance of trade. As in most other sectors, the wood-balance is not a static situation. Demand changes with the level of affluence, tastes and availability of substitutes, price changes and other socio-economic factors. Supply is influenced by market conditions, policy environment, the volume and age of growing stock and other factors. Normally, price changes equate demand with supply in a free market situation. Trade closes the gap between supply and demand, by moving wood from low price areas to high price areas. A wood-balance study also shows the net trade balance of wood movements. When export exceeds import, there is a surplus and when import is higher than export, there is a deficit. If planning aims at a self sustained economy, then measures can be initiated to address a deficit. On the contrary, if natural advantages and opportunities are to be utilised, a different strategy can be adopted. In any case, an analysis of the wood-balance situation provides an understanding of the structure of the wood economy and enables enlightened policy interventions in the wood sector. The first wood-balance assessment of Kerala was done in the year 1987-88 by Krishnankutty (1990). Since then, changes in the wood utilisation pattern and liberalised trade have altered the situation. This is the second wood-balance study for Kerala with reference year 2000-01.

Non-wood forest products (NWFPs), by its very definition, are forest products. They can also be found outside forests such as in home gardens, estates and common lands. In the process of agricultural development, wild plants have been domesticated over centuries of experimentation by farmers. The first phase of transition of a wild plant into agriculture is in the form of cultivation. Pepper, cardamom, cinnamon, ginger and turmeric have been domesticated and integrated into mixed farming home gardens. They are all now considered as agricultural crops. Either the very high demand for that product or the success of the domestication experiment determines whether these plants become true agricultural crop or not. The growth in demand for NWFPs from the ayurvedic drug manufacturing industry and the decline in their availability from forests have contributed to the attempts of growing NWFPs in home gardens. A market survey of NWFPs cultivated in home gardens in Kerala has also been carried out to discuss the issues faced by the cultivators and features of trade and prospects. Those plants, which are not agricultural crops but have come recently under cultivation, have only been considered in this study.

1.1 Objectives

The objectives of this study were i) to estimate the sector-wise demand for wood in Kerala during the reference year 2000-01, ii) to assess the contribution of different sources of wood supply in the same year, iii) to study the wood-balance situation in Kerala during 2000-01, iv) to analyse the fuel consumption pattern and determine the contribution of fuelwood in the fuel-mix in the household sector, v) to study the timber market and design a market monitoring system and vi) to carry out market survey of NWFPs cultivated in home gardens and identify the issues therein.

1.2 Organisation of the Report

The report is organised into seven sections, including that on introduction. Concepts, definitions used

and the methodology are described in Section 2. Sector-wise demand for wood, source-wise supply and wood-balance situation are presented in the third section. Fuel consumption pattern and the contribution of fuelwood in the fuel-mix in the household sector are presented in the fourth section. Wood market in Kerala and a market monitoring system for timber are dealt with in Section 5. Findings of the market survey of NWFPs are discussed in the sixth section. The conclusions emanating from the study are summarised in the last section.

2. METHODOLOGY AND DATABASE

The concepts, definitions used and the methodology adopted in this study are described below.

2.1 Concepts and definitions

Wood is broadly classified as timber and fuelwood. Wood refers to construction timber, industrial wood, poles, fuelwood and charcoal. All types of wood including coconut and palmyra wood, used in solid form as in construction, furniture, fixtures, poles and wood processed by industries such as saw-mill, plywood, veneer, furniture, packing case, pulp, etc., are considered as timber. Fuelwood includes charcoal and all woody materials such as chopped wood, off-cuts and industrial wood-waste used as fuel. In this study, volume of wood is presented in m^3 roundwood. In the case of sawn timber in m^3, its roundwood equivalent in m^3 was calculated using appropriate conversion factors for different timbers. The quantity of fuelwood or charcoal consumed was estimated in weight in tonne which was converted to volume in m^3 roundwood equivalent for aggregation.

The relationship between Consumption, Production and Trade of wood during a year can be shown as 'Consumption = Production + Import - Export'. In this study, 'Consumption + Export' is taken as the effective Demand and 'Production + Import', as the Supply. In any particular year, a portion of the accumulated inventory of wood enters the market as supply, while at the same time part of the production in the same year is added to the inventory. In this study, inventory of wood is ignored as it is assumed to be in a dynamic equilibrium over time. Demand for wood in a year is defined as the effective demand, which is considered identical with the supply in the same year. In this study, the reference year is taken as the financial year 2000-01. As this study in confined to Kerala State, import and export refer to the trade with other States in India and other countries. The total demand for wood during 2000-01 has been estimated under four sectors: household, industries and service (all other wood-using) sectors and export. Similarly the contribution of different sources of wood supply during 2000-01 was assessed under three components: import, forests and non-forest areas (home gardens and estates).

All wood-using entities have been classified into one of four classes namely household, industries and service sectors and export. This is a straight forward classification. Yet it must be clarified that the sawmilling and packing case industries have not been separately shown to avoid double counting. The sawn timber from the sawmilling industry reaches the household, industries and service sectors or they are exported. The product from packing case industry is completely exported. As the output from

the sawmilling and packing case industries was accounted as being used in any of the sectors, the consumption in these two industries is not shown separately. All houses in the residential category were included under the household sector and all other buildings including commercial and government constructions under the service sector.

2.2 Estimation of demand for wood

Demand for wood in a year is the sum of consumption of wood in the household, industries and service (all other wood-using) sectors and export, in the same year. In the household sector, wood is used as timber and fuel. Timber is used for new house construction, repair alternation of existing houses and making furniture, fixtures and implements. Industries sector consists of all industries which consume wood as raw-material and or as fuel. Industries, such as pulp and paper, plywood, veneer, furniture, boat making, handicrafts, etc., utilise wood. Industries, like tile-manufacturing, brick-making, tea-processing, metal industries, automobile workshops, textile-mills and rubber goods, consume wood and or charcoal as fuel. Service sector consists of all wood-using agencies other than household and industries sectors. Business establishments, educational and other institutions, temples, churches, government departments, hospitals, tea-shops, restaurants, hostels, etc. come in the service sector. Wood consumption in this sector is in the form of construction timber or fuelwood or charcoal. The method of estimation of wood consumption in different sectors is explained below.

2.2.1 Wood consumption in the household sector

2.2.1.1 Consumption of timber

A stratified two-stage sampling design was adopted for the estimation of the total quantity of timber used in the household sector of Kerala. The household sector was divided into rural and urban household sectors. Households in all the grama panchayats in Kerala constitute the rural household sector and those in municipalities/corporations constitute the urban household sector. Grama panchayats in Kerala were stratified according to natural regions– lowland, midland, highland and high range regions. The panchayats coming in lowland, midland and highland regions were further divided into those in southern and northern Kerala. Thus altogether, seven strata were formed in the rural sector. Grama panchayats in each stratum were treated as the first-stage units of sampling. Of the total number of grama panchayats in Kerala, two per cent were allocated in the seven strata approximately in proportion to the total number of panchayats in each stratum, ensuring at least two in a stratum. Panchayats within a stratum were selected at random. Altogether, 23 panchayats were selected in all the seven strata comprising the rural sector of Kerala. All the municipalities and corporations in Kerala were grouped together to form the eighth stratum representing the urban household sector. In the urban stratum, all the municipalities and corporations were treated as the first-stage units of sampling and 6 such units were selected at random. The wards in the grama panchayats/municipalities/corporations were treated as the second-stage units of sampling. Two wards each were randomly selected from the chosen 23 grama panchayats and 6 municipalities/corporations.

All the households in the selected wards were visited to collect information such as year of house

construction, whether timber was utilised during the reference year 2000-01 for (i) new house construction, (ii) repair or alterations to the existing houses built before the reference year and (iii) furniture, fixtures and other uses. Actual measurements on all types of timber-use during 2000-01 were made in the selected wards. It was easy to estimate the wood used during the reference period, 'April 2000 to 31 March 2001' in the case of industries as it tallies with this accounting year. But in the case of house construction in the household sector, there was a challenge on how to account for the inventory of timber at the construction site or the timber used in a building during the previous year where the construction was ongoing during the reference year. After much thought and deliberations, the issue was resolved by deciding to record only that portion of timber that has actually been worked and used during the reference year. Any wood work done during the reference year but not fixed before the cut-off date was also included. The same procedure was adopted in the case of fixtures and furniture. Only those which were actually processed during the reference year were considered. The procedure of measuring timber used in construction, fixtures and furniture was as follows: Each item was measured and dimension (length, breadth and thickness) of its individual members was recorded. Allowance for wastage of each member was also made to find out the actual sawn timber used in an item. When multiple numbers of the same item were used in a house, only one was measured and the total was arrived at by multiplying with the number of identical items. Care was taken to record the species of timber in each case. Occasionally the timber could not be identified either by the owner or the survey team. In such cases, the species was recorded as unknown. After measuring the volume of timber used in all types of work in the selected ward, the total volume of timber used the ward in each of the categories of (i) new house construction, (ii) repair or alterations and (iii) furniture, fixtures and other uses, was separately worked out. Based on the ward totals in the sample grams panchayats/ municipalities/corporations, the total quantity of timber used during 2000-01 in a particular category of use was estimated using the formula for two-stage sampling design given in Murthy (1967). The three quantities, corresponding to the above three categories estimated for the rural and urban sectors, were added together to arrive at the total quantity of timber used in the household sector of Kerala.

2.2.1.2 Consumption of fuelwood

For estimating the fuelwood consumption in the household sector, the sampling method adopted was a stratified three-stage sampling design. The first and second-stage units of sampling were the same as in the timber-use survey in the household sector. Households in the selected wards were treated as the third-stage units of sampling. For the preparation of sampling frame for the selection of households in the selected wards, information on household size, extent of homestead land, type of fuels used and their sources were also collected at the time of listing of households. One of the important factors influencing fuel consumption is the economic status of the household. For accounting the variability in fuel consumption, households in each of the selected wards were classified on the basis of annual income. The listing procedure in the selected wards was as follows: The latest compilation of household list was the current electoral roll and it was collected and kept as a guideline to check for missed households. The field survey was started with the visit to each household in the ward and basic information on the household was collected. This included name and address, number of members, land holding size, type of fuels used, sources of fuelwood used, whether timber was used for new construction, addition or repair during the reference period, etc. Income class of each household was

also recorded. All households were grouped under four income classes. The monthly income classes were: Rs.3,000 and below, Rs.3,000 to 6,000, Rs.6,000 to 10,000 and above Rs.10,000. Thereafter, all the households in a selected ward were serially numbered in the ascending order of income class. In each of the selected wards in all the selected panchayats, samples of 25 households were selected by the method of circular systematic sampling for proportional representation of all income classes. Altogether 1,450 households, representing different categories of income classes, in all the strata in Kerala were surveyed for fuel consumption.

Each selected household was visited at least twice by a team of trained personnel for measuring different types of fuels used for cooking and other household purposes. Method of the fuel consumption survey was a follows: In the case of purchased fuelwood or commercial fuel, the quantity and duration of use of such quantities were readily recalled by the sample households. They were recorded. For example, how long a cylinder of LPG or two litre of kerosene lasts was easily recalled and recorded. In the case of purchased fuelwood also the quantity of each purchase or number of bundles were known. When the weight of the bundle was not known, the sample bundles were weighed by the survey team to estimate the quantity. In the case of commercial establishments, the purchase was in the form of as much as a mini truck-load. Here the quantity was known. Consumption of non-wood biomass such as coconut leaf, sheath, husk, shell, etc., was also included during fuel consumption measurements. Consumption of coconut fuels was recorded in terms of number, which was then converted to air-dry weight in kilograms. For converting the number of each item of coconut fuels into kilogram, independent samples consisting of 10 number of each item in air-dry condition were taken and weighed using an electronic balance. This was repeated in different localities in the sample panchayats and average weight per item was estimated. The average weight of each item in air-dry condition was used to convert the number into air-dry weight. In sample households where fuelwood and other materials were stocked, measurement of the fuels used was made. A portion of different fuels stocked in the household required for cooking for a few days was separated and weighed using a circular spring balance. The weighed fuel materials were, then, placed near the oven or near the kitchen depending upon the space available in the house. The household members were requested to use the fuel only from the weighed stock till the next visit. During the second visit after a few days, the fuels left over were separated and weighed to arrive at the actual quantity used during the days between the first and second visit. The real challenge was estimating the quantity of fuelwood in households who gathered it daily from own or neighbouring lands and those who collected it at short intervals, say, a week. Here repeated visits were made and the available quantity was made to estimate the weekly fuelwood use. Prior to the larger survey, seasonal variation in the fuel-use in the sample households were enquired to know the difference between fuel-use during the rainy season and summer or changes in the number of members and customers during different periods of the year. These features were taken into consideration in extrapolating the weekly fuelwood consumption figures to the annual estimate.

While assessing the weight of fuelwood and non-wood biomass fuels during the survey, only air-dry materials were considered for measurements. In this study, the weight of fuelwood and non-wood biomass refers to the weight in air-dry condition. The total quantity of a fuel used in a stratum was estimated using the formula for three-stage sampling plan given in Murthy (1967). The household size is highly correlated with the quantity of different fuels consumed; the ratio estimate is a more

precise estimate of the per capita fuel consumption in the household sector. Based on the size of each household in the sample, the total population with respect to each stratum was also estimated using the same formula given in Murthy (1967). The per capita consumption of a particular fuel in a stratum was estimated as a ratio of the estimate of the total quantity of that fuel used in that stratum to the estimated population in that stratum. Total annual consumption of a fuel in the household sector during 2000-01 was estimated by multiplying the per capita consumption of that fuel with the population as per the 2001 Population Census in each stratum which was complied as follows: The publication of all the Papers of the 2001 Census is not yet complete. Paper I gave the total population of Kerala. Paper II provided the rural-urban break-up at the State level. Paper IV published recently provides the panchayat-wise population. However the panchayat-wise rural-urban break-up has not yet been published. Information on the panchayat-wise rural-urban break-up of population and thereby the stratum population were required for arriving at the stratum total fuelwood consumption in the rural household sector of Kerala. Some later figures available in the Census Website have been used to disaggregate the rural and urban population in each panchayat. However, there was substantial disparity between the aggregate of rural population of each panchayat in Kerala and the earlier reported rural population of the State, if the total urban population and the total population of the State are considered as correct. This excess figure on rural population has been deducted in proportion to the population of each stratum in this study.

2.2.2 Wood consumption in the industries sector

Wood consumption in the industries sector refers to the consumption of wood, fuelwood and charcoal. Industries sector is comprised of two broad groups: organised and unorganised sectors. All industrial units registered under Sections 2(m) and 85 of the Factories Act were included in the organised sector. Factories which are using power and employing 10 or more workers and those which are not using power and employing 20 or more workers on any day during the accounting year come under Section 2(m). Factories employing less than 10 workers and working with the aid of power and those employing less than 20 workers and working without the aid of power on any day during the year come under Section 85. The unorganised sector consists of units registered as small-scale and other unregistered industrial units. Annual Survey of Industries of the National Sample Survey Organisation (NSSO), Government of India, collects information on consumption of raw materials including wood, fuelwood and charcoal. However, the data for the reference year 2000-01 are not available. It was therefore, decided to conduct independent sample surveys in the industries sector for estimating the quantity of wood consumption.

Stratified random sampling design was used for estimating the total quantity of wood consumed in the industries sector. Adopting the same classification of the NSSO for stratification, five classes were considered with workers ranging from 5 and below, 5 - 9, 10 -19, 20 - 49 and 50 or above. In each type of industry, the units were stratified on the basis of average number of workers as above. Of the total number of units, 5 per cent were selected at random from each stratum of each type of industry for detailed survey. The quantity of timber, fuelwood and charcoal consumed in different industries in Kerala during the year 2000-01 was estimated using data collected through the surveys of different timber, fuelwood and charcoal using industries in Kerala. Along with the household survey, data on wood consumption during 2000-01 in all industrial units in the unorganised sector in the selected

wards in the sample panchayats/municipalities/corporations were collected and ward totals were computed. Based on the ward totals, the quantities of timber, fuelwood and charcoal used in different industries in the unorganised sector were estimated using the formula for stratified two-stage sampling design given in Murthy (1967).

