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# Forestry Sector Analysis for the State of Kerala

(Final Report of the Research Project No: KFRI 544/2008 Phase II)

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## Project proposal in brief

| | | |
|---|---|---|
| 1. Project number | : | KFRI 544/2008- Phase II |
| 2. Title of the project | : | Forestry Sector Analysis for the State of Kerala |
| 3. Objective | : | a) To formulate an econometric model useful for projecting the status of supply, demand and price of various forest products in the State.<br>b) To evaluate the status of forest-based industries like sawmilling, pulpwood, plywood, eco-tourism and drug manufacturing and work out their possible future scenarios, to the extent possible, subject to the availability of data.<br>c) To analyze the interrelation between forestry and allied sectors in Kerala. |
| 4. Expected outcome | : | The study will help formulate management strategies and development policies with regard to the forest sector in the State. More specifically, the econometric model will throw light on how the forestry sector operates and indicate trends in supply, demand and price of the forest products considered. The scenario models will indicate the possible future scenario/potential of the forest-based industries under alternative policy regulations. The study will also show the interrelations between forestry and allied sectors in the State. |
| 5. Date of commencement | : | May 2008 |
| 6. Scheduled date of completion | : | June 2010* |
| 7. Funding agency | : | MOS&PI, Government of India |
| 8. Project team | | |
| Principal Investigator | : | Dr. K. Jayaraman |
| Associate Investigator | : | Dr. V. Anitha |

* The project activities had to be suspended for some time due to delay in getting the second installment from the funding agency.

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## Abstract

Sector analysis based on Net State Domestic Product (NSDP) was carried out. Data on NSDP relating to various sub-sectors for the State from 1960-61 to 2003-04 were subjected to time series analysis after appropriate preprocessing. The forestry sector has been undergoing distinct stages of transition in the past. During 1960's, wood production was much high due to large scale conversion of natural forests to plantations as part of Five Year Plans. The next period recorded some stabilization or slight decrease but 1980's showed a rapid decline in production due to stoppage of clear felling and selection felling from natural forests. Production caught up later as plantations raised around four decades earlier were coming to maturity. A more quantitative analysis carried out on NSDP of forest sector using Autoregressive Integrated Moving Average (ARIMA) model indicated an increasing trend for production from forest sector in the immediate future. Analysis based on partial correlation of NSDP of forestry sector with similar values of all other sub-sectors revealed that production from forests has been proceeding more or less independently of other sectors. It was also revealed that the contribution of forest sector to the State income was to the order of 1 to 2 per cent showing the inadequacy of NSDP in evaluating the sector performance.

Analysis based on Gross Domestic Product (GDP) although simple to execute, suffers from the major limitation that only tangible benefits from forests get accounted, grossly underestimating the role of forests in the overall economy. Criteria and Indicators for Sustainable Forest Management (SFM) is a comprehensive approach as it takes into consideration the ecological, environmental and economic issues related to forests. However, the method being a mere passive assessment of the forest and related issues, is more suitable for routine monitoring. Moreover, there are problems in gathering all the required data for periodical evaluation. The logical framework advanced by the Asian Development Bank (ADB) is functional in the sense that key sector problems are identified and their solutions worked out. It also provides guidelines for selecting the most effective strategy for accomplishing the management objectives. Application of the method for practical problems was illustrated using examples related to natural forests, plantations and industries.

The study to evaluate the supply-demand situation of teakwood in Kerala based on econometric modelling indicated that the demand of teakwood in Kerala is highly influenced by the current price of teak, lagged population and lagged per capita income of Karnataka. Similarly, the supply of teakwood is found to be influenced by lagged values of consumption and price of teakwood. The future trends for price and demand worked out showed a generally increasing trend for both teak prices and demand beyond 2004-05 but for the yearly alternating fluctuations in both the cases.

A study on the periodic behaviour of production and price of teakwood indicated that production of teakwood from forest has no significant peaks and hence there is no cyclical pattern. For the quantity exported, a peak was suggestive corresponding to the frequency 0.20 i.e., there was a cycle with period of five years but in the case of quantity imported, there were no significant cycles. The spectral analysis of teak price revealed

peaks around the frequency of 0.30 i.e., a cycle of length around three years. Since there is a noticeable peak at the frequency 0.175, roughly, a five year cycle is observed in the case of substitute price. On the whole, some market adjustment mechanism seems to be operating with a cycle of three to five years.

Study on pulpwood requirements in the State was carried out using data obtained from Hindustan Newsprint Ltd (HNL). The time series data gathered consisted of annual supply of different kinds of raw material from government and other sources including Kerala Forest Development Corporation Ltd. (KFDC) for the period from 1982-83 to 2008-09, consumption of raw materials and production of newsprint for the period 1983-84 to 2008-09. HNL uses different types of raw material such as wood, bamboo, reed and waste paper. Nearly 40 to 50 per cent of the total consumption consisted of wood. The next important material was reed but over the years, the percentage contribution came down drastically. Instead, bamboo was being increasingly utilized. Forecasting of pulpwood consumption and newsprint production was carried out using ARIMA model. The projections made for the six years after 2008-09 showed further increase in total consumption of raw materials and production of newsprint in HNL.

The survey on forest-based industries was directed to ecotourism, sawmilling and raw drug manufacturing units. Pulpwood industry being not much dependent on forests was excluded from this report. The tourism traffic to Kerala depicts an increasing trend over the years. The average number of domestic tourists to Kerala during the period 1980 to 2003 was 2,201,960 per year and the year 2003 recorded the highest number of domestic tourist flow with 5,871,228 tourists. Annual increase of foreign tourists' arrival to Kerala during the given period is 11,047. The visitors flow to the Wildlife Sanctuaries (WLSs) and National Parks (NPs) of the State depicts an increasing trend during the period 1998-2006 with an annual average flow of 663,255.

The sawmilling units are spread over the entire State except those parts having larger area under forest. Of the total number of 2214 registered units, 93 per cent of the sawmills are small-sized employing less than 10 workers. Examination of the year of inception of a cross section of the population showed that there has been stagnation in the growth of the industry with little or no addition in the number of units in recent times. This is largely because the Forest Department stopped issuing No Objection Certificate (NOC) to new entrepreneurs.