2.2.3 Wood consumption in the service sector

Wood consumption in the service sector is in the form of construction timber or fuelwood or charcoal. Timber-use in this sector is mostly in the construction of non-residential buildings like government institutions, business establishments, educational institutions, hotels, schools, hostels, hospitals, temples, churches, etc. Along with the household survey, all non-residential establishments in the selected wards in the sample grams panchayats/municipalities/corporations were visited. There was 100 per cent coverage of establishments in the selected ward and actual measurements on all types of timber-use for (i) new building construction, (ii) repair or alterations to the existing buildings constructed before the reference year and (iii) furniture, fixtures and other uses during 2000-01, were made. Fuelwood consumption in this sector is in the form of fuelwood or charcoal in tea-shops, restaurants, schools, hostels, hospitals, etc. The coverage of fuelwood consumption during 2000-01 in the establishments functioning in the selected wards was also complete. Using the ward total consumption of timber, fuelwood and charcoal in the sample panchayats/municipalities/corporations, consumption of timber, fuelwood and charcoal in the service sector during 2000-01 was estimated using the formula for stratified two-stage sampling plan given in Murthy (1967).

2.2.4 Export of wood

Export refers to the quantity of wood moved out of Kerala to other States in India and that actually exported to other countries. The quantity of timber moved out of Kerala by road was compiled from registers maintained at all the inter-State border forest check-posts. There are inter-State exits from Kerala to neighbouring States where there are no forest check-posts. For estimating the quantity of outflow of timber, the registers kept at the sale tax check-post were also perused. The data collected include species and quantity of timber and charcoal moving through each route. Besides, data from records available at railway stations as well as Kochi and Kozhikode Chambers of Commerce and Industries for Ports were taken to estimate the total volume of export of wood.

2.3 Assessment of wood supply

Supply of wood during the year 2000-01 is defined as the production in Kerala plus the import during the same year. Different sources of wood production in Kerala are forests, home-gardens and private estates of rubber, cardamom, coffee, and tea. Production refers to the actual quantity of wood extracted and used during the reference year 2000-01. The method of assessing wood production and import is given below.

2.3.1 Import of wood

Import includes the quantity of wood coming to Kerala from other States in India and from other

countries. Quantity of wood imported to Kerala was estimated from data available in the registers maintained at the ports, railway stations and all inter-State border forest and sales tax check-posts.

2.3.2 Wood production from forests

For estimating the recorded production of timber from forests, data available in the Annual Administration Report of the Kerala Forest Department was taken. The recorded timber production from forests, shown in the annual administration report, is the wood reaching the government timber depots during the reporting year. The current year's sale includes part of the current year's receipt and also the leftover stock of the previous year. So, the wood production from forests was the average of the production during 1999-2000 and 2000-01. The unrecorded production of fuelwood from forests was taken as the quantity of fuelwood used by people living within and adjoining the forests. The per capita consumption of fuelwood in households within the forests of Periyar Tiger Reserve was estimated by Krishnankutty (2002). Using the per capita consumption and population living within forests during 2001, the quantity of fuelwood removed from forests of Kerala was estimated.

2.3.3 Wood production from home gardens and estates

Timber and fuelwood from home gardens and estates are used in the household and other sectors and a part of the timber is exported. The total wood production from home gardens and estates was estimated in an indirect way. The Rubber Board has estimated the rubber wood production from rubber plantations during 2000-01. The distribution of stem wood (commercial timber) and branch wood (fuelwood) has been reported as 60 and 40 per cent respectively. Based on the rubber wood production during 2000-01 and the proportion of timber and fuelwood, production of timber and fuelwood from rubber plantations was estimated. Wood production from all other sources within Kerala, i.e.; from forests and rubber plantations, has been assessed and the quantity of import was fully accounted for. The remaining quantity of the total demand for wood, which can only come from home gardens and estates of cardamom, coffee and tea, was determined as the production from home gardens and estates other than rubber.

2.4 Fuel consumption pattern

For examining the fuel consumption pattern in the household sector of Kerala, quantities of different fuels consumed in physical units were converted in terms of primary energy units to arrive at a common total. For this, calorific values of different fuels reported in Advisory Board on Energy (1985) were used to convert the quantities equivalent to kilocalories. Based on the conversion factors, the quantities of fuelwood and other fuels were converted into primary energy units in kilocalories. Only a part of the primary energy is actually available for cooking due to differences in fuels and differences in the efficiency of cooking appliances. Therefore, the quantities in terms of primary energy were again converted in terms of *useful heat* by multiplying the quantity of primary energy with the appliance efficiency expressed in proportion. Consumption of different fuels in terms of *useful heat* in kilocalories was used to examine the fuel consumption pattern in the household sector.

2.5 Monitoring of wood market

Trends in the movement of timber to and from Kerala were examined using time series data on import and export of timber through the inter-State border check-posts of Kerala. For examining the short-term trends, data on import and export during the period from 1996-97 to 2000-01 from the entire inter-State border forest check-posts and sale tax check-posts where there is no forest check-posts, were collected. For analysing the long-term trends, data from 6 most important forest check-posts (Manjeswaram, Muthanga, Noolpuzha, Walayar, Aryankavu and Parassala) during the period from 1981-82 to 2000-01 were collected. Volume of trade, data availability and continuity were the important criteria for the selection of the check-posts.

2.6 Survey of NWFPs cultivated in home gardens

The major markets of NWFPs in Kerala were visited and discussions were held with the NWFPs traders to identify the areas where NWFPs plants are cultivated and brought to the market. Based on the information from the traders and manufacturing units, cultivators were located and details on species cultivated, its crop requirements, marketing channels and prices were gathered. Interviews were conducted with NWFPs cultivators and traders to understand the features of trade and problems in cultivation and marketing.

3. WOOD-BALANCE SITUATION IN KERALA

Demand for wood in the household, industries and service (other wood-using) sectors and for export is analysed in this section, followed by estimation of wood supply through import, production from forests and estates. Thereafter, the wood-balance situation in Kerala during the reference year 2000-01 is presented.

3.1 Demand for wood in Kerala

3.1.1 Household sector

Timber consumption in the household sector during 2000-01 is presented in Table 3.1. The total quantity of timber used is estimated as 6,16,000 m^3 roundwood. Three forms of timber demand come from the household sector. They are for construction of new residential houses; addition/repair in existing houses; and furniture, fixtures and other uses. Among these, new houses accounted for 83 per cent of the demand. An interesting finding is the species preferences in the actual consumption of timber. Nearly 50 per cent of the timber consumed was accounted by two timbers, jack wood and anjily, from the home gardens. These are the traditionally important evergreen trees grown in most of the home gardens in Kerala. Coconut wood is mainly used for beams and rafters. The contribution of coconut wood is marginally higher than that of teak. Mango planks are used for doors and cheap furniture. All these species come entirely from home gardens in Kerala. Teak wood was used in small quantities in the household sector for furniture, door and window shutters. Teak used in the household sector comes

mostly from the home gardens. Teak wood from forest plantations in Kerala and natural teak imported from Myanmar are also used in the household sector. The quantity of rosewood used is extremely small. Of the total consumption in the household sector, around 14 per cent is classified as other timbers. They are mostly unidentified timbers. During the field survey when timber measurements were made in the sample households, there were instances where the family members or the investigators could not properly identify the species of timber painted over or supplied by a contractor. Those were grouped along with other timbers. Jack emerges as the tree of Kerala, preferred for growing and using as timber. It also provides fruit, fodder and shade.

Table 3.1 Consumption of timber in the household sector

(m^3 roundwood)

Timber	New house	Addition/ repair of old house	Furniture and other uses	Total	
				Volume	% to total
Jack wood	1,70,802	16,739	7,132	1,94,673	31.6
Anjily	92,520	9,192	7,458	1,09,170	17.7
Teak	63,561	5,582	4,712	73,855	12.0
Coconut wood	45,601	27,308	2,011	74,920	12.2
Imported timbers	51,014	5,442	1,292	57,748	9.4
Mango wood	6,360	1,446	134	7,940	1.3
Vaka	6,546	661	631	7,838	1.3
Rosewood	3,909	1,028	136	5,073	0.8
All other timbers	68,013	10,531	6,057	84,601	13.7
Total timber	5,08,326	77,929	29,563	6,15,818	
	(82.5)	(12.7)	(4.8)		(100.0)

There are a range of fuels used for cooking in the household sector. Information on the fuel-mix is presented in the next section. Here only the component fuelwood is dealt with. Table 3.2 shows the consumption of fuelwood for cooking and other purposes in the household sector during 2000-01. The estimated fuelwood consumption in Kerala is 57,08,000 metric tonnes equivalent to 76,10,000 m^3 roundwood equivalent. A quantity of 103,89,000 m^3 fuelwood equivalent of non-wood biomass material, such as coconut leaf, sheath, husk and shell, was also consumed as fuel. The total wood consumption in the household sector of Kerala during 2000-01 was 82,26,000 m^3 roundwood equivalent (Table 3.3) of which fuelwood accounted for the major share (93%).

Table 3.2 Consumption of fuelwood in the household sector

Fuelwood*	Quantity (tonne)	Quantity (m^3 roundwood equivalent)	% to total
Rubber wood	3,67,117	4,89,489	6.4
All other wood	53,40,512	71,20,683	93.6
Total fuelwood	57,07,629	76,10,172	100.0

* Does not include non-wood biomass fuels such as coconut leaf, sheath, husk, shell, etc.

Table 3.3 Total wood consumption in the household sector of Kerala

Wood	Quantity (m^3 roundwood equivalent)	% to total
Timber	6,15,818	7.5
Fuelwood	76,10,172	92.5
Total wood	82,25,990	100.0

3.1.2 Industries sector

Timber sawing and packing case units are the important wood-using industries in Kerala. Sawn timber is used in the household and service sectors, industries like furniture and for export. Packing cases are entirely exported to other States in India. Consumption of sawn timber and packing cases was already accounted for in the total demand for timber. Therefore to avoid double counting, wood used in the saw milling and packing case industries is not shown separately. Among the wood using industries in Kerala, packing case manufacturing is the largest. These units depend on rubber wood as raw material. During the period of the study the packing case industry was thriving due to the availability of rubber wood from re-plantation of the existing rubber estates. Kerala has substantial area under rubber plantations and the Rubber Board provides a subsidy for replantation. The Kerala government policy of banning the export of unprocessed rubber wood to favour the local wood possessing industry also helped this industry to obtain rubber wood cheap. Subsequently, this ban on export of unprocessed rubber wood from Kerala has been lifted and the processing units in Kerala have to pay competitive prices for raw material.

Table 3.4 gives the volume of timber consumed as raw material in industries sector during 2000-01. The total quantity of timber used in the industries sector, other than saw milling and packing case industries, is estimated as 8,65,000 m^3 roundwood. The highest consumption of wood was in the splints and veneer industry. *Matty* is the preferred species for splints, rubber wood and vatta are used for match box veneers. In areas, where the match units are clustered, the cultivation of *matty* in home gardens is popular. Plywood industry ranked next followed by pulp and paper industry. Plywood

Table 3.4 Consumption of timber in the industries sector#

Industries	Quantity (m^3)	% to total
Match splints & veneer	4,73,177	54.7
Plywood	2,43,631	28.2
Pulp and paper	98,998	11.5
Wooden furniture and fixtures	43,852	5.0
Others*	5,088	0.6
Total wood	8,64,746	100.0

#Consumption of timber in the saw-milling and packing case industries are not shown under the industries sector to avoid double counting. * Industries producing hand tools, industrial goods, wooden structural goods, pencil, photo frames, wooden toys, wooden boats, etc.

industry which was traditionally dependent on forest timber has switched over to rubber wood. Most of the plywood units in Kerala now use rubber wood as raw material, however there are a few units manufacturing high value plywood depending on imported timber. The pulp industry in Kerala saw the exit of a major private sector unit which used forest bamboo and eucalypt plantation wood. The only surviving pulp industry unit is a public sector newsprint factory which obtains its raw material from the forests of Kerala and through import from neighbouring States. The unit also uses imported pulp which has become cheap due to the liberalisation policy. The wood-based furniture industry in Kerala has also declined due to the easy availability of cheaper substitutes of plastic chairs, cupboards and tables of steel, MDF, etc. The availability of teak wood poles from the thinning of forest plantations has sustained this industry to a great extent.

Consumption of fuelwood in the industries sector is given in Table 3.5. The estimated total consumption of fuelwood is 7,98,000 tonnes equivalent to 10,63,000 m^3 roundwood. Tile and brick industry accounted for about 90 per cent of the fuelwood consumption in this sector. The total consumption of charcoal is estimated as 31,000 tonnes equivalent to 1,84,000 roundwood equivalent of which 42 per cent was used by textile mills (Table 3.6). The total wood consumption in the industries sector is 21,12,000 m^3 of roundwood equivalent of which timber accounted for 41 per cent and fuelwood and charcoal, the remaining 59 per cent (Table 3.7).

Table 3.5 Consumption of fuelwood in the industries sector

Industries	Quantity (tonne)	Quantity (m^3 roundwood equivalent)	% to total
Tiles & brick	7,16,063	9,54,751	89.8
Tyre & rubber products	49,269	65,692	6.1
Textiles	13,828	18,437	1.7
Food products	1,310	1,747	0.2
Ayurvedic medicines	6,446	8,595	0.8
Others*	10,660	14,213	1.4
Total fuelwood	7,97,576	10,63,435	100.0

* Industries such as plywood, dairy products, printing and binding, allopathic medicines, casting of iron and steel, metal utensils, bakery products, soap, matches, knitting mills, repair of motor vehicles, etc.

Table 3.6 Consumption of charcoal in the industries sector

Industries	Quantity (tonne)	Quantity (m^3 roundwood equivalent)	% to total
Textile mills	12,972	77,832	42.3
Rubber products	4,426	26,556	14.4
Hand tools	3,196	19,176	10.4
Tile industries	2,378	14,268	7.8
Metal industries	1,491	8,946	4.9
Others*	6,186	37,116	20.2
Total charcoal	30,649	1,83,894	100.0

* Automobile workshop, bell metal works, industrial machinery, repair of ships and boats, engineering goods, blacksmithy, etc.

Table 3.7 Total wood consumption in the industries sector of Kerala

Wood	Quantity (m^3 roundwood equivalent)	% to total
Timber	8,64,746	40.9
Fuelwood	10,63,435	50.4
Charcoal	1,83,894	8.7
Total wood	21,12,075	100.0

3.1.3 Service sector

Timber demand in the service sector is in the form of construction timber for non-residential and commercial buildings. Consumption of timber for building constructions in this sector is shown in Table 3.8. The estimated timber consumption is 10,000 m^3. In building constructions in the service sector, there is substitution of timber with metal and glass. In fact very little timber is directly used. Plywood and MDF is used minimally. Government of India directives to the Central Public Works Department to reduce or avoid the use of timber in their buildings have had a domino effect. Most public buildings now have very little timber component. The decline in the demand for timber is most noticeable in the case of newly built commercial and public buildings.

Table 3.8 Consumption of timber for building constructions in the service sector

(m^3 roundwood)

Timbers	New building	Addition/ repair of old building	Furniture and other uses	Total	
				Volume	% to total
Anjily	2,732	1,472	158	4,362	41.7
Teak	1,680	353	0	2,033	19.4
Jack wood	1,158	0	371	1,529	14.6
Imported timber	397	0	0	397	3.8
Coconut wood	212	0	0	212	2.0
Other timbers	950	964	23	1,937	18.5
Total timber	7,129	2,789	552	10,470	100.0

The fuelwood demand in the service sector comes from tea shops, restaurants, schools, hostels, hospitals and similar institutions. The estimated consumption of fuelwood and charcoal is 15,11,000 m^3 roundwood equivalent (Table 3.9). Traditionally all tea shops had a charcoal burning samovar. It was observed that with the shift towards LPG, most tea shops have stopped using the charcoal burning samovar. As in the household sector, the institutions in the tertiary sector have also switched over to LPG substantially, causing a decline in the demand for fuelwood in this sector. However the increased availability of rubber fuelwood makes it a viable fuel for hotels and commercial establishment in the rural areas. The estimated total wood consumption in the service sector is 15,21,000 m^3 roundwood equivalent *(Table 3.10) of which timber accounted for only below one per cent.*

Table 3.9 Consumption of fuelwood in the service sector

Fuels	Quantity (tonne)	Volume (m^3 roundwood equivalent)	% to total
Fuelwood	9,37,311	12,49,748	82.7
Charcoal	43,527	2,61,162	17.3
Total fuelwood	-	15,10,910	100

Table 3.10 Total wood consumption in the service sector of Kerala

Wood	Volume (m^3 roundwood equivalent)	% to total
Timber	10,470	0.7
Fuelwood	15,10,910	99.3
Total wood	15,21,380	100.0

3.1.4 Export of wood

The export of timber from Kerala is substantial, accounting for 5,74,000 m^3 (Table 3.11). But 86 per cent of the export comprised of packing case, mainly of rubber wood. Teak and rosewood together accounted for only about three per cent of the total export. Teak wood export outside India is negligible; the bulk of it is exported to other States in India. Rosewood is the more important timber exported to other countries.

Table 3.11 Export of timber from Kerala to rest of India and other countries

(m^3 roundwood)

Destination of export	Packing case wood*	Teak	Rosewood	Other timbers	Total
Export to rest of India	4,96,042	13,812	209	61,570	5,71,633
Export to other countries	0	113	2,393	0	2506
Total export	4,96,042	13,925	2,602	61,570	5,74,139
	(86.4)#	(2.4)	(0.5)	(10.7)	(100.0)

* Primarily sawn rubber wood. Also *mango wood, vatta,* cashew wood, etc. # Percentage to row total.

Table 3.12 shows the direction of export of timber from Kerala to rest of India during 2000-01. The direction of export of timber from Kerala to rest of India is indicative. It is based on the direction of movement and roads through which wood is exported outside Kerala. For example, Manjeswaram forest check-post on National Highway 17 leads to Mumbai which is a major consumption centre of timber. Mumbai does not mean the city of Mumbai alone. It could also include the other centres in Maharashtra and Gujarat. Likewise, several roads to the east from the districts of Kasaragod, Kannur, Wyanad and Malappuram lead to Karnataka State. The leading wood consuming urban centres in Karnataka are Bangalore and Mysore. So timber moving out of Kerala through check-post at Muthanga, Baveli, Iritty, Jalsur, Mavinhalla, Noolpuzha, Panathur, Tholpetty, Ukkuda, Vazhikkadavu, etc. were

grouped together and shown to be oriented towards Bangalore. Timber moving out of Kerala through check-posts at Walayar, Anappady, Gopalapuram, Meenakshipuram, etc. and sale-tax check-post at Govindapuram were grouped together and shown to be oriented towards Coimbatore and Trichy. Similarly the direction towards Madurai was based on the timber movements through check-posts at Aryankavu, Achenkovil, Bodymettu, Chinnar, Kambammettu, Kottavasal, Kumily, Parassala, etc.

Table 3.12 Direction of export of timber from Kerala to rest of India

(m^3 roundwood)

Wood	Mumbai	Bangalore	Coimbatore and Trichy	Madurai	Total	
					Volume	% to total
Packing case						
Rubber wood	1,96,838	19,813	2,21,718	16,819	4,55,188	79.6
Mango wood	7,803	1,617	13,540	30	22,990	4.0
Vatta	14,475	0	0	0	14,475	2.6
Cashew wood	1,780	1,584	25	0	3,389	0.6
Packing case total	*2,20,896*	*23,014*	*2,35,283*	*16,849*	*4,96,042*	*86.8*
Timber						
Teak wood	92	1,565	5,492	328	7,477	1.3
Teak poles	0	4,271	1,611	453	6,335	1.1
Silver oak	17,771	647	1,388	0	19,806	3.5
Anjili	210	139	67	308	724	0.1
Venga	0	194	338	2	534	0.1
Eucalypt	117	40	281	16	454	0.1
Rosewood	0	135	55	19	209	0.0
Jack wood	90	10	8	0	108	0.0
Other timbers	9,949	8,436	14,784	6,775	39,944	7.0
Timber total	*28,229*	*15,437*	*24,024*	*7,901*	*75,591*	*13.2*
Total timber export	2,49,125	38,451	2,59,307	24,750	5,71,633	100.0

Sawn packing case wood accounted for 87 per cent of the total export. Rubber wood alone accounted for 80 per cent. Mango wood, vatta and cashew wood made up the rest of packing case wood. Among timbers exported other than packing cases, silver oak recorded the largest volume of about 20,000 m^3. Originally introduced as shade tree in tea plantations, it is widely grown in the hills of Wyanad District. It can be seen in Table 3.17 that silver oak import accounted for 26,000 m^3. In fact, there was only a net import of 6,000 m^3 of silver oak wood. The export of eucalypt was also an actual outflow of the large volume of eucalypt import. The export of eucalypt is in the form of sawn wood from among the larger dimension eucalypt imported from other States for construction purposes. The teak wood exported was 14,000 m^3. It represented 18 per cent of the export of timber, excluding packing cases, to other States in India. Nearly half of it was composed of poles from thinning of forest teak plantations. Actually, there was hardly any net export of teak as the export is equally matched by the import of teak logs mainly from Myanmar (Tables 3.16 and 3.17). There is hardly any import of poles into Kerala. Detailed analysis of the pattern of trade is made in Section 5.

3.1.5 Demand for wood in Kerala : An overview

Table 3.13 shows the sector-wise demand for wood in Kerala. The estimated total demand for wood is 122,61,000 m^3 roundwood equivalent. Of the total demand, household sector accounted for the major share (66%), industries sector ranked next (17%), followed by service sector (12%). Wood export accounted for five per cent of the total demand for wood. Of the total household demand for wood, fuelwood accounted for the major share (92%). Of the total industrial demand, wood as fuel constituted 59 per cent and as timber 41 per cent. In the service sector, the demand for wood as fuel was 99 per cent and as timber only one per cent of the demand for wood. Of the total demand for wood in all the sectors together, wood as fuel accounted for 83 per cent and as timber 17 per cent. Household sector, accounting for 73 per cent of the demand for fuelwood, is the largest sector using fuelwood. Of the total demand for timber, industries sector accounted for 42 per cent, household sector 30 per cent and export 28 per cent. The volume of timber used in the service sector was negligible. The total demand for teak wood is estimated as 96,000 m^3 of which household sector accounted for 77 per cent (Table 3.14). Teak wood used in the industries and service sectors were only 7 and two per cent respectively. Teak wood export accounted for 14 per cent of the total demand for teak wood.

Table 3.13 Sector-wise demand for wood in Kerala during 2000-01

(m^3 roundwood equivalent)

Sectors	Timber		Fuelwood		Total wood	
	Volume	% to total	Volume	% to total	Volume	% to total
Household#	6,15,818	29.8	74,37,996	73.0	80,53,814	65.7
Industries	8,64,746	41.9	12,47,329	12.2	21,12,075	17.2
Service	10,470	0.5	15,10,910	14.8	15,21,380	12.4
Export	5,74,139	27.8	0	0.0	5,74,139	4.7
Total demand	20,65,173 (16.8)	100.0	101,96,235 (83.2)	100.0	122,61,408 (100.0)	100.0

The household fuelwood consumption was actually higher by 1,72,176 m^3 as half of the estimated quantity of 3,06,065 m^3 of saw-mill waste and 19, 143 m^3 of wood waste from other industries (5 per cent of the total industrial wood used except pulpwood) utilised as fuel in the household sector was not included to avoid double counting.

Table 3.14 Sector-wise demand for teak wood in Kerala during 2000-01

Sectors	Volume (m^3 roundwood)	% to total
Household	73,855	76.7
Industries	6,481	6.7
Service	2,033	2.1
Export*	13,925	14.5
Total demand for teak wood	96,294	100.0

* Teak wood export to other countries was only 0.4%.

Comparing the changes in the demand for timber from 1987-88 to 2000-01, it is observed that the demand has declined from 24,93,000 to 20,65,000 m^3. In the household sector, the change was from 11,33,000 to 6,16,000 m^3. This decline was primarily due to the shift from tiled roof to concrete roof houses and availability of cheaper substitutes of steel, aluminium and concrete frames for doors and windows. Use of concrete and steel door frame and use of glass and plywood for shutters have also increased. These changes are the reasons for the decline in timber-use in construction. In ordinary houses, the quantity of timber used has reduced considerably compared to houses of the same size traditionally built. However in the luxury housing sector, there is a noticeable change for conspicuous consumption of teak. Availability of a variety of substitutes for furniture and fixtures has contributed to a decline in the demand for timber in the household sector. In the service sector, in spite of a boom in construction activity, the almost total substitution of wood with other materials has caused a dramatic decline from 2,24,000 m^3 to 10,000 m^3 during this period. This trend may affect the pattern of timber consumption in the household sector in due course. In the industries sector alone, there was an increase in demand from 7,42,000 m^3 during 1988 to 8,65,000 m^3 in 2001. The growth in rubber wood production and a policy favouring local wood processing units has contributed to the increase in the demand from industries sector. Packing case industry accounted for the bulk of the industrial demand. As the entire output of the packing case industry was exported outside Kerala, it was included under the head 'export'. In the earlier study, it was accounted under the industries sector. The export of packing cases which was 3,19,000 m^3 in 1988 increased to 4,96,000 m^3 during 2001. The export of timber was 5,74,000 m^3 including packing case. The export excluding packing case wood was 78,000 m^3 which is slightly higher than the previous figure of 75,000 m^3.

Compared to the situation in 1987-88 when the total demand for fuelwood was 121,52,000 m^3, the demand after 13 years was only 101,96,000 m^3. In the household sector, an increase from 65,91,000 to 76,10,000 m^3 roundwood equivalent during 1987 to 2001 is observed. The estimate for fuelwood consumption during 1987 was based on secondary data (Government of Kerala, 1986). In retrospect, it seems likely that the earlier figure on fuelwood consumption was an underestimate for two reasons. Firstly, the methodology adopted in that study was based on recall method which cannot be considered as very reliable. Secondly, it was confined to southern Kerala where LPG connections were already widespread compared to northern Kerala. During the period between 1987 and 2001, the population of Kerala increased by over 3 million which definitely has its impact on the total fuelwood consumption in the household sector. In the urban areas, a shift from fuelwood to LPG is spectacular. Profuse production of fuelwood and non-wood fuel materials in the home garden agriculture is one reason for the continued use of fuelwood in the household sector. However, affluent houses have completely shifted to LPG pointing to a faster trend in substitution of fuelwood with LPG. There has been a decline in demand in other fuel using sectors. In the industries sector, the decline has been of a more drastic nature due to the actual decline in the number of units in the fuelwood using industries sector. Tile and brick making, an important fuelwood using industry, has declined considerably due to the preference for concrete roof and the popularity of cement hollow bricks. Multi storied commercial buildings with concrete frames, cheaper houses and compound walls now use cement hollow bricks instead of burnt bricks thereby reducing the demand for fuelwood. Tea factories traditionally used fuelwood for curing tea. But this has changed during the last decade due to the shift towards furnace oil instead of fuelwood. Ayurvedic medicine manufacturing involving boiling of plant decoctions has

been modernised in the large scale units and the shift towards Good Manufacturing Practices (GMP) has relied on LPG as fuel for most processes. Potteries have also declined due to the increased use of aluminium vessels. But units diversifying into flower pots and decorative items have managed to survive. Bell metal industries have also declined due to the competition from large vessels of aluminium. Therefore, charcoal demand from the bell metal industries in Kerala has also declined. Textile mills also use charcoal in its manufacturing process. The decline of the textile industries in Kerala has reduced the demand for charcoal from that sector. The decline in the demand for fuelwood in the service sector is notable (39,15,000 to 15,11,000 m^3). The widespread use of LPG in hotels and teashops is the reason for the decline. In the industries sector, on the other hand, the decline has occurred (from 20,42,000 to 12,47,000 m^3) due to the fact that the major user namely, the brick and tile manufacturing industry suffered a decline in fortune due to the competition from substitutes such as cement hallow bricks and concrete roofing. In conclusion, the fuelwood scenario in Kerala is comfortable with a deficit only for charcoal.

3.2 Supply of wood in Kerala

3.2.1 Import of wood

Total wood imported to Kerala during 2001-01 was 5,47,000 m^3. Of the total, 43 per cent consisted of charcoal and 57 per cent was true timber (Table 3.15). Wood was imported to Kerala from rest of India (71%) and from other countries (29%). Among timber species, teak accounted for 5 per cent and rosewood one per cent. Other species accounted for 94 per cent of all timber import. Imported timbers

Table 3.15 Import of wood to Kerala from the neighbouring States and other countries

(m^3 roundwood equivalent)

Origin of import	Teak	Rosewood	Other timbers	Charcoal	Total
Import from the neighbouring States	521	2,664	1,48,439	2,36,813	3,88,437 (71.0)
Import from other countries#	14,071	0	1,44,843	0	1,58,914 (29.0)
Total import	14,592 (2.7)	2,664 (0.5)	2,93,282 (53.5)	2,36,813 (43.3)	5,47,351 (100.0)

* Percentage to column total. # Import of 13,494 tonnes of wood-pulp was not considered.

from other countries coming to Kerala enter India either through the Tuticorin or Mangalore Port. Tuticorin Port is on the east coast in Tamil Nadu and Mangalore on the west coast in Karnataka. These ports are connected by National Highways to Kerala. Timber entering into Kerala through forest check-posts at Walayar, Anappady, Gopalapuram, Meenakshipuram, etc. Aryankavu, Achenkovil, Bodymettu, Chinnar, Kambanmettu, Kottavasal, Kumily, Parassala, etc., and sale-tax check-post at Govindapuram is grouped together and shown as that coming through Tuticorin Port. Timber entering into Kerala through Manjeswaram forest check-post on National Highway 17 is shown as that coming through Mangalore Port. Of all timbers species, pyncado from Myanmar accounted to 43 per cent (3.16). This species has

been found greater acceptance in Kerala due to its low price and almost cylindrical form providing very high out-turn. The second important species is natural teak from Myanmar. This is mostly used for decorative front doors in expensive houses. Gurjan and keruing are other important species from Myanmar. Kussia and purpleheart timbers are imported from Guyana. Malaysian sal and merban are imported from Malaysia. Paduak and gurjan were also coming from Port Blair in Andaman Islands.

Table 3.16 Import of timber to Kerala from other countries

(m^3 roundwood)

Timbers	Ports		Total	
	Tuticorin *	Mangalore#	Volume	% to total
Pynkado	31,590	36,298	67,888	42.7
Teak	6,299	7,772	14,071	8.8
Gurjan	560	7,807	8,367	5.3
Kussia	4,494	1,396	5,890	3.7
Paduak	2,022	1,907	3,929	2.5
Keruing	3,820	7	3,827	2.4
Billinga	2,811	688	3,499	2.2
Malaysian sal	3,181	0	3,181	2.0
Other timbers$	24,002	24,260	48,262	30.4
Total	78,779	80,135	1,58,914	100.0

* Includes timber from Port Blair. # Includes imported timber of 16,092 m3 to Kerala by rail from Mangalore Port.
$ Timbers such as merban (Malaysia), purpleheart (Guyana), etc.

The import of timber from the neighbouring States was from the hills of Karnataka and Tamil Nadu States (Table 3.17). Eucalypt wood cultivated in the plains was also entering Kerala in a big way. Based on the roads through which timber enters Kerala, the origin of the timber was located and grouped under three heads. A small quantity of timber entered Kerala through Manjeswaram check-post. It was from the South Canara part of Karnataka State. The hills of Coorg in Karnataka and Nilgiris in Tamil Nadu support good tree vegetation and timber produced in these parts enters Kerala through check-posts at Muthanga, Baveli, Iritty, Jalsur, Mavinhalla, Noolpuzha, Panathur, Tholpetty, Ukkuda, Vazhikkadavu, etc. From the rest of Tamil Nadu, bulk of the import was in the form of charcoal. Eucalypt wood cultivated in the agricultural lands in Tamil Nadu also entered into Kerala through check-posts at Walayar, Anappady, Gopalapuram, Meenakshipuram, Govindapuram, Aryankavu, Achenkovil, Bodymettu, Chinnar, Kambanmettu, Kottavasal, Kumily, etc. Among timber import, eucalypt was the most important accounting for 1,13,000 m^3 which is about 74 per cent of the import of all timbers. Small dimension eucalypt accounting for around half of the total quantity was used by the newsprint factory as pulpwood and larger dimension eucalypt wood was used as construction timber. Silver oak accounted for 26,000 m^3, the next highest quantity of import (17%). The net import of silver oak wood was only 6,000 m^3 (see also Table 3.12). The relatively low price of this species makes it quite attractive. Casuarina poles accounted for about six per cent of the imported timber. These are used as substitute for bamboo for temporary constructions. The quantity of high value timber such as teak and rosewood accounted for only a negligible share from the neighbouring States.