A survey of the sawmilling units in the State based on stratified random sampling highlighted the mean annual outturn of the small sized units to be 806 $m^3$, and that of larger units to be 1958 $m^3$. Together, a total of nearly 1.95 million $m^3$ of wood get processed through these sawmills annually. About 85 per cent of the total outturn is claimed by the small units. The capacity utilization of the small units is 65 per cent and that of large units is estimated as 86 per cent. The major sources of the timber used in furniture making and timber sales are homesteads (53%) and import (34%), while forest depots account for 12 per cent. Teak (29%), pynkado (26%) and jack (15%) were the most preferred timbers used for direct sales and furniture making by sawmill owners. The timber brought by customers for sawing mostly comes from homesteads (92%). The most

common species brought by customers for sawing are mango (28%), jack (23%), coconut (14%), anjily (9%) and teak (6%).

The fact that the outturn is far below the installed capacity is an indication of the additional activity possible in the industry without any major structural changes. Shortage of raw material is the major constraint faced by the industry. Hence, technological advancements have not made their way into the industry in a big way. Since homesteads continue to be the major source of wood, tree planting in homesteads needs to be promoted by appropriate legal and policy changes. The major timber species coming from homesteads happen to be teak, jack and mango. Pynkado is one of the preferred timbers that are imported. Since, there is shortage of wood in the internal market, import could also be liberalized. The mill owners in general indicated problems in securing or renewing license, unnecessary harassment from officials of different Departments among others. Some changes in this front could also be thought of.

The raw drug industries in Kerala are shifting their focus from the classical formulations to the nutraceutical market. Analysis of the status of raw drugs in Kerala projects an ever increasing demand as the sales value of raw drugs and its collection charges depict an overall increasing trend during the period 1985-2004. Lack of availability of quality raw materials, lack of appropriate government policy and fluctuation in price are the common constraints identified by these units. The development of raw drug industry in the state will depend on the capacity of the units to take advantage of emerging opportunities, the ability to compete in global market place and the commercial viability of the various activities.

Forests provide humanity a multiplicity of goods and services. Agriculture and certain industries have close dependence on forests. The domesticated plants and animals have their origin in forests. Similarly, the rivers which irrigate agricultural lands are sustained by forests. However, the population pressure had resulted in destruction of forests in the past. Presently, agriculture claims over 54 per cent the land area in the State whereas forests occupy around 28 per cent of the land area mostly confined to hilly tracts. Forests and agriculture play an important role in the economy of the State but their percentage contribution in physical terms have been decreasing over time.

The chief industries centered on forests in the State are sawmilling and related industries, ecotourism and raw drug industry. The survival of these industries is dependent either on the forest produce or the forest sites. Forest plantations constitute substantial quantities of raw material to the wood-based industries. Much of minor forest produce comes from natural forests. The forests provide shelter and means of livelihood for the hill tribes. They provide employment to the socially and economically backward communities, particularly the women and tribal people. However, the number of persons employed in agriculture, hunting, forestry and fishing, in public and private establishments in Kerala, illustrates a continuous decline in the past.

## 1. Introduction

Forests and forestry are becoming an increasingly larger issue in the context of the current scenario of global warming and related environmental concerns. It has been repeatedly emphasized that forests play a pivotal role not only in maintaining the environmental stability but also for meeting the several economic and socio-cultural objectives put forth by the increasing population. However, in many developing countries, forests have been a subject of large scale exploitation leading to deforestation and forest degradation. Thanks to many international efforts, such countries across the globe have been gearing up to conserve and manage the remaining tracts of forests in a sustainable manner. India has been no exception to this phenomenon is well depicted by its National Forest Policy 1988 which laid emphasis on environmental stability and Joint Forest Management. Forests of the State of Kerala are also currently managed in line with the principles laid down in the National Forest Policy but a detailed analysis in this respect seemed to be in order and hence this project.

Although the project title is broad based, the study had the following specific objectives as of developing an econometric model for forest products, evaluating the status of forest based industries and analyzing the interrelation between forestry and allied sectors. However, the discussions have been made on many aspects without loss of generality.

Before embarking upon the details of work done, some general concepts and definitions are reviewed in the following. A sector comprises for the most part, the producing or operating units in the economy that have a common function or output. Thus, sectors are segments in the economy identified in terms of their contributions to the economy and daily quality of life. Policies and regulations from the government institutions contribute to regulating and administering each sector. Sector analysis refers to the process of identifying possibilities for improving sector performance.

Forest sector thus comprises all goods and services related to forests. Like any other sector, forest sector also does not stand in isolation. It has inter-linkages with many other sectors and is subject to government policies and regulations implemented from time to time. Conservation and production have been two major themes operating in the sector which had their implications in the management of this important renewable natural resource. Globally, the major issues that are currently discussed in relation to forest sector are forest degradation, climate change, social and environmental services provided by the forests and sustainable forest management many of which are highly relevant even locally. This report examines some of these issues in the States' context.

Although started ambitiously, availability of appropriate and reliable data was a major constraint in the study. Hence, the scope of conclusions and recommendations arising from this report is also limited to this extent.

## 2. Forest Sector of Kerala – An appraisal

Kerala is a small state in the southwestern corner of India. It represents 1.18 per cent of the total area of India but claims around 3.5 per cent of the total population of the Country with a population density of 819 persons per $km^2$. Forests occupy 11,265 $km^2$ (FSI 2009), which is 29 per cent of the total geographical area of the State. Management of the forests is vested with the Government. Felling from natural forests is completely banned. The Western Ghats, a sizeable portion of which is in Kerala, is one of the 34 global hotspots of biodiversity in the world. There are about 500 species utilized as Non Timber Forest Products (NTFP). The tribal communities in and around forests mostly depend on NTFP for their subsistence. Forest plantations occupy about 10 per cent of the area under forests. Teak and eucalypts have been the principal forest plantation species. At present, they account for 57,855 and 24,500 hectares respectively. Kerala is a state, which has notified tourism as an industry. There are five national parks, eleven wildlife sanctuaries, two bird sanctuaries and one tiger reserve some of which are highly preferred locations for tourists.

Management of forests in the State is vested with the State Government. The Forest Department operates under the legal framework of the State and the Country. Since the forests are in the concurrent list, the forest management policies are in line with the National Forest Policy of the Country.

In the past, agriculture was a highly competitive sector affecting the forests leading to its destruction. About 46 per cent of the total geographical area is now occupied by homegardens and 16 per cent by private estates of rubber, cardamom, coffee and tea. The traditional tree crops grown in homesteads are coconut, jack, mango, cashew, teak, anjily among others. The recent liberalization of rules on felling of trees from homesteads has opened up avenues for more agroforestry options in the State. Homegardens and estates, particularly, rubber plantations form the major source of wood supply in the state. The major wood-based industries are sawmilling, packing case, plywood, splints and veneers, pulp and paper, among others. There are around 4000 wood-based units, which depend not only on forests but also on homegardens and estates, for their wood requirements.

Kerala has the legacy of achieving enviable standards in important areas such as literacy, life expectancy and other material quality of life through progressive policies and public action of the State and other social institutions through democratic means. Although the current per capita income is inadequate to support such achievements, the deficiency is supposedly met by the high inflow of migrants' remittance.

The state of Kerala is thus unique in many respects and an overall assessment of the present status and future prospects in quantitative terms using the modern analytical tools has become the need of the day in order to formulate definitive strategies for the development of the forest sector of the State in relation to the overall socioeconomic scenario prevailing in the region.

## 3. Sector analysis

### 3.1. Analysis based on Net State Domestic Product (NSDP)

One straight forward indicator that can be used in sector analysis is the GDP. Quite often, NSDP is used in economic analysis which is GDP less depreciation or consumption of capital. The data on NSDP relating to various sub-sectors for the State from 1960-61 to 2003-04 were collected from the reports of the Directorate of Economics and Statistics, Government of Kerala. The values were then brought to the base year of 1980-81 using forward and backward splicing. An appreciation of the overall context of the State economy would be helpful before proceeding with the analysis of forestry sector. A comparison of the overall trend in the NSDP for the State in relation to that of the Country is made in Figure 3.1. For effective scaling, the index values with the base year of 1980-81 are shown, instead of absolute values of the NSDP.

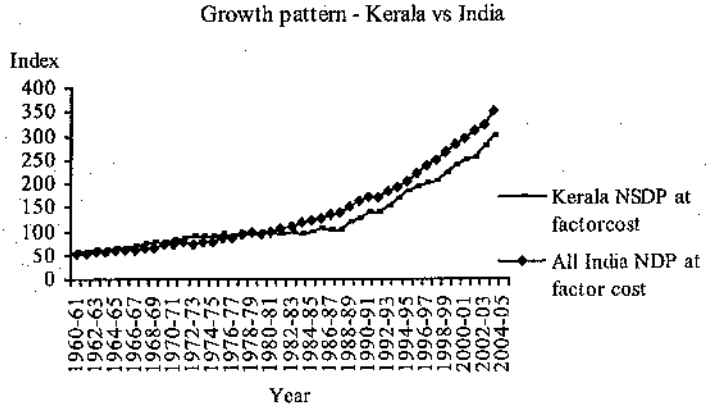



Figure 3.1. Trend in NSDP (index value) for Kerala in relation to that of India

Figure 3.1 depicts a distinct change in the growth pattern of the State economy since 1986-87. Subrahmanian (2005) had observed that the change is possibly due to the liberalization policies introduced at the national level during 1980's with some lag for the State to respond.

The growth patterns in major sub-sectors of the State viz., agriculture, industries and service sectors are shown in Figure 3.2. The sub-sectors correspond to the primary, secondary and tertiary sectors of the traditional typology after some modifications. The corresponding growth rates based on exponential function are shown in Table 3.1. Although the primary sector has recorded a higher growth rate after 1986-87, this rate is much low when compared to that of secondary or tertiary sectors.

Table 3.1. Growth rates of agriculture, industry and service sectors

| Sector | 1960-61 to 1986-87 | 1987-88 to 2003-04 |
|---|---|---|
| Primary (Agriculture) | 1.06 | 2.89 |
| Secondary (Industry) | 3.40 | 6.32 |
| Tertiary (Service) | 3.21 | 8.17 |

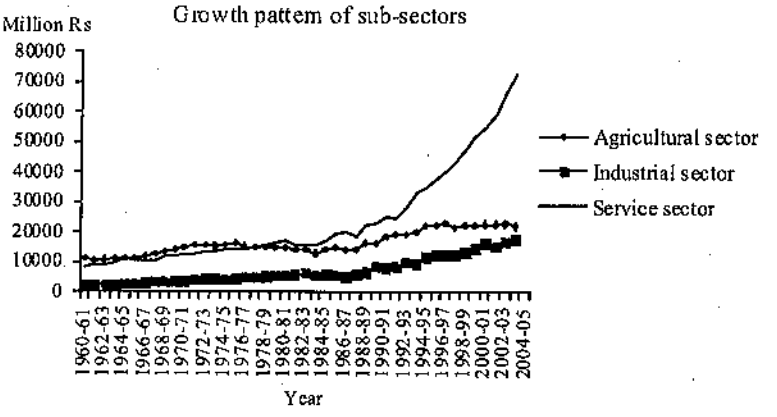



Figure 3.2. Trends in NSDP for major sub-sectors of Kerala

Within the primary sector comprising agriculture, forestry and fisheries, the growth patterns were much different as shown in Figure 3.3 and Table 3.2.

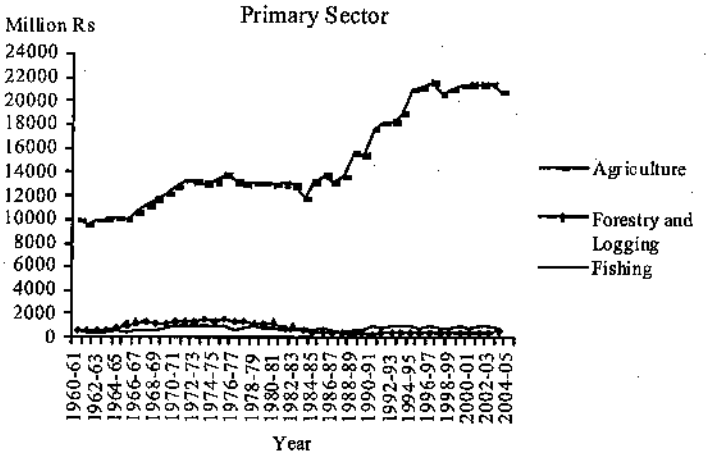



Figure 3.3. Trends in NSDP for agriculture, forestry and fisheries sub-sectors of Kerala

Table 3.2. Growth rates of agriculture, forestry and fisheries sectors

| Sector | 1960-61 to 1986-87 | 1987-88 to 2003-04 |
|---|---|---|
| Agriculture | 1.23 | 2.81 |
| Forestry | 0.64 | 2.98 |
| Fisheries | 0.47 | 2.84 |

An expanded version of the changes in the forestry sector is depicted in Figure 3.4.