Table 3.17 Import of timber and charcoal to Kerala from rest of India

(m^3 roundwood equivalent)

Timbers	South Canara	Coorg and Nilgiris	Rest of Tamil Nadu	Total	
				Volume	% to total
Eucalypt	0	74,501	38,107	1,12,608	29.0
Silver oak	435	20,092	5,392	25,919	6.7
Casuarina poles	10	28	8,735	8,773	2.2
Rosewood	443	2,221	0	2,664	0.7
Teak	0	521	0	521	0.1
Other timbers	126	1,013	0	1,139	0.3
Charcoal	0	0	2,36,813	2,36,813	61.0
Total	1,014	98,376	2,89,047	3,88,437	100.0

3.2.2 Wood production from forests

Table 3.18 shows the wood production from forests during 2000-01. The recorded production of wood from forests was assessed as 1,02,000 m^3 roundwood equivalent of which timber, billets and poles accounted for 86 per cent and fuelwood the remaining 14 per cent. Teak including poles accounted for 49 per cent of the total production from forests. A quantity of 6,01,703 tonnes equivalent to 8,02,270 m^3 of fuelwood used in the household sector was obtained from forests. A quantity of 37,317 tonne equivalent to 49,756 m^3 of fuelwood was used by people living within forests. The estimated unrecorded production of fuelwood from forests is 8,52,026 m^3 roundwood equivalent. Total production of fuelwood from forests during 2000-01 was 8,66,890 m^3 roundwood equivalent. The unrecorded production of charcoal from forests was assessed as 2, 08,243 m^3 roundwood equivalent. This was taken as the difference between the total consumption of charcoal in Kerala and the quantity of imported charcoal.

Table 3.18 Wood production from the forests of Kerala

Products	Quantity and unit	Volume (m^3 roundwood equivalent)	% to total
Teak logs	29,103 m^3	29,103	28.4
Teak billets	5,446 tonne	8,378	8.2
Teak poles	292 '000 Nos	12,784	12.5
Eucalypt wood	23,702 tonne	27,560	26.9
Other timber#	8,753 m^3	8,753	8.6
Billets of other timber	7,007 tonne	933	0.9
Fuelwood	11,148 tonne	14,864	14.5
Total	-	1,02,375	100.0

Production of rosewood was only 67 m^3.

3.2.3 Wood production from home gardens and estates

The total rubber wood production in India during 2000-01 was estimated as 16,02,000 m^3 by the Rubber Board of India (George and Joseph, 2002). Out of the total rubber wood production, the

quantity available in Kerala was assessed as 85 per cent. So the production of rubber wood in Kerala is estimated as 13,61,700 m^3. On conversion, stem wood accounts for 60 per cent and fuelwood 40 per cent of the commercial wood volume of each tree. The production of stem wood and fuelwood was assessed as 8,17,020 and 5,44,680 m^3 respectively. The total production of timber from home gardens and estates other than rubber, is assessed as 8,50,104 m^3 and that of fuelwood as 83,39,609 m^3 roundwood. Timber accounted for 9 per cent of the total wood production from home gardens and estates of cardomom, coffee and tea.

Teak wood production from home gardens and all estates is assessed as 31,437 m^3 roundwood. For cutting and transporting notified timbers from private land including home gardens, such as teak wood and rosewood, a pass issued by the appropriate forest official is required as per the forest regulations. The law provides that a vehicle transporting notified timber can be confiscated along with the timber if caught without a pass. The procedure to obtain such a pass is complex and time consuming. So in areas away from forests and on routes where forest checking is infrequent, timber is cut from home gardens and transported without obtaining pass. The available data as per the Forest Department during the decade 1991-2001 is presented in Table 3.19. It is interesting to note that the timber production has reduced by half between the two 5-year periods. The annual teak wood production from private lands has declined from 11,000 to 8,000 m^3 according to the pass issued by the department. The annual production of teak wood and rosewood during 1999-2001 were 8,000 and 2,000 m^3 respectively pointing to substantial market arrival of timber from home gardens. The actual wood production from home gardens and private estates would be far higher than these figures, due to the reason given above and also in case of notified timbers felled and used locally. For timber such as jack, no pass is required and those timbers do not come under the purview of the Forest Department statistics.

Table 3.19 Wood production from private lands as per cutting permits

(Production per annum)

Period	Timber (m^3)			Fuelwood (tonne)			Total (in m^3 roundwood equivalent)
	Teak	Rose wood	Others	Teak	Rose wood	Others	
1991-1996	11,288	2,498	56,137	1,234	614	58,262	1,50,322
1996-2001	8,307	2,330	48,531	745	278	14,578	80,122
1999-2001	8,029	2,062	38,352	389	190	9,564	62,046

Does not include poles, sandalwood, etc.

3.2.4 Supply of wood in Kerala : An overview

Wood supply in Kerala from home gardens, rubber estates, forests and import is shown in Table 3.20. The figure on wood production from home gardens includes wood production from private estates of cardamom, coffee and tea. Since production from such estates was negligible, it is not shown separately. Home gardens contributed 75 per cent of the total wood supply. Rubber estates alone contributed 11 per cent. Forests produced only about 10 per cent although the recorded production was only about one per cent of the total supply. Wood imported from other States and countries was 4 per cent of the total wood supply. When timber production alone is considered, the contribution of home gardens is

matched with that of rubber estates. Forests produced only four per cent. Import accounted for 15 per cent of the total supply of timber in Kerala. When teak wood production is considered (Table 3.21), contribution of forests was substantial (52%). Import accounted for 15 per cent of the total teak wood production and the remaining 33 per cent was contributed by home gardens and private estates.

Table 3.20 Source-wise supply of wood in Kerala during 2000-01

(m^3 roundwood equivalent)

Sources of supply	Timber		Fuelwood		Total wood	
	Volume	% to total	Volume	% to total	Volume	% to total
Home gardens*	8,50,104	41.2	83,39,609	81.8	91,89,713	74.9
Rubber estates	8,17,020	39.6	5,44,680	5.4	13,61,700	11.1
Forests	87,511	4.2	10,75,133	10.5	11,62,644	9.5
Import#	3,10,538	15.0	2,36,813	2.3	5,47,351	4.5
Total supply of wood	20,65,173	100.0	101,96,235	100.0	122,61,408	100.0

*Includes production from private estates of cardamom, coffee and tea. # Timber import from other countries is 51.2 %.

Table 3.21 Source-wise supply of teak wood in Kerala during 2000-01

Sources of supply	Volume (m^3 roundwood)	% to total
Home gardens*	31,437	32.6
Forests	50,265	52.2
Import	14,592	15.2
Total supply of teak wood	96,294	100.0

*Includes teak wood production from private estates of rubber, cardamom, coffee and tea.

3.3 Wood-balance situation during 2000-01

Table 3.22 shows the wood-balance situation in Kerala during 2000-01. The consumption and production of wood in Kerala during 2000-01 were 116,87,000 and 117,14,000 m^3 roundwood equivalent respectively. The difference of 27,000 m^3 was the net export, where the export and import of wood were 5,74,000 and 5,47,000 m^3 respectively. With regard to timber, the consumption and production were 14,91,000 and 17,54,000 m^3 with a net export of 2,63,000 m^3. In the case of fuelwood, consumption and production were 101,96,000 and 99,60,000 m^3 with a net import of 2,36,000 m^3 roundwood equivalent of charcoal.

The wood-balance situation in Kerala during 2000-01 revealed a comfortable position with both an export surplus for total wood and also for total timber. The source of this surplus was rubber wood that contributed to an export of 4,55,000 m^3. In the case of teak wood, the production and consumption matched with only a small deficit of 667 m^3. In the case of all other timbers, the consumption exceeded production showing a deficit of 1,91,000 m^3. A substantial quantity of charcoal was imported from the neighbouring State of Tamil Nadu. This accounted for the entire quantity of fuelwood import.

Table 3.22 Wood-balance situation in Kerala during 2000-01

('000 m^3 roundwood)

Wood	Demand		Supply		Net export*
	Consumption	Export	Production	Import	
(0)	(1)	(2)	(3)	(4)	(5) = (2) – 4)
Teak wood	82	14	81	15	(-) 1
Rubber wood	362	455	817	0	(+) 455
All other timbers	1,047	105	856	296	(-) 191
Total timber	1,491	574	1,754	311	(+) 263
Fuelwood	10,196	0	9,960	236	(-) 236
Total wood	11,687	574	11,714	547	(+) 27

* There was a net export of 2,63,000 m^3 of timber and a net import of 2,36,000 m^3 roundwood equivalent of fuel.

4. FUEL CONSUMPTION PATTERN IN THE HOUSEHOLD SECTOR OF KERALA

The household sector is the largest fuelwood using sector accounting for 73 per cent of the total fuelwood consumption in Kerala. Fuel-mix and per capita consumption of different fuels in households in the rural and urban regions in Kerala during 2001-02 is given in this section. Fuel consumption pattern was analysed and the contribution of fuelwood in the fuel-mix was also determined.

4.1 Distribution of households by fuel-mix

Distribution of households accounting to fuel-mix during 2000-01is given in Table 4.1. Based on the sample survey, the total number of households in the rural areas has been estimated as 54,11,000 and that in the urban areas as 17,51,000 households. Those depending on biomass alone comprise 42 per cent of the total households. Households using a combination of biomass and kerosene comprise 9 per cent. In rural areas, households using biomass fuels alone accounted for 52 per cent. While in urban areas, it was only 10 per cent dependent entirely on biomass fuels. Another eight per cent of households supplement biomass with kerosene. Two broad classifications can be made: that is, households depending on biomass fuels alone and those that have access to LPG connection. Biomass fuels include fuelwood and non-wood biomass such as coconut fuels. The number of households with LPG connection in Kerala is estimated as 34,91,000 representing 49 per cent of all households. All combinations of fuel-mix in households without LPG connections accounted for 51 per cent of the total number of households (Table 4.2). In urban areas, households having LPG connections and using a combination of LPG and other fuels accounted for 82 per cent while it was only 38 per cent in rural areas. Households depending on LPG alone accounted for 34 per cent in urban areas while in the rural areas it was only two per cent of the total households.

Table 4.1 Distribution of households by fuel-mix during 2001-02

(Number in '000)

Fuel-mix	Rural		Urban		Kerala	
	Number	% to total	Number	% to total	Number	% to total
LPG and biomass	1,960	36.2	822	46.9	2,782	38.8
LPG alone	94	1.7	596	34.0	690	9.6
LPG and electricity	2	0.1	17	1.0	19	0.3
Fuelwood alone	873	16.1	16	0.9	889	12.4
Coconut fuels alone	205	3.8	33	1.9	238	3.3
Fuelwood and coconut fuels	1,754	32.4	124	7.1	1,878	26.2
Fuelwood, coconut fuels and kerosene	507	9.4	140	8.0	647	9.1
Fuelwood, coconut fuels and biogas	13	0.2	1	0.1	14	0.2
Kerosene alone	3	0.1	2	0.1	5	0.1
Total number of households in Kerala	5,411	100.0	1,751	100.0	7,162	100.0

Table 4.2 Distribution of households by access to LPG during 2001-02

(Number in '000)

Fuel-mix	Rural		Urban		Kerala	
	Number	% to total	Number	% to total	Number	% to total
With LPG	2,056	38.0	1,435	82.0	3,491	48.7
Without LPG	3,352	61.9	314	17.9	3,666	51.2
Kerosene alone	3	0.1	2	0.1	5	0.1
Total number of households	5,411	100.0	1,751	100.0	7,162	100.0

4.2 Per capita annual consumption of fuels

The per capita annual consumption of the absolute quantity of different fuels in the households in the rural and urban regions of Kerala in 2001-02 is shown in Table 4.3. Fuelwood is one of the biomass fuel used in the household sector. In fact, non-wood biomass fuels including coconut leaf, husk, shell and crop residue together was the more important item in the fuel-mix of the household sector of Kerala. In physical units, the per capita annual consumption of coconut fuel was 433 kg for the whole of Kerala. Even in the urban areas, the per capita consumption of coconut fuels was 210 kg per annum. Actual fuelwood consumption including that of coconut and palmyra wood was predominantly in the rural areas. Fuelwood consumption in the rural area was 226 kg per capita per year whereas in the urban areas, it was just 43 kg per capita per year. The other cooking fuels used are LPG, kerosene and electricity.

4.3 Fuel consumption pattern

Table 4.4 shows the per capita fuel consumption pattern in Kerala in a more comparable useful heat terms in kilocalories (kcal) per day. The per capita fuel consumption is 748 kcal per day in rural areas,

Table 4.3 Per capita annual fuel consumption during 2001-02

Fuel type	Per capita annual consumption		
	Rural	Urban	Kerala
Coconut fuels (kg)	501	210	433
Fuelwood (kg)	226	43	178
LPG (kg)	9	30	14
Kerosene (litre)	2	5	3
Electricity (kWh)	0	5	1
Saw dust and others (kg)	1	0	0

The average moisture content of fuelwood in air-dry condition was about 12 per cent on an oven-dry weight basis. Weight measured was air-dry weight.

while it is 761 kcal per day in urban areas. Part of the difference between the useful heat consumed in the rural and urban areas was due to the dependence on restaurants for at least one meal during travel to adjoining urban areas for employment, shopping or other business. Part of the difference was due to the relative poverty in the rural areas and less cooking. Among the different fuels, coconut fuels are dominant. In rural areas, about 45 per cent of the *useful heat* was obtained from coconut fuels and it accounted for 43 per cent of the fuel consumption in Kerala. In urban areas, LPG accounted for 67 per cent of all fuels used. This is the second largest component among different fuels consumed in the household sector of Kerala. Fuelwood occupies only the third place accounting for 25 per cent of the fuels consumed in Kerala and most of this was in the rural areas. In the urban areas, it was only six per cent. Kerosene is still being used as a cooking fuel in the urban and rural areas. The quantity of electricity consumed as fuel was marginal and confined to urban households.

Table 4.4 Fuel consumption pattern in Kerala in energy units

(*Useful heat* consumed per capita per day in kcal)

Fuel type	Rural		Urban		Kerala	
	Quantity	% to total	Quantity	% to total	Quantity	% to total
Coconut fuels[#]	333	44.5	135	17.7	287	38.1
Fuelwood	235	31.4	44	5.8	186	24.7
LPG	152	20.3	507	66.6	237	31.5
Kerosene	28	3.7	70	9.2	42	5.6
Electricity	0	0.0	5	0.7	1	0.1
Saw dust and others	0	0.1	0	0.0	0	0.0
Total	748	100.0	761	100.0	753	100.0

Useful heat is obtained by multiplying primary energy quantities with their appliance efficiencies expressed in proportions. [#] Fuels from coconut/ palmyra palms such as leaf, sheath, shell, husk and other crop residues excluding wood. * The figures in parentheses are percentages to total.

To examine the influence of income on fuel consumption pattern, the sample households were classified into four income classes. Table 4.5 shows the per capita *useful heat* consumption per day in all households in Kerala by income classes. The fuelwood consumption which was 32 per cent in the poorest households

drops to five per cent in the highest income class of above Rs 10,000 per month. The same trend is observed for coconut fuels and kerosene. For LPG and electricity, on the other hand, there is an increasing trend in consumption with respect to the increase in income. It is interesting to see that LPG consumption, which is 10 per cent in the total *useful heat* consumed in the lowest income class, increases to 62 per cent in the highest class. With a rise in income, therefore, there was a shift from biomass fuels, such as fuelwood and coconut fuels, towards an increase in use of LPG.