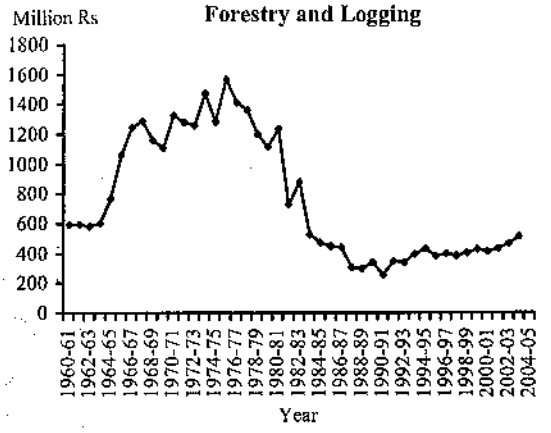



Figure 3.4. Trends in NSDP of forestry sector of Kerala

It can be seen that the forestry sector has been undergoing distinct stages of transition in the past. To make things clear, the decade-wise growth rates worked out are shown in Table 3.3.

Table 3.3. Decade-wise growth rate in forestry sector

| Period | Growth rate |
|---|---|
| 1961-62 to 1970-71 | 9.45 |
| 1971-72 to 1980-81 | -1.17 |
| 1981-82 to 1990-91 | -12.34 |
| 1991-92 to 2000-01 | 1.80 |

During 1960's, the production was much high due to large scale conversion of natural forests to plantations as part of Five Year Plans. The next period was that of some stabilization or slight decrease but 1980's showed a rapid decline in production due to stoppage of clear felling and selection felling from natural forests. Production caught up later as plantations raised around four decades earlier were coming to maturity.

The policy of conservation of forests executed since the mid 80's in the State restricted the exploitation of forests and as a result, a number of substitutes of wood in the form of plastics, fibre-based furniture, steel and other metal based products were progressively used in construction, furniture industry and production of transport equipments among others.

A more quantitative analysis was carried out on NSDP of forest sector in order to understand future trends. ARIMA model of Box *et al.* (1994) was used to describe the series. A time series that is modelled as a linear combination of its own past values and past values of an error series is known as ARMA model. An ARIMA model is usually denoted by the notation, ARIMA ($p$, $d$, $q$) where $p$ is the order of the autoregressive part,

$d$ is the order of differencing, $q$ is the order of the moving average process. Given a dependent time series $\{Y_t = 1 \le t \le n\}$, mathematically, ARIMA model is written as

$$(1-B)^d Y_t = \mu + \frac{\theta(B)}{\phi(B)} a_t \qquad (3.1)$$

where $t$ indexes time

$\mu$ is the mean term

$B$ is the backshift operator; that is, $BX_t = X_{t-1}$

$\phi(B)$ is the autoregressive operator, represented as a polynomial in the back shift operator: $\phi(B) = 1 - \phi_1 B - \phi_2 B^2 ... - \phi_p B^p$

$\theta(B)$ is the moving-average operator, represented as a polynomial in the back shift operator: $\theta(B) = 1 - \theta_1 B - \theta_2 B^2 - ... - \theta_p B^p$

$a_t$ is the independent disturbance, also called the random error.

Results of the time series analysis done using Box-Jenkins model are depicted in Figure 3.5. There is much agreement between the observed and the fitted values during the estimation phase with a total $R^2$ of 0.90 (90%). Second order differencing was required to make the series stationary. The fitted model was ARIMA (1, 2, 1) after logarithmic transformation. The parameter estimates are reported below.

| | |
|---|---|
| Intercept | : -1.770 (0.596) |
| Autoregressive parameter | : -0.335 (0.158) |
| Moving average parameter | : 0.999 (5.607) |

Although some of the parameters were non-significant, they were retained in the model to make the forecasts better. Alternative models tried had larger forecast error. The projections made for the ensuing 7 years after 2003-04 showed further increase in the production from the forests in Kerala as per the present trends.

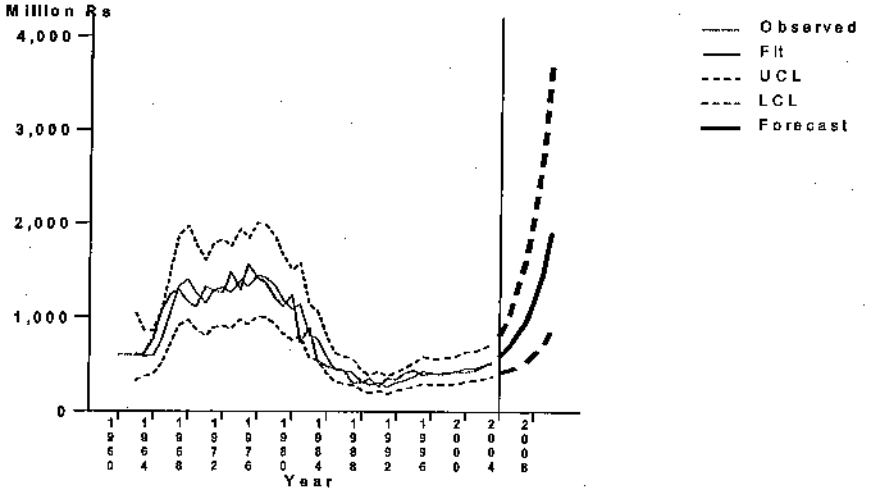



Figure 3.5. Projection of forest sector NSDP based on ARIMA model

One of the objectives specified was to study the interrelation of forestry sector with that of allied sectors. In order to have a glimpse of any such relationships, partial correlation of NSDP of forestry sector with similar values of all other sub-sectors were worked out using the multiple time series data on NSDP. The partial correlations between forestry and other sectors eliminating the influence of total NSDP are reported in Table 3.4.