Table 4.5 Fuel consumption pattern (rural and urban households combined) according to income class

(*Useful heat* consumed per capita per day in kcal)

Fuel type	Monthly income class (Rs.)				All classes
	< 3000	3000 – 6000	6000 – 10000	> 10000	
Coconut fuels#	356	269	199	131	287
	(51.9)	(36.2)	(25.3)	(15.7)	(38.1)
Fuelwood	221	216	127	42	186
	(32.2)	(29.1)	(16.1)	(5.0)	(24.7)
LPG	71	206	423	618	237
	(10.4)	(27.8)	(53.8)	(74.0)	(31.5)
Kerosene	37	51	38	30	42
	(5.4)	(6.9)	(4.8)	(3.6)	(5.6)
Electricity	0	0	0	14	1
	(0.0)	(0.0)	(0.0)	(1.7)	(0.1)
Saw dust and others	1	0	0	0	0
	(0.1)	(0.0)	(0.0)	(0.0)	(0.0)
Total	686	742	787	835	753
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Fuels from coconut/ palmyra palms such as leaf, sheath, shell, husk and other crop residues excluding wood. * The figures in parentheses are percentages to total.

Tables 4.6 and 4.7 show the fuel consumption patterns according to income classes, in rural and urban households respectively. The decline in fuelwood consumption with rising income can be observed in both rural and urban areas. However, the low level of fuelwood consumption in the urban areas and its negligible use in the higher income class is noteworthy. In the case of coconut fuels also, a very sharp decline is noticeable with increasing income in the urban areas. But in the rural areas, coconut fuels continued to be an important component shifting from 52 per cent to 35 per cent only with rising income. The perennial and steady availability of coconut fuels in the rural areas may be one reason for its popularity. But a more fundamental reason could be lack of availability of an alternative. Undoubtedly, LPG is the preferred alternative and it accounted for 86 per cent of the useful heat consumed in the highest income class in the urban areas. In the same income class in the rural areas, only 49 per cent of the useful heat was obtained from LPG. Lack of access to LPG supplies, may be the reason for the difference between the rural and urban areas. In the case of the lowest income class, contribution of LPG to the useful heat consumed was disproportionately low (15%). Kerosene consumption for cooking is low in the rural areas. Electricity was used as fuel only in the highest income class only in the urban households and saw-dust and others were used only in the lowest income class in the rural areas.

Table 4.6 Fuel consumption pattern in rural households according to income class

(*Useful heat* consumed per capita per day in kcal)

Fuel type	Monthly income class (Rs.)				All classes
	< 3000	3000 – 6000	6000 - 10000	> 10000	
Coconut fuels #	365	302	290	295	333
	(52.2)	(39.9)	(34.1)	(34.9)	(44.5)
Fuelwood	231	262	205	113	235
	(33.1)	(34.6)	(24.1)	(13.4)	(31.4)
LPG	70	156	337	414	152
	(10.0)	(20.6)	(39.7)	(49.0)	(20.3)
Kerosene	32	36	18	23	28
	(4.6)	(4.8)	(2.1)	(2.7)	(3.7)
Electricity	0	0	0	0	0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Saw –dust and others	1	1	0	0	0
	(0.1)	(0.1)	(0.0)	(0.0)	(0.1)
Total	699	757	850	845	748
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Fuels from coconut/ palmyra palms such as leaf, sheath, shell, husk and other crop residues excluding wood. * The figures in parentheses are percentages to total.

Table 4.7 Fuel consumption pattern in urban households according to income class

(*Useful heat* consumed per capita per day in kcal)

Fuel type	Monthly income class (Rs.)				All classes
	< 3000	3000 - 6000	6000 – 10000	> 10000	
Coconut fuels #	242	150	72	55	135
	(45.6)	(21.6)	(10.3)	(6.6)	(17.7)
Fuelwood	98	52	15	8	44
	(18.5)	(7.5)	(2.2)	(1.0)	(5.8)
LPG	82	386	545	713	507
	(15.4)	(55.6)	(78.2)	(86.0)	(66.6)
Kerosene	109	106	65	33	70
	(20.5)	(15.3)	(9.3)	(4.0)	(9.2)
Electricity	0	0	0	20	5
	(0.0)	(0.0)	(0.0)	(2.4)	(0.7)
Saw-dust and others	0	0	0	0	0
	(0.0)	(0.0)	(0.0)	(0.0)	(0.0)
Total	531	694	697	829	761
	(100.0)	(100.0)	(100.0)	(100.0)	(100.0)

Fuels from coconut/ palmyra palms such as leaf, sheath, shell, husk and other crop residues excluding wood. * The figures in parentheses are percentages to total.

Fuel-mix in the household sector is influenced by two factors, the first is the income level and the second is availability of options. Comparison of the rural and urban fuel consumption in Kerala overlaid with income levels of households shows that rising income and availability of modern fuels such as LPG accelerate the shift towards increasing use of LPG in the household fuel consumption. At the same time, fuelwood as a household cooking fuel loses its demand with increasing income and urbanisation. In the previous section, it was shown that Kerala is self sufficient in fuelwood. The only import was charcoal for specific uses. Already there is a surplus of coconut fuels which just rot or eaten by termite for lack of effective demand. The contribution of forests to the total fuelwood supplies was marginal and therefore there is no need to consider fuelwood production in the forests as a legitimate function of forestry in the future. As the Experiment on Eco-development in the Periyar Tiger Reserve has shown (Krishnankutty, 2002), if LPG is made available in rural areas or forest enclaves there is a preference for LPG and the limiting factor is only the poverty of some households. If some income generation opportunities are available or if LPG is supplied to such areas along with a targeted subsidy, then the benefit is mutual for the households as well as for the Forest Department resulting in less pressure of fuelwood collection and consequent improvement in the conservation of forests.

Table 4.8 shows the change in the percentage distribution of *useful heat* consumed per capita per day in the rural and urban households in Kerala between 1987-88 and 2000-01. The contribution of biomass fuels declined from 95 per cent in 1987-88 to 76 per cent in 2000-01 in the rural households while it declined from 54 per cent to 24 per cent in the urban households within a span of 13 years. What is striking about the change in fuel-mix during the period of 13 years is the rising contribution of LPG in both rural and urban areas. While the contribution of LPG in households in rural areas was less than one per cent in 1987-88, it has become 20 per cent in 2000-01. In urban households, it increased from 17 per cent in 1987-88 to 67 per cent in 2000-01. LPG has replaced coconut fuels more than fuelwood which has declined drastically in the urban households. Kerosene which contributed 27 per cent of the household fuels in the urban areas in 1987-88 has declined to nine per cent in 2000-01 mainly due to the increased availability of LPG in the urban areas. Therefore, the overall demand for fuelwood has been declining due to the increasing availability of LPG over years. This trend is bound to continue since more than half of the total number of households in Kerala is yet to get access to LPG connections.

Table 4.8 Change in fuel-mix in the household sector of Kerala during 1987 to 2001

(Percentage distribution of per capita *useful heat* consumption)

Fuel-mix	1987-88*		2000-01	
	Rural	Urban	Rural	Urban
Coconut fuels #	59.4	25.3	44.5	17.7
Fuelwood	35.3	28.5	31.4	5.8
LPG	0.9	17.2	20.3	66.6
Kerosene	3.7	26.7	3.8	9.2
Electricity	0.7	2.3	0.0	0.7
Total	100.0	100.0	100.0	100.0

Fuels from coconut/ palmyra palms such as leaf, sheath, shell, husk and other crop residues excluding wood. * The data of 1987-88 is from Krishnankutty (1990).

5. WOOD MARKET IN KERALA

In this section, an analysis of the fuelwood and timber markets in Kerala is attempted. Trends in the import and export of timber, important timbers in the inter-State trade, direction of export and origin of import are also indicated.

5.1 Fuelwood market in Kerala

Fuelwood is the most important component of wood in volume terms. It is almost 5 times of the volume of timber used in Kerala. However, most of the fuelwood production is complementary to the production of timber during conversion of trees or of replanting rubber plantations. There are very few trees exclusively used as fuelwood. The most prominent among such trees is tamarind tree which is highly priced as fuelwood and has no demand as timber or industrial wood irrespective of the girth of the tree. Almost all other trees have a timber value more than that of fuelwood and the stem portion is used as timber. The estimate of the total fuelwood consumption in Kerala is more than matched by the non-wood biomass fuels. For instance, while the total fuelwood consumption in all sectors was around 101,96,000 m^3, the consumption of coconut fuels was around 103,89,000 m^3 fuelwood equivalent in the household sector alone. Most of the fuelwood and coconut fuels are used very near the production sites, sometimes, within the same household or neighbourhood. In the case of plantation wood such as rubber or any other timber, the fuelwood produced during conversion is purchased and used in industries, tea-shops and restaurants.

Although the consumption of fuelwood in the household sector was high, much of it was obtained from own home gardens or collected free from the neighbourhood. Purchased fuelwood was quite limited and an occasional affair in many households. Regular fuelwood market is in the form of retail shops selling fuelwood of rubber, cashew, tamarind and mango trees. Tamarind wood is preferred for traditional preparation of ayurvedic medicines. About 10 per cent of the total fuelwood used during 2000-01 was rubber wood. All of these were purchased and came through the fuelwood market. Harvesting of large quantities of rubber trees from plantations is the source of large volume of timber and fuelwood. Amballur in Thrissur District and Perumbavoor in Ernakulam District are respectively the major rubber wood fuelwood and timber markets in Kerala. Tile and brick making units meet their fuelwood requirement through the market at Amballur. Packing case and plywood units in the region obtain their timber requirement through the market at Perumbavoor.

The industrial demand for fuelwood slightly declined due to reduction in the production in the tile and brick industries which are the major consumers. The brick industry is maintaining its demand in spite of the challenge from cement hollow bricks. The other fuelwood using industries such as tea factories are also shifting towards alternate fuels such as furnace oil. In the household sector also there is a decline due to the shift towards LPG, even in rural areas where there is plentiful availability of fuelwood. In the rural households, a mix of fuels is used. There is a shift away from non-wood biomass fuels to fuelwood in the more affluent households. Fuelwood use in the service sector, particularly in tea-shops and restaurants, which previously purchased large quantity of fuelwood, have by and large shifted to LPG. There is no import of fuelwood to Kerala, except charcoal. There are specialised uses

of charcoal such as in textile industry, bell metal manufacturing, engineering workshops and also in smaller quantities for electrical earthing, tea-shops, mobile ironing services, etc. There is an efficient network of wholesalers and retailers of charcoal obtaining their supplies mainly from Tamil Nadu. A portion of the charcoal supply is obtained clandestinely from the forests. Notwithstanding the high volume of fuelwood used in Kerala, in value terms it is quite small when compared to the market for timber and industrial wood.

5.2 Timber market in Kerala

Organised trade in timber has a long history in Kerala which was famous for timbers such as teak, sandal, rosewood, ebony and venga. Most of these timbers came from the natural forests where it was abundant. The expansion of agriculture and plantations at the cost of natural forests has resulted in drying up of the supplies of such timbers from the natural forests. Timber production from forests currently is eucalypt and teak wood from plantations. The entire production of eucalypt wood from the forests is supplied to a newsprint factory in Kerala. The eucalypt wood that comes into the market in Kerala and sold through sawmills is imported mainly from Karnataka and a smaller portion from Tamil Nadu. Apart from teak, a small quantity of timber such as *chadachy*, *maruthu*, *venga*, *venteak*, etc. reach the forest timber depots, as wind fallen or extracted from encroached areas. In volume terms, the quantities are negligible and declining. Out of the total production of 13,000 m^3 roundwood equivalent of teak poles from forest plantations, 6,000 m^3 was exported to Tamil Nadu. Out of the total production of 37,000 m^3 logs including billets, about 7,500 m^3 was exported to the neighbouring States (Tables 3.18 and 3.12). At the same time 14,000 m^3 of teak wood was imported from other countries and 500 m^3 from Karnataka, resulting in a net import of 7,000 m^3 quality larger girth teak wood (Tables 3.16). In the timber market in Kerala, forests are important only in the case of teak wood production. Rest of the timber including rosewood that comes to the market is from home gardens. Import is another major source of timber in Kerala. Of the total timber consumed in Kerala, 21 per cent was imported from other countries and rest of India. For monitoring the market for timber in Kerala, it is necessary to have a background on the species that are important for trade and the trends in the import and export. To observe the short-term trends the data on import and export, during the period from 1996-97 to 2000-01 covering all the check-posts, were compiled. For the long-term trend covering the period from 1981 to 2001, data from six major check-posts were used. Consistency and continuity of data availability determined the selection of the six major check-posts for the long-term trends. These data are intended to indicate the relative changes over time.

The short-term trends in import of wood are presented in Table 5.1. The five year data on import of total timber from other countries reveal a steady rising trend. Pynkado, teak, gurjan, kussia, paduak, keruing and billinga are the major imported timber species. The names of imported timbers are loosely used or modified in the trade parlance to resemble local names. The same timber may be sold to different customers under different names. Lack of familiarity with the names of imported timbers often causes them to be recorded in check-post registers as just imported timber. The relatively large volume of imported 'other timbers' during 1996-97 and relatively small volume during 2000-01 indicate that with more familiarity with the names of individual species they are more accurately recorded. Teak import has increased more than three-fold during this period, although there is a slight decline

during 2000-01. Larger girth natural teak from Myanmar is coming to the Kerala market which is now starved of logs in the higher girth classes due to the lowering of rotation age in the forest teak plantations. In the case of import of wood from rest of India, the year 1998-99 appears to be an unusual year with high level of import of eucalypt wood. The closure of the rayon factory during the period may have affected the import of eucalypt in the subsequent years. A rising trend of silver oak import is observed (Table 5.1). This calls for some explanation which is made alongside the next table on trends in timber export. The import during the last two years is double the level of the initial years. The import of casuarina poles shows a declining trend while that of rosewood an increasing trend. The import of charcoal shows a substantial increase during the period between 1996-97 and 1998-99. The declining availability of charcoal from local sources may be a reason for the higher import, even while some of the traditional users of charcoal may have cut down its use by shifting over to LPG. Specific industrial users such as textile mills, metal industries, engineering workshop, etc., maintain a steady demand for charcoal.

Table 5.1 Short-term trends in import of timber and charcoal

(m^3 roundwood equivalent)

Timbers	1996-97	1997-98	1998-99	1999-00	2000-01
From other countries					
Pynkado	1,384	13,517	36,113	65,511	67,889
Teak	5,546	10,101	16,593	16,692	14,071
Gurjan	3,238	13,336	11,570	17,564	8,367
Kussia	6,189	8,373	7,982	5,724	5,890
Paduak	1,818	2,289	2,625	1,771	3,929
Keruing	726	11,071	5,675	3,568	3,827
Billinga	1,038	3,539	1,488	1,081	3,499
Malaysian sal	4,182	5,975	3,904	4,571	3,181
Other timbers	76,196	59,395	50,725	39,696	48,262
Sub total	*1,00,317*	*1,27,596*	*1,36,675*	*1,56,178*	*1,58,914*
From rest of India					
Eucalypt	31,666	58,292	1,89,727	49,823	112,608
Silver oak	8,426	9,741	7,667	16,003	25,919
Casuarina poles	16,530	11,591	10,134	8,186	8,773
Rosewood	891	1,363	1,083	1,187	2,664
Teak	208	72	152	173	521
Charcoal	1,59,553	1,79,778	2,36,666	2,05,968	2,36,813
Other timbers	114	383	528	461	1,139
Sub total	*2,17,388*	*2,61,220*	*4,45,957*	*2,81,801*	*3,88,437*
Total wood import	3,17,705	3,88,816	5,82,632	4,37,979	5,47,351

Among forest plantations, eucalypt received a substantial amount of investment during the last three decades. Eucalypt wood from the forests of Kerala is now exclusively used by a newsprint factory. Production of eucalypt wood during 2000-01 was 28,000 m^3 which accounted for about two per cent of the total timber production in Kerala. When the timber and industrial wood output from Kerala forests alone is considered, eucalypt accounted for 32 per cent. Import of eucalypt wood to Kerala was of the

order of 1,13,000 m^3 which is more than 4 times of the production from the forest plantations in Kerala. Extensive areas of agricultural lands in the dry zones of Karnataka and Tamil Nadu have been planted with eucalypt. Much of the eucalypt wood imported to Kerala was used in the construction sector. In the liberalised trade situation, import of pulp can be a cheaper option for the pulp based unit and a large growing stock of eucalypt may not be an economically attractive proposition. The conservation implication of maintaining a large area under eucalypt plantations in the forests also needs a fresh assessment.