Table 3.4. Partial correlations of NSDP of forestry sector with other sectors

| Sector | Partial correlation with forestry sector NSDP |
|---|---|
| Agriculture | -0.17 |
| Fishing | 0.47 |
| Mining and Quarrying | -0.62 |
| Manufacturing | -0.44 |
| Electricity, Gas and Water supply | 0.41 |
| Construction | 0.12 |
| Transport, Storage and Communications | 0.17 |
| Trade, Hotels and Restaurants | 0.54 |
| Banking and Insurance | -0.16 |
| Real estate, Ownership of dwelling etc. | 0.40 |
| Public Administration | -0.66 |
| Other services | -0.50 |

There are no significant correlations to commend upon except those with mining and quarrying and also public administration. We may therefore conclude that production from forests has been proceeding more or less independently of other sectors.

All said and done, one important limitation of the above analysis was that the contribution from the forest sector to the state income was too low (1.6 %) as can be seen from the following Table 3.5.

Table 3.5. Contribution of the different sectors to the total State income for 2003-04 (Rs)

| **Sector** | **At current price** | **Percentage** |
|---|---|---|
| Agriculture | 122093 | 13.8 |
| Forestry and Logging | 14313 | 1.6 |
| Fishing | 12746 | 1.4 |
| **Sub Total: Primary** | **149152** | **16.9** |
| Mining and Quarrying | 1730 | 0.2 |
| Manufacturing | 68021 | 7.7 |
| Electricity, Gas and Water supply | 118740 | 13.5 |
| **Sub Total: Secondary** | **188490** | **21.4** |
| Construction | 15336 | 1.7 |
| Transport Storage and Communications | 73307 | 8.3 |
| Trade, Hotels and Restaurants | 209915 | 23.8 |
| Banking and Insurance | 58754 | 6.7 |
| Real estate, Ownership of dwelling etc. | 77513 | 8.8 |
| Public Administration | 35863 | 4.1 |
| Other services | 73908 | 8.4 |
| **Sub total: Tertiary** | **544595** | **61.7** |
| **NSDP at factor cost** | **882237** | **100.0** |

*Source: Economic Review 2006*

This is not to understate the importance of the forest sector but owes mainly to the computation of NSDP which is based on production approach for the primary sector. The NSDP for forest sector is based on the commercial value of the saleable product from forests like timber, firewood and NTFP. All the intangible benefits like carbon sequestration, soil and water conservation, biodiversity, among others are presently unaccounted in the computation of GDP and thus the contribution from forestry remains underestimated. Hence, there was a need for going for alternative frameworks for analyzing the sector performance. One such framework is that of the Criteria and Indicators (C&I) for SFM. However, paucity of data prevents a detailed analysis using this approach. A more plausible means is one that is offered by the ADB which is examined in the next section.

### 3.2. Analysis based on ADB framework

The basis of this framework is that described by Saldanha and Whittle (1998) which involves a problem-oriented approach. The different steps involved are detailed in Figure 3.6.

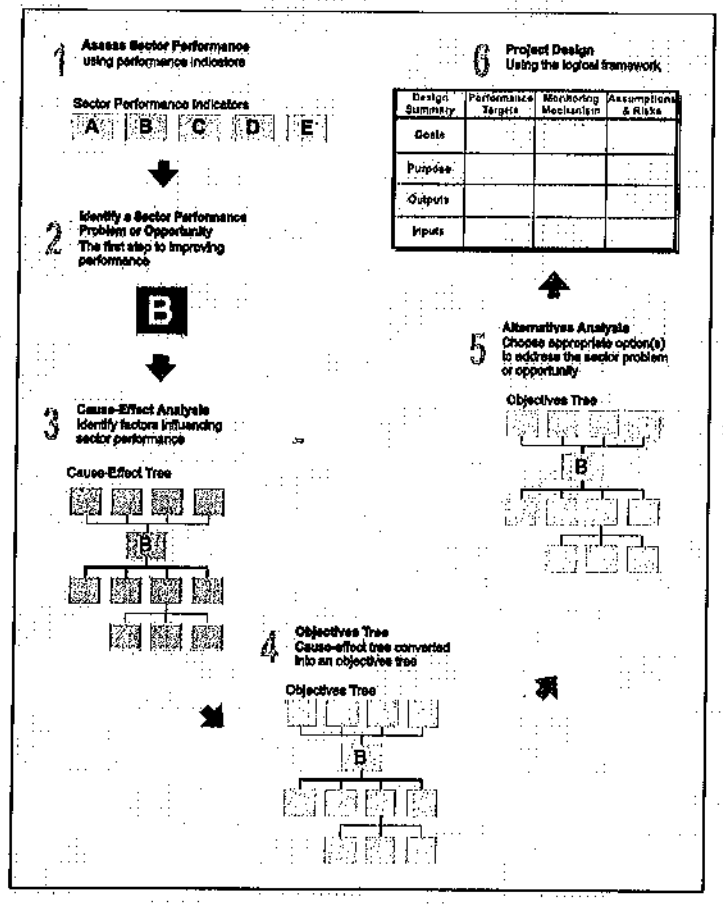



Figure 3.6. Steps in sector analysis under ADB framework

The method starts with an assessment of sector performance using corresponding indicators and is followed by identification of a key sector problem or opportunity. Next, a cause and effect analysis is conducted which is later converted into an objective tree indicating the steps to be taken for achieving positive changes. During this process, several alternatives could emerge and there is the task of choosing the appropriate option (s) to address sector problem or opportunity. Ideally, some experimental data would be required to choose between these alternative options. However, an alternative analysis can be conducted by setting certain criteria and scoring the effectiveness of these options with respect to each of these criteria. All the scores are out of 10 points. The scores assigned for different options can then be multiplied by the relative weights assigned for each criterion and added up to get the total score for each option. The option getting the highest score gets considered for implementation. Setting physical targets and monitoring follow, specifying the assumptions and risks involved. An attempt to illustrate the application of this approach for forest sector analysis is made herewith.

Without losing generality, one may ascertain that the forest sector comprises three sub-sectors, viz., natural forests, plantations and associated industries. Each sub-sector has a mandate of its own, like issues related to natural forests are predominantly conservation-oriented, the emphasis with respect to plantations lies on productivity. The industries are concerned with utilization of forest products. The performance indicators that can be used in respect of each sub-sector are indicated in Figure 3.7. Forest cover, wildlife abundance and soil status seem to be the key variables that need to be monitored with regard to natural forests. Of late, climatic changes also have become relevant in the global context. Information on productivity, soil status and product prices will cover most of the issues related to plantations. Outturn, capacity utilization and product price appear to be the most important variables as far as industries are concerned although the specifications may differ depending on the product under reference.