The short-term trends in the timber export are shown in Table 5.2 (For direction-wise trends, see Appendices 1.1 to 1.13). Timber export from Kerala is dominated by sawn rubber wood as the packing case material. The trend in rubber wood export is also rising. Substantial quantity of mango wood, vatta and cashew wood were also exported every year. The cashew wood export has declined over the years. Among timbers, teak appears to be a major export item from Kerala with a volume between 11,000 and 18,000 m^3. But this is deceptive when the volume of import of teak wood is recalled. The actual net export of teak wood has reversed during the five-year period and became net import since 1998-99. This is a combined effect of increase in consumption and decline in production both in home gardens and forest plantations.

Table 5.2 Short-term trends in export of timber

(m^3 roundwood)

Wood	1996-97	1997-98	1998-99	1999-00	2000-01
Packing case wood					
Rubber wood	2,69,681	3,70,895	2,69,099	4,36,426	4,55,188
Mango wood	25,731	37,856	16,687	22,942	22,990
Vatta	7,472	9,297	10,982	7,476	14,475
Cashew wood	8,411	9,239	3,969	3,200	3,389
Sub total	*3,1,1295*	*4,27,287*	*3,00,737*	*4,70,044*	*4,96,042*
Timber					
Teak	17,680	13,534	13,319	10,999	13,812
Silver oak	32,061	27,120	13,196	15,534	19,806
Anjili	458	567	350	806	724
Venga	1,630	560	257	143	534
Eucalypt	1,133	640	365	498	454
Rosewood	364	167	101	145	209
Jack wood	225	162	411	60	108
Other timbers	51,959	50,309	40,888	41,340	39,944
Sub total	*1,05,510*	*93,059*	*68,887*	*69,525*	*75,591*
Total wood export	4,16,805	5,20,346	3,69,624	5,39,569	5,71,633

The export of silver oak was mainly to the Mumbai market. The production of silver oak from the Wayanad region of Kerala made it an important export commodity. The decline in local production was being offset by increasing import of silver oak from the adjoining parts of Tamil Nadu and Karnataka, sawn and re-exported to the Mumbai market. It must be noted that the export volumes do not represent the production within Kerala. The net export of silver oak was, in fact, declined steadily during this

period from 24,000 m^3 in 1996-97 to 5,000 m^3 in 1998-99, after which there was a net import reaching 6,000 m^3 during 2000-01. In the case of eucalypt also, the export figures represent only a tiny fraction of the actual import of eucalypt pulpwood and timber. The export was sized eucalypt timber. Nominal quantities of *anjily, venga*, rosewood and jack wood were also exported from Kerala. They came mainly from home gardens and estates in Kerala.

The long-term trend in the timber market in Kerala can be seen from Tables 5.3 (see also Appendices 2.1 to 2.5) and 5.4 (see also Appendices 3.1 to 3.3) which give the trends in import and export of wood to and from Kerala during the last 20 years. The average volume per annum during successive 5-year periods is shown in the Tables. No clear pattern can be discerned from the aggregate figures of export

Table 5.3 Long-term trends in import of timber and charcoal

(Average volume per annum in m^3 roundwood equivalent)

Period	Teak	Rose wood	Sandal	Casuarina	Other timbers	Charcoal	Total
1981-82 to 1985-86	594	709	192	1842	34876	9113	47326
1986-87 to 1990-91	935	1147	242	981	77022	79253	159580
1991-92 to 1995-96	1873	833	24	4148	73225	55507	135610
1996-97 to 2000-01	11583	382	209	2933	120043	57698	192848

* Data from six major forest check-posts at Manjeswaram, Muthanga, Noolpuzha, Walayar, Aryankavu and Parassala.

Table 5.4 Long-term trends in export of timber

(Average volume per annum in m^3 roundwood equivalent)

Period	Teak	Rosewood	Rubber wood	Other timbers	Total
1981-82 to 1985-86	33,109	189	60,983	3,63,473	4,57,754
1986-87 to 1990-91	24,298	179	1,08,290	1,35,522	2,68,289
1991-92 to 1995-96	18,507	370	2,16,890	1,03,071	3,38,838
1996-97 to 2000-01	4,392	103	3,04,727	90,034	3,99,256

* Data from six major forest check-posts at Manjeswaram, Muthanga, Noolpuzha, Walayar, Aryankavu and Parassala.

and import of timber. Moreover, when specific species such as teak, rosewood and rubber wood are examined, very clear long-term trends can be observed. The annual export of teak which stood at around 33,000 m^3 during the period from 1981-82 to 1985-86 has fallen sharply to just 4,000 m^3 during the period from 1995-96 to 2000-01. On the other hand, the annual import of teak wood has grown spectacularly from around 600 m^3 to 12,000 m^3 during the above period. When the international export of teak wood from Kerala is considered, the decline in the volume of export is more profound (Table 5.5). While the annual export of teak was of the order of 900 m^3 in the 1970's, it was only 93 m^3 during 1997-2001 period. Non-availability of logs in larger girth classes is the primary reason for the poor performance in the international market. The shortening of rotation of teak plantations reduced the production of high value larger girth logs. It is important to note that Kerala which was once a supplier of teak wood has become a net importer of teak wood since 1996.

Among timber exported from Kerala, ebony was the most highly priced. Over-exploitation in the past

has led to its local extinction for all trade purposes. Rosewood is the next highly priced timber in Kerala. Substantial quantity of rosewood was exported to other countries. While the international export of rosewood from Kerala was of the order of 17,200 m^3 annually during the early 1970's, it has declined to 1,400 m^3 annually during 1997-2001period (Table 5.5). It may be noted that the production from the forests was 67 m^3 annually during 1999-2001 (Table 3.18). The production of rosewood from private lands in Kerala was 2,000 m^3 annually during 1999-2001 (Table 3.19) and the import from Karnataka was of the order of 2,700 m^3 during 2001 (Table 3.17). A similar fate of ebony awaits rosewood, if conservation efforts are not effective.

Table 5.5 Long-term trends in international export of timber

(Average volume per annum in m^3)

Period	Teak	Rosewood	Other timbers	Total
1971-72 to 1975-76	899	17,197	603	18,699
1976-77 to 1980-81	517	7,730	955	9,202
1981-82 to 1985-86	112	1,641	453	2,206
1986-87 to 1990-91	39	1,396	277	1,712
1991-92 to 1995-96	21	1,128	94	1,243
1996-97 to 2000-01	93	1,408	1	1,502

The phenomenal growth of rubber wood export from Kerala during the last 20 years is commendable and perhaps an unanticipated outcome. Unlike species such as silver oak, eucalypt, rosewood or even teak, rubber wood export came exclusively from Kerala's production as there was no import of rubber wood. In fact, Kerala accounts for nearly 85 per cent of India's total rubber wood production. The export of other timbers shows a continuous decline during the 20-year period while the total import has increased.

5.3 Market monitoring system for timber

The traditional system of forest check-posts at the State borders and at strategic locations leading from the timber rich reserve forests continue to function more or less efficiently. There exists a good system of documentation of timber movement and details such as species, volume, origin and destination of each truck-load is recorded. Currently this information is utilised for forest protection to check illegal tree felling in the forests. There is now an opportunity to share this information for the larger purpose of monitoring the trade in timber. In the design of a market monitoring system for timber, these check-posts can be the foundation or the source of primary information on import and export of wood. In fact the data on import and export can directly point to the wood-balance of the State. As mentioned earlier, with increasing familiarity, the species name of a variety of imported timbers is being recorded. Information on the quantity and species of timber flow in and out of the State reveals the market preference for particular species and also its availability. The phenomenal growth of rubber wood export was totally unanticipated a few decades ago. There are also seemingly a circular movement of timber flowing in and out quickly through the State with or without conversion as in the case of silver oak. A casual visit to a timber depot can provide information on type of timber that is being marketed. But to understand the quantum of timber movement, it is important to monitor the inflow and outflow of timber.

Kerala was always famous as a wood surplus State. This continues to be true due to the prolific production of rubber wood. But this is actually not part of a larger plan of wood production. It just happened as a coincidence to the emergence of newer clones of higher productivity of latex-producing rubber trees. Inevitably, the favourable price situation and subsidy from the Rubber Board promote faster re-plantation and the consequent of windfall of wood production. Actually, when true timber species alone are considered, Kerala is no more a wood-surplus State. Monitoring of the timber market and wood-balance is therefore a critical necessity. To monitor timber market in Kerala, it is possible to consider the participation of Trade and Industry Associations as partners and stakeholders in the timber business. If reporting of timber sales and custom sawing at the saw mills is comprehensive, it will cover the entire production and use of timber in the household and service sectors. Similarly if the wood-using industry associations are co-opted as partners in monitoring wood consumption in industries, it will cover the industrial demand for wood in Kerala. To motivate the trade and industry associations, to assess their total consumption month-wise or annually and share such information among them and with the rest of the society, it is necessary to build a relationship of mutual respect and trust. It is very much in their self interest to report honestly on wood production and consumption, because policy support in a democratic society depends heavily on public understanding and goodwill towards them. In the event of an industrial crisis, they can use such information to influence policy in their favour. A transparent and voluntary reporting system under the auspices of the trade and industry associations would be much more acceptable and credible than a parallel government mechanism relying on officials who cannot effectively ensure compliance to their request for data. Information from trade and industry associations would also be more authentic since they have a lifetime exposure to the intricacies of their business. Therefore a complementary system which uses both the import-export statistics from the border check-posts, ports and railways together with the data from the association of saw mills and timber traders and also the association of different wood-using industries say, packing case, plywood, furniture, etc. is to be used to monitor the wood production, consumption and trade in Kerala.

The backbone of a market monitoring system should be a regular collection and dissemination of price and stock of important timbers. The Department of Economics and Statistics, Government of Kerala, already covers essential commodities, spices, agriculture produces, industrial products, gold, silver, etc. They have a regular system of disseminating price statistics to the media. Important timbers such a teak, rosewood, sandal, jack wood, *anjily* and rubber wood could be included in their list of regular price statistics. The Forest Department and the timber depots should communicate the current prices and quantity sold to the Department of Economics and Statistics for wider dissemination. Due to the wide variability in the quality of timber even within a particular girth and quality class, it is important to provide weighted average prices based on the quantities sold and not just simple average price. Prices of the non-wood forest products in the major wholesale markets should also be collected by the Department of Economics and Statistics so that farmers interested in their cultivation can take a well informed decision regarding the investment prospects of particular species.

The Department of Economics and Statistics, which has a wide network of offices throughout Kerala and is already dealing with collection of statistics on different products, can effortlessly accommodate timber also as one more item in their long list of market surveys. They have a system of reporting which is both current and credible. They can coordinate and consolidate the periodic reports from the

border check-posts managed by the Kerala Forest Department and from trade and industry associations and if necessary, they can even carry out sample checks to verify the reliability of reported figures. The frequency of reporting timber trade statistics should be monthly. More frequent reporting is unnecessary. Already a monthly reporting system exists with respect to forest check-post data. For consumers planning to purchase timber, the last month's price would be a reliable guide to the current price they can expect and also the choices available to them in different locations. Seasonal fluctuation can also be observed if monthly data is available.

5.4 Timber marketing options

The Forest Department has a long tradition of producing and marketing timber. Timber depots were established in locations close to important timber markets and well accessible locations. With the decline in availability of timber from natural forest, many of the depots have been converted into office cum residential complexes or just closed down. Teak wood from plantations is now the most important timber in the functioning depots. It is possible to increase the revenue from teak wood auctions by improving marketing. Smaller lots or even a single log can be auctioned so that actual consumers can participate. There have been innovative experiments in retailing timber in the depots. The time lag in confirmation of auction and exorbitant loading charges in certain depots discourage actual consumers in venturing into government timber auctions. Of late, there has been a move to reduce the lot size in the monthly auctions at the government depots so that actual consumers can also participate in the bidding. This may turnout to be a major turn around and a good public relation venture. So far, timber auction at the timber depots is an exclusive venue for timber merchants. Retailing can create a more people-friendly image for the Forest Department which traditionally favoured industrial consumers and traders. A proper market monitoring system which takes into account the seasonal variation in demand and availability of stock can enhance consumer friendly services.

6. MARKET SURVEY OF NWFPs CULTIVATED IN HOME GARDENS

Most of the NWFPs are harvested from the forests and public lands. Among the NWFPs, only a few belonging to the class of medicinal plants are cultivated in home gardens. In this section, an overview of NWFPs market, cultivation of NWFPs in home gardens, the issues therein and the need for extension programmes are discussed.

6.1 Market of NWFPs in Kerala

The NWFPs produced in Kerala come to the market through gatherers, who collect them from the forests and public lands, and cultivators. Private collection agents are active in all the important centres of production. Tribal cooperative societies are also active in forest areas. The contribution of cultivators to the total production of NWFPs in Kerala is negligible. The collection agents are linked to the wholesale traders who dominate the market. Commission agents who supply to manufacturing units and exporters who supply NWFPs to markets in India and abroad get their supplies from the wholesale traders and in some cases directly from the collection agents. Retail traders of NWFPs serve the local market of retail

consumers. Locally available medicinal plants come directly to the retail traders, particularly those items that are to be used as fresh. Most of the NWFPs are dried items such as roots, bark, seed or whole plant.

Among the different players in the NWFPs trade, the wholesale traders and the Scheduled Caste, Scheduled Tribe (SCST) Federation are the most powerful in their ability to influence prices. The SCST Federation has been given the monopoly right for the collection from forests. They have a network of tribal co-operative societies that carry out the actual collection and bring the collected produce to their regional depots. The Federation conducts auctions of NWFPs collected through the cooperative societies. A production unit, Ayurdhara, has been started in Thrissur. The tribal co-operatives collect only limited items from the forest. Items not collected by the society are purchased by private traders who bring them to the market. Large ayurvedic medicine manufacturing units who also have their own system for procurement are able to influence the prices in the market. The manufacturing units have grown in number and in their plant capacity during the last few years. Traditional wholesalers and exporters control the trade. The retail shops and manufacturing units obtain their requirements through these wholesale traders. Some of the larger manufacturing units have their own traditional contractors who arrange to supply all the items required for each medicine preparation together as a package in the required volume according to the required quality standard. These wholesalers have their own collection agents in different parts of the State or have close links with independent collection agents or gatherers. Very few manufacturing units purchase NWFPs from the gatherers directly. The number of people depending on NWFPs collection is declining due to local scarcity and also due to poor returns for their labour. On the other hand, due to the decline in employment in the agriculture sector, particularly with regard to the paddy crop which absorbed a large number of women labour, a shift towards seasonal foraging for collection of NWFPs from public lands is observed.

The NWFPs market in Kerala is dominated by about 40 groups of traders. It is a family business for most of the major players and they have been active in the business for several generations. Thrissur is the major centre of trade with largest concentration of NWFPs wholesale traders and also ayurvedic medicine manufacturing units. Traders in Thrissur supply major medicine manufacturing units around Thrissur and also exports NWFPs to Gujarat, Punjab and Kolkotta. Vadakara in Kozhikode District is the second important market for NWFPs in Kerala. The produce from Wyanad and neighbouring areas of Kozhikode come to the Vadakara market. It is the major export centre to Delhi, Mumbai, etc. Kozhikode, Ernakulam, Kollam, Palakkad, Kottayam, and Kannur also have a substantial presence of NWFPs wholesale traders and retail shops. Ernakulam, particularly the Mattanchery area, has a concentration of Commission Agents and import-export traders.

The traditional open market where the gatherers come and sell their collection has vanished from most parts of the State. However, it still exists in Kottayam and Vadakara. In Kottayam, the open market functions weekly early in the morning every Monday and in Vadakara the weekly market is on Tuesday. Smaller scale open markets function in Perambra (Kozhikode) on Sunday and at Chenganassery on Monday. The Chalai market in Thiruvananthapuram also trades in NWFPs. While the Kottayam market supplies Alappuzha and Kollam, the Vadakara market supplies traders from Kannur, Kozhikode and Kasargode. In the absence of an institutional mechanism to support such markets it is inevitable that these open markets will die out or be squeezed out for want of space in urban centres.

The growth in the volume of packaged ayurvedic medicines has changed the traditional system of manufacture. Modern machines, pulverisers and steam cookers are used in place of traditional processes that required many days to complete. The large volume of raw material handled makes it difficult to separate adulterants or substitutes. Further, unlike in the traditional vaidyasalaas where there was a personal link between the physician and patient, the large scale ayurvedic medicine manufacturing units depend more on their advertising and marketing skills than the personal rapport with the patient or community. The new generations of ayurvedic physicians are more attuned to work as dispensing physicians prescribing patent medicines unlike their predecessors who prepared their own medicines.

6.2 Cultivation of NWFPs in home gardens

Natural forests are the abode of NWFPs resources which once covered the entire land area of Kerala. Land use changes and agricultural development has replaced much of the original vegetation by commercial crops. Kerala has a rich tradition of identifying NWFPs which have a commercial potential. Experimental cultivators of spices have domesticated a range of crops that once were NWFPs, but now part of the regular home garden agriculture. Crops like pepper, turmeric, ginger, etc., are now cultivated on an extensive scale for the global market. Spices like cardamom which require higher altitude and cooler microclimate have also been developed as a commercial crop. New items of NWFPs, which have a high price in the market and scarce, in relation to their demand, are domesticated by experimental cultivators who bring them into regular agriculture. All kinds of spices and condiments were cultivated as pure crops or in mixtures in home gardens from very ancient times.

Cultivation of medicinal plants as a commercial venture is of recent origin. The increase in price of some items and their amenability for cultivation has facilitated cultivation of medicinal plants in home gardens in different parts of the State. Among the cultivators, three groups can be identified. The first group consists of experimental cultivators. They are pioneers trying out their own schemes for the cultivation of new crops. They develop their own technology with the experience they have in other crops. Some of them go further, in course of time, and become commercial cultivators which are the second category. While the experimental cultivators may cultivate several species, the commercial cultivators stick to just one or two species and they do it intensively. The experimental cultivators are often unclear about their market prospects while the commercial cultivators try to secure an assurance from a wholesale trader or a manufacturing unit to buy his crop at a previously agreed price. However, there is no guarantee or sanctity for such oral agreements that the commercial cultivator may find that the prices have changed during the period the crop has taken to mature. Some crops which do not store well can cause serious loses due to seasonal fluctuations of prices. The third group of cultivators is those who grow medicinal plants without a genuine commercial motive. They are often farmers with good experience and often with supplementary income from other sources. Their aim often is to create and maintain a diversity of crops in their home garden. Some sell seedlings or cuttings. They are usually motivated by the desire for local recognition or farming awards from the government or farm publications. There is also a possibility of being nominated to government committees. This group do a service of publicity and maintain a sort of demonstration garden on which extension agencies can build upon for their training programmes. However, the income from medicinal plants would be almost nil for such farmers. NWFPs species commercially cultivated in home gardens are listed in Appendix

4.1. The locations of cultivation are given in Appendices 4.2 and 4.3. Among the species *neelamari* and *koduveli* are more important.

6.3 Issues in cultivation

The fundamental problem with the cultivation is that it has to be competitive with the collection from the wild or import of cultivated produce from other States where land and labour are cheaper. The availability of adulterants also suppresses the price of genuine items. The absence of standard grading procedures adds to the woe of the cultivators. Government incentives, if any, can be availed only by large farmers or manufacturing units in the name of research. Most of the cultivated NWFPs are seasonal crops, so a steady output cannot be obtained. Knowledge regarding demand and prices in different market is also imperfect leading to poor harmonisation of harvests and high prices. The average prices of selected NWFPs at different points of trade during 2001-02 are given in Appendix 4.4.

For the cultivation of NWFPs species, a range of information is required for the farmer to become successful. The type of land required for each species is different. Some species require wet land or land with good irrigation. Others may require dry land and can survive drought. Duration of crops can range from a couple of months such as for *bhrahmi* to nine months for *karimkurnji*, ten months for n*eelamari*, *iruveli* and *chittamruthu*; 12 months for *koduveli* and *thippali* or up to 30 months for *sathavari*. The labour requirement for each crop must also be known since hired labour could be quite costly in Kerala. N*eelamari*, *karinachi* and *vayampu* require high labour inputs. Current market price, seasonal fluctuations and past trend must also be known before a farmer can venture into cultivation. It is important for the farmer to know the purchase price offered by a wholesaler or manufacturing unit since the retail price or the selling price is very different from the buying price. It would also be wise to keep in mind that neither traders nor manufacturing units are interested in stocking a commodity for long. Their existing system allows them to secure their requirements whenever necessary, through their network of brokers or collection agents. A farmer can be disappointed if he harvests a crop and finds that no one is willing to buy his crop at that particular time. If the crop is perishable, his entire investment goes waste. Successful commercial cultivators always arrange with some purchaser before venturing into cultivation. Large scale manufacturing units have their own traditional contractors who supply their raw material requirements as a package (*koottu*) with all its ingredients together. This is very convenient for the manufacturing unit, since, if even one of the ingredients is not available, the process cannot be started while the perishable item will be ruined. Manufacturing units are willing to pay a higher than market price to their traditional contractors, primarily because of their mutual trust and also because the contractors bear the risk of loss in stocking perishable items. It is often impossible for a farmer with one or two items to supply directly to large scale medicine manufacturing units. With the increase in the scale of manufacturing units, a small producer growing a limited quantity in his home garden would find it very difficult to sell his produce to a manufacturing unit since the quantity is insignificant. In this situation, only farmers who can produce a fairly large volume through an intensive cultivation programme can obtain a reasonable price for his produce. However some crops cannot be kept long after harvest so that the farmer is forced to sell at the prevailing price which fluctuates sharply between seasons within a year.

Lack of an organised market for the sale of cultivated NWFPs items and proper grading rules for quality determination complicates the marketing problems for the producers. The availability of cultivated items from other parts of the country with less labour costs and also with high inputs of fertilisers makes cultivation less advantages in Kerala. Many items are available from the wild growth inside and outside forests. Their price is often equated with the harvesting cost and the transport cost with a small margin. Cultivation of such items inevitably becomes unremunerative. In the market, when produce from the wild are available, these are preferred to cultivated items since the wild produce is supposed to have better medicinal properties due to the absence of pollution, fertiliser and pesticide residues.

Lack of familiarity with the market and the prices in different markets often lead to low price realisation for farmers. Post harvest technology, scientific storage and packaging are yet to be developed for most NWFPs species. Forest rules regarding transportation of NWFPs could also be a threat to cultivators and traders since they can be harassed for holding or transporting the items. Perishability of some items presents an added risk in its cultivation. Unlike perennial crops in the home gardens, most NWFPs items are used as whole plant so that continuous yields are not possible. Currently the Medicinal Plants Board is providing encouragement and subsidies to farmers having a tie-up with any manufacturing unit. It is easier for large commercial farmers to avail such government subsidies than a small farmer with a small holding with no guaranteed buy back arrangement. It is also necessary to know investment requirements for each species for a unit of land area. The absence of any reliable cost benefit studies make investment in NWFPs cultivation highly speculative. Some crops require shade; some can be grown as monoculture. Crops specific requirements and frequency of irrigation if necessary must be known before investment are made. Agencies that promote NWFPs cultivation sometimes indicate the level of investment required per acre of land. It may not be known what rates of labour costs are included and whether all the relevant costs including costs of planting material, land development etc. are included.

6.4 Training to extension officers

There is a need for providing information on opportunities for cultivation of NWFPs to meet the increasing demand and to help conserve the resource in the forests. There is also a need to enhance bio-diversity in home gardens and to foster traditional folk medicine. The Kerala Forest Department has the capability and mandate to take the leadership in this venture. As the formal protectors of bio-diversity in the State, there is an opportunity for the Forest Department to reach out to the people and spread the message of conservation. The concept of District Forest Information Centres is an ideal proposition to serve this purpose. The social forestry wing of the Department, which will man the proposed District Forest Information Centres, organised a training programme in June 2003 at Thiruvananthapuram. As part of this Project, one of the Investigators conducted classes for capacity building of the officers. The topic covered was promoting NWFPs cultivation in home gardens and marketing possibilities.

The participants in the training programmes were exposed to the market scenario for NWFPs and the opportunities for promoting cultivation in home gardens. The extension officers were sensitised on the issues and questions that cultivators may raise regarding the availability of quality planting material

and cultivation technology to be adopted. The need for preparing a package of practices for cultivation, harvest and post harvest care as well as grading and quality control of NWFPs was impressed upon the officers. Awareness regarding market risk and uncertainty was also created.

6.5 Need for extension programmes

All of agriculture started with the domestication of wild plants by selection and breeding by innovative farmers. In the case of species we now call as NWFPs, if the cultivators succeed in production, and market stabilises, these species become regular agricultural crops. NWFPs items have now become scarce and there is an opportunity to domesticate, cultivate and sell these products to a rapidly growing indigenous medicine market. The State Level Medicinal Plants Board is supporting the cultivation of medicinal plants by farmers and institutions which have a buy-back arrangement with any processing unit. Many leading medicine manufacturing units are promoting the cultivation of their raw material by the farmers in their neighbourhood and arranging to supply quality planting material.

The District Forest Information Centres (DFIC) proposed to be opened in several District Headquarters are expected to become the focal points for information regarding the market situation, potential of different species and availability of planting material. The infrastructure facilities created by the Social Forestry Wing and the Central Nurseries of the Forest Department can be utilised to produce planting material of NWFPs species in demand. The extensive network of Krishi Bhavans in all Panchayats in the State can be utilised for the supply of NWFPs planting material to farmers interested in its cultivation. Proximity to important market and collection centres, edaphic conditions in each locality, the expertise and labour available within each household would determine the type and quantity of NWFPs planting material required by a farmer. Several non-government voluntary organisation and some large scale ayurvedic medicine manufacturing units are already in the filed of promoting the cultivation of NWFPs species in farm lands. The Swaminathan Foundation, Agro-biodiversity Centre in Puthurvayal, Kalpetta, is active in Wyanad. The Peermede Development Society, The Solidarity Movement and Devikulam Taluk Oushadha Sasya Krishi Vikasana Sankham are active in Idukki District. The Kottakal Aryavaidyasala is promoting cultivation in Malappuram District. The NWFPs promotion scheme of government agency like Sate Medicinal Plants Board and the DFIC should involve farmers to take up cultivation of NWFPs in agricultural lands.

The demand from the medicine manufacturing industry should not be a justification to open up the forests to NWFPs cultivation since Kerala has a previous experience of conditionally allowing cardamom cultivation in the Cardamon Hills Reserve Forests of Idukki District. The primary regulation of prohibiting tree felling and conversion to other crops or even alienation of land by the original assignees or leases could not be effectively implemented. Forestry's attempt, to produce raw material for the private sector rayon manufacturing unit in Mavoor which lasted only a few decades, is recent history. But its adverse impact on forests may last several centuries. The natural biodiversity, lost due to the clearance of natural vegetation and replaced with a monoculture plantation, has not been valued yet. Therefore, as the forest policy directs, industrial needs, be it for wood or non-wood raw materials, have to be met from sources other than forests. The forests should be maintained for conservation, cultural and education purposes. Two sound reasons for the promotion of NWFPs cultivation outside

forests are 1) to reduce the pressure of NWFPs collection from forests 2) to sustain an industry in which Kerala has a lot of strength. The ayurvedic medicines serve as a health care alternative to the modern system of medicine. The new IPR regime of the WTO is bound to increase the cost of patented medicines in the allopathic system, where most patents are held by Western multinational companies. Thus, promoting NWFPs cultivation is defending our rights for health care.

Traditional indigenous knowledge regarding household remedies for common ailments can be popularised and a medicinal plants garden can be promoted in all households for their own or their neighbourhood requirements. The non-commercial nature of such gardens can lead to a limited self sufficiency regarding common medicines and can become a cultural defence against the rising cost of patented medicines. Therefore, there is no need for District Forest Information Centres or the extension services to go beyond providing a package of practices for cultivation and post harvest technology. The focus should be on maintaining the natural bio-diversity in all landscapes: forests, agricultural lands and home gardens. If bio-diversity conservation can be promoted as a cultural necessity or as heritage conservation or even as a tourist attraction, then it is more sustainable than promoting the intensive monoculture cultivation of a few species. Natural history should be an important element in the school syllabus so that knowledge of natural bio-diversity is not lost to coming generations. Knowledge, familiarity and understanding the cultural or medicinal worth of different species can help to create awareness among people and can motivate policy makers to frame suitable policies integrating the conservation of biodiversity into the regular development planning in all land-using activities.

7. SUMMARY AND CONCLUSIONS

The demand for wood (timber and fuelwood), supply and wood-balance situation during the reference year 2000-01 and the findings of the market survey are summarised in this section.

The effective demand for timber (construction timber, industrial wood and poles) and fuelwood including charcoal in Kerala during 2000-01 is estimated as 122,61,000 m^3 roundwood equivalent. Out of this, 83 per cent was used as fuelwood and 17 per cent as timber. The sector-wise analysis showed that the household sector accounted for 66 per cent, industries consumed 17 per cent, service (other wood-using) sector utilised 12 per cent and export accounted for five per cent. Of the total demand for timber of 20,65,000 m^3 roundwood, the industries sector had a higher demand for timber (42%) than the household sector (30%). When the export demand for packing case was also considered along with the industrial demand, 66 per cent of the total demand for timber was from the industries sector. Export of timber excluding packing cases accounted for only four per cent of the total demand for timber. The total demand for fuelwood was 101,96,000 m^3 roundwood equivalent of which charcoal accounted for four per cent. Around half of this quantity of charcoal was imported from Tamil Nadu. Of the total demand for fuelwood, household sector accounted for 73 per cent and the service sector, 15 per cent. In the service sector, fuelwood was used for cooking, mostly in restaurants, schools and hostels. Industrial demand was 12 per cent of the total demand for fuelwood.

On the supply side, home gardens and estates produced 86 per cent of the total wood supply. Forests provided around one percent of the total wood supply when the recorded wood production figure was used. When the quantity of the unrecorded removal was included, the contribution of forests came to around 10 per cent. The wood import to Kerala was 4% of the total supply of wood. A substantial quantity of wood import was in the form of charcoal from Tamil Nadu. When timber is considered, Kerala is a net exporter with a surplus of 2,63,000 m^3 of timber. In the supply of timber in Kerala, forests provided only four per cent. Home gardens and estates provided 81 per cent of the total timber supply. An important finding of the study is the growing importance of rubber wood in the industrial wood category. Rubber wood accounted for 47 per cent of the total timber production in Kerala. It is used as packing case material and exported to other States. It is the mainstay of the plywood industry in Kerala.

During 2000-01, forests contributed 62 per cent and home gardens produced 38 per cent of the total teak wood production of 82,000 m^3 in Kerala. Demand for teak wood was mainly from the household sector (77%) for construction and furniture within the household sector. Industrial production of furniture accounted for seven per cent of the total demand for teak wood. Of the total demand for timber in Kerala, teak accounted for five per cent. Export of teak wood from Kerala to other States in India was almost 14,000 m^3 which is 18 per cent of the total export of actual timber excluding packing case. Of this, 55 per cent was teak logs and the remaining 45 per cent was poles. There is a clear declining trend in the export of teak wood in Kerala. The volume of export of teak wood from Kerala declined to around one eighth during 1981 and 2001. When the international export of teak wood from Kerala is considered, the decline in the volume of export is more profound. While the annual export of teak wood was of the order of 900 m^3 in the 1970's, it was only 93 m^3 during 1997-2001period. Non-availability of logs in larger girth classes is the primary reason for the poor performance in the international market. The shortening of rotation of teak plantations reduced the production of high value larger girth logs.