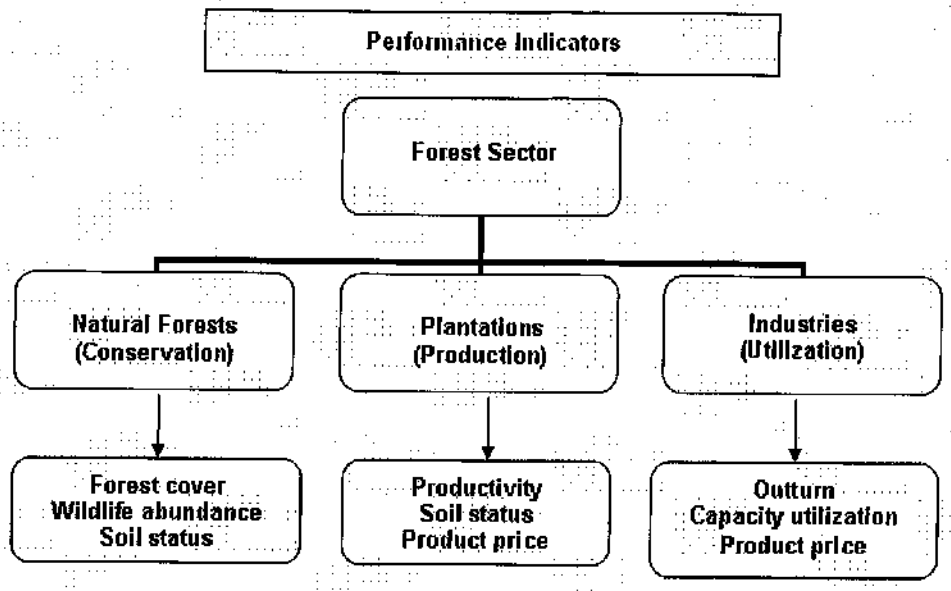



Figure 3.7. Performance indicators for different sub-sectors of forest sector

There is a need to define and also specify the units for these variables but most of them are universally known. For instance, forest cover is presently most easily assessed through remote sensing, expressed in $km^2$, and is classifiable as 'open' and 'closed'. Many scientific methods have been devised for estimating wildlife abundance expressed in terms of density, i.e., numbers per $km^2$. Soil status however is a broad term comprising not just fertility but all other edaphic components. Externally, the loss of surface soil qualifies as a single indicator of the soil status and annual loss of top soil in terms of soil depth is relatively easy to measure. There is a standard set of climatic variables that are monitored most important of which are temperature and rainfall. The universal measure for productivity for tree crops is the mean annual increment per hectare. Product price is usually expressed in terms of value per unit of finished product. Outturn refers to the total annual production and capacity utilization indicates the extent to which installed strength is utilized.

The subsequent steps in the process are explained for each sub-sector separately in the Indian context with special reference to Kerala State.

### 3.2.1. Natural forests

Figure 3.8 shows the cause and effect analysis performed for the key problem of forest degradation. The deficient sector outputs include fire, grazing, illicit felling, illicit collection of NTFP and encroachment. These deficiencies arise from ineffective enforcement of regulations, inadequate infrastructure and lack of cooperation from people. Deficient institutional capabilities and inadequate policies resulting from inadequate financial and technical resources have been identified as reasons for the

situation. Forest degradation causes reduced regeneration, reduction in wildlife numbers, shortage of raw materials and reduced environmental benefits. All these impacts get reflected in respective manners at the national level as well.

When adequate financial and technical resources are provided, institutional capabilities are strengthened and good policies emerge resulting in effective enforcement of regulations, adequate infrastructure and people's participation in forest management. When institutions function well, the sector outputs improve and will in turn bring the forests in better conditions. The consequent impacts will be improved regeneration, increase in wildlife numbers, enhanced production and environmental benefits. These impacts are then well carried over to the national level (Figure 3.9).

As could be seen from Figure 3.9, controlling fire, grazing, illicit felling, collection of MFP and encroachment form the different alternatives for improving the forest conditions. The alternative analysis conducted is illustrated in Tables 3.6 and 3.7. It turns out that controlling fire seems to be best option for improvement of forest conditions taking into account its immediate effect, easiness to implement, financial and economic viability, social and political acceptance and the widespread impact (Tables 3.6 and 3.7).

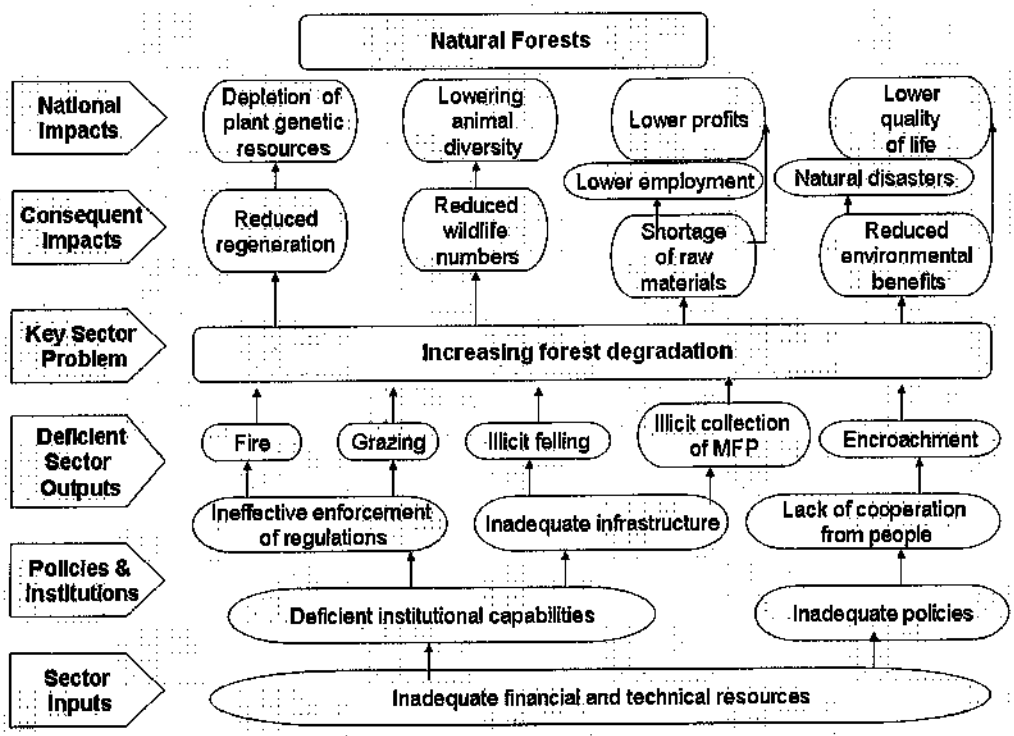



Figure 3.8. Key sector problem and cause and effect analysis for natural forests

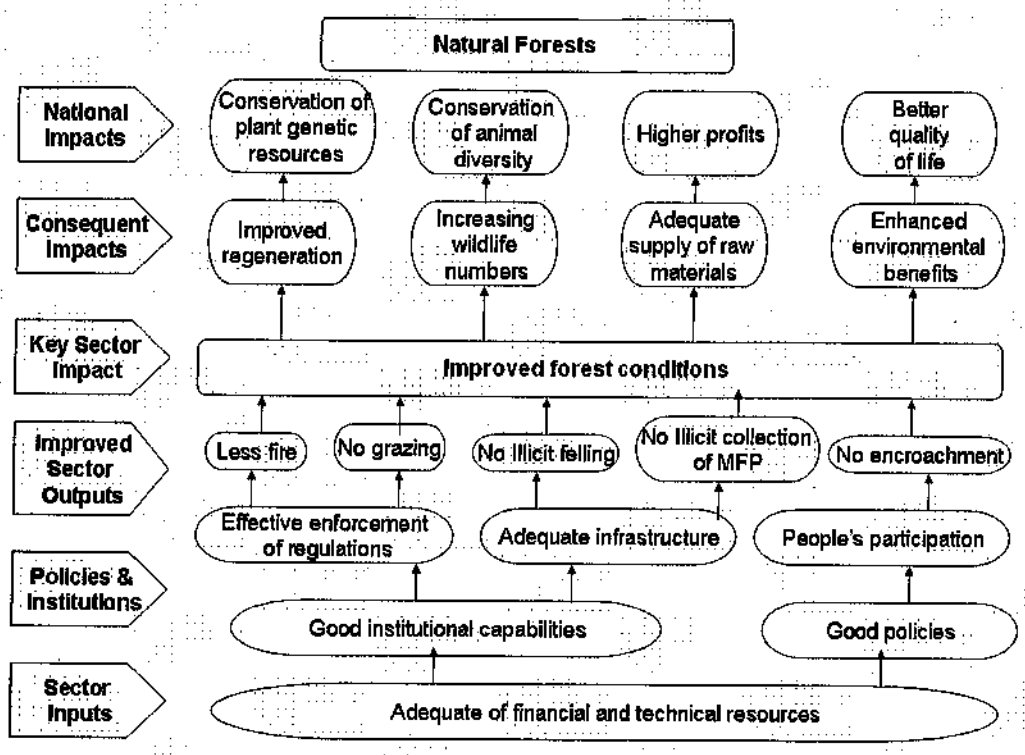



Figure 3.9. Objective tree for improvement of natural forests

Table 3.6. Performing an alternative analysis for natural forests

| Criteria | Relative weight | Controlling fire | Score | Controlling grazing | Score | Controlling illicit felling | Score | Controlling MFP collection | Score | Controlling encroa-chment | Score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quickness of results | 10 | Immediate effect | 10 | Long term effect | 5 | Immediate effect | 8 | Immediate effect | 8 | Immediate effect | 8 |
| Institutional capacity to implement | 5 | Requires employing fire watchers | 10 | Requires additional staff | 8 | Requires additional staff | 8 | Requires additional staff | 8 | Within the powers of the staff | 8 |
| Financial and economic viability | 5 | Viable | 8 | Viable | 8 | Not very good | 5 | Viable | 8 | Viable | 8 |
| Social and political acceptability | 5 | Acceptable | 10 | Not high | 7 | Difficult to implement | 5 | Not high | 5 | Low | 5 |
| Most widespread effect | 5 | Has widespread effect | 10 | Fairly effective | 7 | Fairly effective | 7 | Effective | 7 | Effective | 7 |

Table 3.7. Computations in alternative analysis for natural forests

| Criteria | Relative weight | Score | Weight * Score (Fire) | Score | Weight * Score (Grazing) | Score | Weight * Score (Illicit felling) | Score | Weight * Score (MFP) | Score | Weight * Score (Encroa-chment) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quickness of results | 10 | 10 | 100 | 5 | 50 | 8 | 80 | 8 | 80 | 8 | 80 |
| Institutional capacity to implement | 5 | 10 | 50 | 8 | 40 | 8 | 40 | 8 | 40 | 8 | 40 |
| Financial and economic viability | 5 | 8 | 40 | 8 | 40 | 5 | 25 | 8 | 40 | 8 | 40 |
| Social and political acceptability | 5 | 10 | 50 | 7 | 35 | 5 | 25 | 5 | 25 | 5 | 25 |
| Most widespread effect | 5 | 10 | 50 | 7 | 35 | 7 | 35 | 7 | 35 | 7 | 35 |
| Total Index of performance | | | 290 | | 200 | | 205 | | 220 | | 220 |

### 3.2.2. Plantations

Figure 3.10 shows the cause and effect analysis performed for the key problem of decreasing productivity levels of forest plantations. The problem is identified to be the result of poor genetic stock, low management inputs, soil erosion due to the relatively higher soil exposure in plantations, illicit felling and to some extent, fire. These deficiencies arise from poor technology, inadequate infrastructure and ineffective enforcement of regulations. Inadequate research programmes and deficient institutional capabilities could be contributing to the above situation in the wake of inadequate financial and technical resources. Low productivity of plantations puts higher pressure on homesteads as a timber source, results in increased imports due to shortage of raw materials. Poor condition of plantations also results in reduced environmental benefits. At the national level, this leads to loss of tree cover, loss of foreign exchange, lower profits and lower quality of life due to lower employment and natural disasters.