Comparing the change in the demand for fuelwood between 1988 and 2001, it is observed that the demand has declined. Change in fuel-mix in the household and service sectors favouring LPG and its easier availability are the major reasons for the decline. In the urban areas, the shift from fuelwood to LPG is spectacular. The profuse production of fuelwood and non-wood biomass fuels in home gardens is one reason for their continued use in the household sector. However, affluent houses have completely shifted to LPG pointing to a faster trend in substitution of fuelwood with LPG. In short, the fuelwood scenario in Kerala is comfortable with a deficit only for charcoal. In the case of timber also, there has been a decline in the demand from 1988 to 2001. In the household sector, house construction designs have changed from tiled roofed structures with wooden ceiling to concrete roof. Use of substitutes for timber has also increased. These changes are the reasons for the decline in timber-use in construction. Along with this, a variety of substitutes for furniture and fixtures have contributed to the decline in the demand for timber in the household sector. It may be noted that in the luxury houses, the use of quality teak wood has in fact increased. In the service sector, in spite of a boom in construction activity, the almost total substitution of wood with other materials has caused a dramatic decline in the demand during this period. This trend may affect the pattern of timber consumption in the household sector in

due course. In the industries sector alone, there has been an increase in demand. The growth in rubber wood production and a policy favouring local wood processing units has contributed to the increase in the demand from industries sector.

Households depending exclusively on biomass fuels account for 42 per cent of the total number of households in Kerala, while those who have access to LPG connection account for 49 per cent. Among different fuels used in the household sector, the largest component is non-wood biomass fuels (coconut fuels) accounting for 38 per cent of the total *useful heat* consumption. LPG ranks next with 32 per cent while fuelwood comes third with 25 per cent. When the fuel consumption pattern across income classes were analysed, the increase in reliance on LPG with rise in income and the simultaneous decrease in the consumption of fuelwood and coconut fuels were observed. This was true for both the rural and urban areas. The high consumption of LPG in urban areas reflects its increased availability. Therefore, both income levels and availability determine the shift away from biomass fuels to LPG. A comparison of the current fuel consumption pattern with that of 1988 shows that the changes are momentous and it is likely to continue.

In the timber trade in Kerala, rubber wood is the most important item of export. About 80 per cent of the timber export to other States in India was contributed by rubber wood. Among construction timbers, jack wood is the most important in both production and consumption. The import and export of teak is more or less balanced, but the constituents are different. While larger girth teak logs are imported to Kerala from other countries, poles from forest teak plantations are exported to other States in India. Import of silver oak transiting through Kerala appears as export also. There is a local market for cheap timbers which is served by silver oak and eucalypt wood. These timbers may be partially replacing the more abundant coconut wood in construction.

The market survey of NWFPs cultivated in home gardens in Kerala indicates that the output is negligible in the trade. There is a need to promote the cultivation of NWFPs outside the forests, particularly in home gardens, to reduce the pressure on forests from where they are presently collected to support a promising health care industry in Kerala. There is an opportunity for the Kerala Forest Department to take the initiative in creating awareness for natural biodiversity conservation both within and outside the forests.

The wood balance study shows that Kerala is a wood surplus State where a substantial quantity of rubber wood is produced and exported as packing case. There is a great potential to modernise the wood processing industry to utilise and add value to the large volume of rubber wood produced in the State. The market survey revealed that there is a deficit in large girth timber which is currently being imported. A policy favouring the growing of large girth timber must be adopted by the Kerala Forest Department and the rotation age of forest plantations, particularly of teak, must be increased. To conserve the wood resource of the State, for self reliance and more importantly for environmental reasons, the degrading dependence on biomass fuels must be reduced. For this, a proactive policy of providing LPG connection to every household must be targeted. To enable a quick transition, the LPG distribution network has to expand to cover the entire State, particularly around forests.

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Appendix 1.1
Direction of export of rubberwood

(Volume in m^3 round wood equivalent)

Year	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	97,103	14,012	1,44,914	12,684	968	2,69,681
1997-98	1,49,210	12,653	1,93,902	14,507	623	3,70,895
1998-99	1,36,541	17,731	1,02,009	12,614	204	2,69,099
1999-00	1,48,796	22,873	2,51,110	13,648	0	4,36,426
2000-01	1,96,838	19,813	2,21,718	16,819	0	4,55,188

[1] Through Manjeswaram forest check-post on National Highway 17. [2]Through forest check-posts at Muthanga, Baveli, Iritty, Jalsur, Mavinhalla, Noolpuzha, Panathur, Tholpetty, Ukkuda, Vazhikkadavu, etc. [3]Through forest check-posts at Walayar, Anappady, Gopalapuram, Meenakshipuram, etc. and sale-tax check-post at Govindapuram. [4]Through forest check-posts at Aryankavu, Achenkovil, Bodymettu, Chinnar, Kambanmettu, Kottavasal, Kumily, etc. [5] Through forest check-post at Parassala.

Appendix 1.2
Direction of export of *mango wood*

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	12,220	1,386	12,077	49	0	25,731
1997-98	11,142	3,713	22,914	73	15	37,856
1998-99	8,665	2,729	5,240	53	0	16,687
1999-00	8,782	1,767	12,341	52	0	22,942
2000-01	7,803	1,617	13,540	30	0	22,990

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.3
Direction of export of silver oak

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	25,811	4,112	2,127	11	0	32,061
1997-98	23,092	2,132	1,895	0	0	27,120
1998-99	12,241	717	238	0	0	13,196
1999-00	14,103	424	1,006	0	0	15,534
2000-01	17,771	647	1,388	0	0	19,806

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.4
Direction of export of teakwood

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	615	6,584	7,503	2,733	245	17,680
1997-98	775	6,830	4,100	1,447	381	13,534
1998-99	386	4,985	7,093	825	30	13,319
1999-00	98	4,693	5,548	661	0	10,999
2000-01	92	5,836	7,103	781	0	13,812

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.5
Direction of export of *vatta*

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	7,472	0	0	0	0	7,472
1997-98	9,220	77	0	0	0	9,297
1998-99	10,713	247	0	0	22	10,982
1999-00	7,476	0	0	0	0	7,476
2000-01	14,475	0	0	0	0	14,475

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.6
Direction of export of cashew wood

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	7,099	1,312	0	0	0	8,411
1997-98	8,673	566	0	0	0	9,239
1998-99	2,830	1,139	0	0	0	3,969
1999-00	2,238	962	0	0	0	3,200
2000-01	1,780	1,584	25	0	0	3,389

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.7
Direction of export of *anjili*

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	45	14	129	197	73	458
1997-98	210	44	274	28	11	567
1998-99	192	59	34	55	11	350
1999-00	483	207	53	63	0	806
2000-01	210	139	67	308	0	724

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.8
Direction of export of *venga*

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	37	643	29	706	216	1,630
1997-98	0	311	29	14	207	560
1998-99	19	155	29	13	42	257
1999-00	8	103	29	3	0	143
2000-01	0	194	338	2	0	534

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.9
Direction of export of eucalypts wood

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	738	0	201	194	0	1,133
1997-98	439	0	201	0	0	640
1998-99	164	0	201	0	0	365
1999-00	153	117	201	27	0	498
2000-01	117	40	281	16	0	454

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.10
Direction of export of rose wood

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	39	162	163	0	0	364
1997-98	24	92	30	21	0	167
1998-99	9	38	44	9	0	101
1999-00	2	119	24	0	0	145
2000-01	0	135	55	19	0	209

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.11
Direction of export of jack wood

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	188	36	0	1	0	225
1997-98	145	14	0	2	0	162
1998-99	357	49	0	4	0	411
1999-00	8	52	0	1	0	60
2000-01	90	10	8	0	0	108

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.12
Direction of export of *venteak*

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	0	9	31	256	22	319
1997-98	0	8	31	116	3	158
1998-99	7	46	31	0	0	85
1999-00	0	24	31	28	0	83
2000-01	0	0	31	0	0	31

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 1.13
Direction of export of *thani*

(Volume in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1996-97	56	49	0	0	0	105
1997-98	0	86	0	0	0	86
1998-99	17	0	0	0	0	17
1999-00	0	0	0	0	0	0
2000-01	35	3	0	0	0	38

Footnotes 1 to 5 are the same as those given in Appendix 1.1

Appendix 2.1
Long-term trend in import of teak wood

(Average volume per annum in m^3 round wood equivalent)

Period	South Canara[1]	Coorg and Nilgiris[2]	Tamil Nadu[3]	Total
1981-82 to 1985-86	336	0	258	594
1986-87 to 1990-91	562	0	373	935
1991-92 to 1995-96	1,673	6	194	1,873
1996-97 to 2000-01	8,873	55	2,655	11,583

[1] Through forest check-post at Manjeswaram. [2]Through forest check-posts at Muthanga and Noolpuzha. [3]Through forest check-posts at Walayar, Aryankavu and Parassala.

Appendix 2.2
Long-term trend in import of rosewood

(Average volume per annum in m^3 round wood equivalent)

Period	South Canara[1]	Coorg and Nilgiris[2]	Tamil Nadu[3]	Total
1981-82 to 1985-86	376	44	289	709
1986-87 to 1990-91	255	68	824	1,147
1991-92 to 1995-96	784	24	25	833
1996-97 to 2000-01	300	81	1	382

Footnotes 1 to 3 are the same as those given in Appendix 2.1

Appendix 2.3
Long-term trend in import of sandal

(Average volume per annum in m^3 round wood equivalent)

Period	South Canara[1]	Coorg and Nilgiris[2]	Tamil Nadu[3]	Total
1981-82 to 1985-86	0	56	136	192
1986-87 to 1990-91	0	16	226	242
1991-92 to 1995-96	5	9	10	24
1996-97 to 2000-01	9	22	178	209

Footnotes 1 to3 are the same as those given in Appendix 2.1

Appendix 2.4
Long-term trend in import of casuarina

(Average volume per annum in m^3 round wood equivalent)

Period	South Canara[1]	Coorg and Nilgiris[2]	Tamil Nadu[3]	Total
1981-82 to 1985-86	118	7	1,717	1,842
1986-87 to 1990-91	0	51	930	981
1991-92 to 1995-96	0	4,073	75	4,148
1996-97 to 2000-01	1,122	1,266	546	2,934

Footnotes 1 to3 are the same as those given in Appendix 2.1

Appendix 2.5
Long-term trend in import of charcoal

(Average volume per annum in m^3 round wood equivalent)

Period	South Canara[1]	Coorg and Nilgiris[2]	Tamil Nadu[3]	Total
1981-82 to 1985-86	35	0	9,078	9,113
1986-87 to 1990-91	0	0	79,253	79,253
1991-92 to 1995-96	12	0	55,495	55,507
1996-97 to 2000-01	128	14	57,556	57,698

Footnotes 1 to3 are the same as those given in Appendix 2.1

Appendix 3.1
Long term trend in export of teak wood

(Average volume per annum in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1981-82 to 1985-86	1,848	1,262	21,137	8,018	844	33,109
1986-87 to 1990-91	3,071	1,514	14,341	5,079	293	24,298
1991-92 to 1995-96	1,981	1,589	10,326	4,040	571	18,507
1996-97 to 2000-01	393	252	2,893	723	131	4,392

[1] Through forest check-post at Manjeswaram. [2]Through forest check-posts at Muthanga and Noolpuzha. [3]Through forest check-post at Walayar. [4]Through forest check-post at Aryankavu. [5] Through forest check-post at Parassala.

Appendix 3.2
Long term trend in export of rosewood

(Average volume per annum in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1981-82 to 1985-86	140	0	49	0	0	189
1986-87 to 1990-91	78	2	91	0	8	179
1991-92 to 1995-96	71	146	141	3	9	370
1996-97 to 2000-01	15	40	41	8	0	103

Footnotes 1 to5 are the same as those given in Appendix 3.1

Appendix 3.3
Long term trend in export of rubber wood

(Average volume per annum in m^3 round wood equivalent)

Period	Bombay[1]	Bangalore[2]	Coimbatore and Trichy[3]	Madurai[4]	Nagarcovil[5]	Total
1981-82 to 1985-86	13,420	0	46,806	758	0	60,983
1986-87 to 1990-91	24,271	128	82,813	1,079	0	1,08,290
1991-92 to 1995-96	73,119	19,338	1,19,182	4,208	1,042	2,16,890
1996-97 to 2000-01	1,45,698	13,661	1,30,980	14,029	359	3,04,727

Footnotes 1 to5 are the same as those given in Appendix 3.1

Appendix 4.1
Cultivation of NWFP plants in home gardens

NWFPs	Scientific name	Plant type	Parts used
Adalodakam	*Adathoda bedomel*	Shrub	Whole part
Adapathiyan	*Holestema ada-kodien*	Climber	Root
Koduveli	*Plumbago zeylanica*	Herb	Root
Neelaamari	*Indigofera tinoteria*	Herb	Leaf and root
Sathavari	*Asparagus racemosus*	Climber	Root
Thipalli	*Piper longum*	Climber	Corn
Kasthurimanjal	*Cucurma aromatica*	Herb	Rhizome
Chittaratha	*Alpinia calcarata*	Herb	Root
Vayampu	*Acorus calamus*	Herb	Rhizome
Karimkurinji	*Strobilanthus ciliatus*	Shrub	Stem
Naruneendi	*Hemidesmus indicus*	Climber	Root
Iruveli	*Colias sylanicus*	Shrub	Stem
Chittamruthu	*Tinospora cordifolia*	Climber	Stem

Appendix 4.2
Locations of cultivators of NWFP in home gardens

Type of cultivators	Region	Location
Experimental	Thiruvananthapuram	Palode
	Idduki	Adimali, Kanjikuzhi
	Kozhikode	Quilandi
	Wayanad	Kalpetta, Venode, Meppady, S.bettery, Puthurvayal
Commercial	Pathanamthitta	Addor, Thengamom
	Alapuzha	Cherthala, Komalapuram
	Kottayam	Pravithanam
	Ernakulam	Perumbavoor, Malayatoor
	Thrissur	Ollur, Kunnankulam, Wadakanchery
	Malapuram	Valanchery, Palapetty, Kulathur
	Kozhikode	Vadakara
	Wynadu	
Publicity / awards	Idduki	Kattapana, Thodupuzha, Anakkayam
	Kottayam	Pala
	Thrissur	Pudukkad

Appendix 4.3
Important regions of NWFP cultivation in home gardens

Species	District	Location
Neela amari	Thrissur	Ollur, Wadakanchery, Kunnankulam,
	Malappuram	Kulathur
	Kozhikode	Vadakara
	Idukki	Anakayam
	Ernakulam	Perumbavoor
	Wynadu	S.Bathery
Koduveli	Thrissur	Varantharapilly, Wadakanchery, Pudukkad, Pallikunnu,
	Malapuram	Kulathur, Valanchery
	Kozhikode	Vadakara, Quilandy
	Ernakulam	Perumbavoor, Malayatoor
	Thiruvananthapuram	Muthanakuzhi
	Wayanad	Niravilpuzha
	Palakkad	Kanjirampuzha
	Kannur	Vadakara, Payyannur
	Pathanamthitta	Thengamam
	Kollam	Punalur
	Idukki	Kattapana, Adimali
Iruveli	Ernakulam	Perumbavoor
	Alapuzha	Cherthala, Adoor, Komalapuram
Chittaratha	Idduki	Adimali, Kattapana, Thodupuzha
Vayambu	Idduki	Mankulam
	Thrissur	Ollur
Avanuk	Kollam	Thrikovilvattom
Neervalam	Wayanad	Nallarachal
Koovalam	Trivananthapuram	Palode
Kasthurimanjal	Trivananthapuram	Palode
	Idukki	Adimali
	Ernakulam	Perumbavoor
Thippali	Thrissur	Pudukkad
	Alapuzha	Adoor

Appendix 4.4
Prices of NWFP at different points of trade during 2001-02

(Rs.per kg)

Species	Gatherer	Collection agent	Wholesale trader	Retail trader	Manufacturing unit
Koduveli	25-30	35	38-40	50-60	40-42
Neelaamari	6-15	15-30	-	40-60	12-15
Kasthurimanjal	12-20	20-25	25-30	30-40	25-30
Karimkurinji	3-6	8-10	8-12	10-12	8-10
Iruveli	15-20	20-22	20-25	34-40	20-22
Adalodakam	8-10	10-14	12-14	14-19	14-16
Chittamruth	4-6	6-8	8-10	10-12	7-9
Sathavari	4-6	7-8	8-10	10-12	6-8
Nannari	20-23	35-45	36-60	60-80	36-45
Adapathiyan	30-50	80-120	120-140	140-180	90-140
Vayampu	20-25	26-30	30-40	35-40	25-30