In the presence of adequate financial and technical resources, institutional capabilities are strengthened followed by good research programmes resulting in better technology, adequate infrastructure and effective enforcement of regulations. Good plantation technology with high management inputs and effective soil conservation brings in higher productivity. Control on illicit felling and fire help protect the resource. Improved productivity puts less pressure on homesteads for production of wood. Higher domestic

production implies fewer imports, more availability of raw materials and enhanced environmental benefits on account of the larger growing stock. These impacts are then carried over to the national level (Figure 3.11).

Plant improvement programme, provision of higher management inputs, soil conservation, control of illicit felling and fire form the different alternatives for improving productivity (Figure 3.11). The alternative analysis conducted is illustrated in Tables 3.8 and 3.9 for plantations. It turns out that several options are desirable. Providing high management inputs and controlling fire are preferable on account of the quickness of results. Plant improvement programme, although effective, has long gestation period.

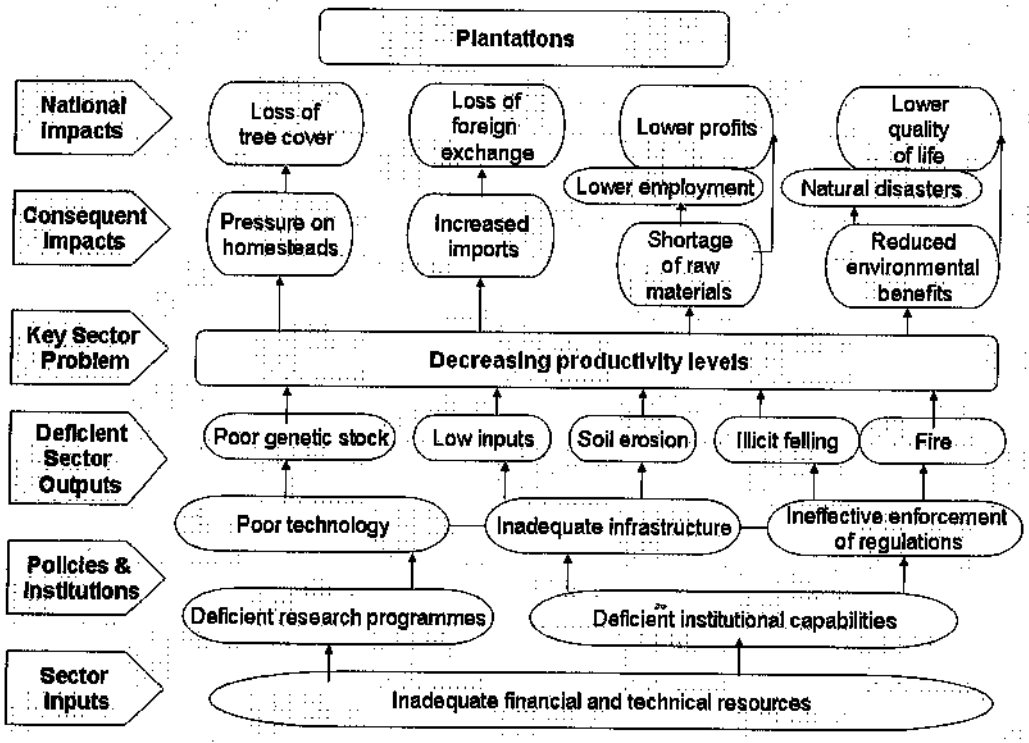



Figure 3.10. Key sector problem and cause and effect analysis for plantations

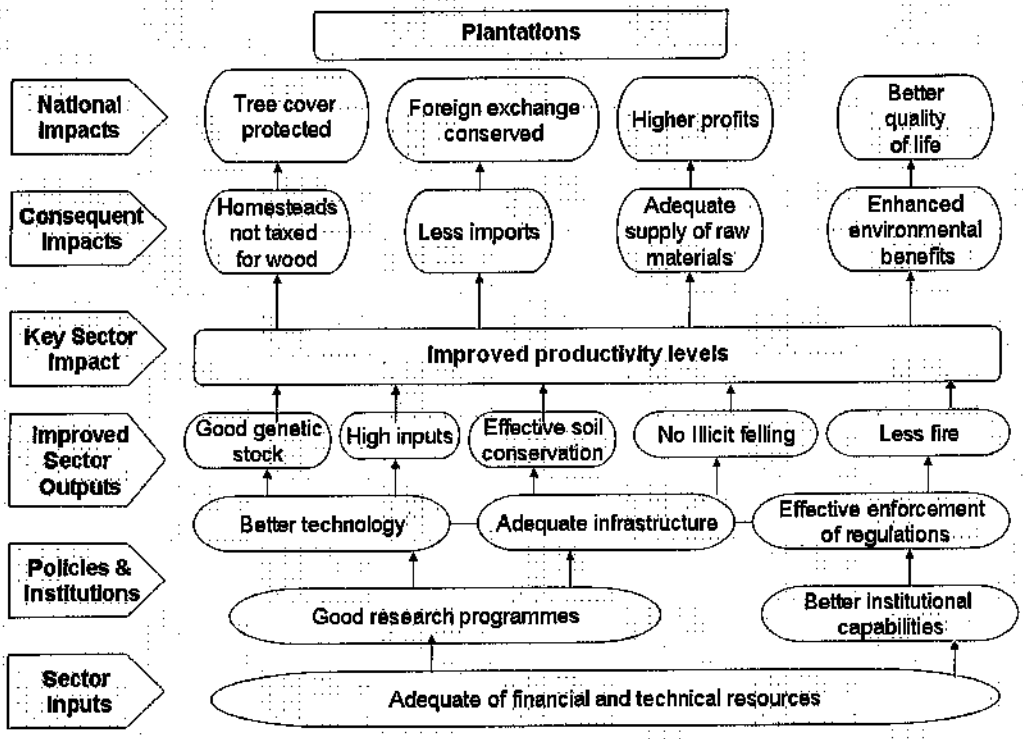



Figure 3.11. Objective tree for improvement of plantations

Table 3.8. Performing an alternative analysis for plantations

| Criteria | Relative weight | Plant improvement programme | Score | High inputs | Score | Effective soil conservation | Score | Controlling Illicit felling | Score | Controlling fire | Score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quickness of results | 10 | Long- term effect | 5 | Quick effect | 10 | Quick | 8 | Immediate effect | 8 | Immediate effect | 8 |
| Institutional capacity to implement | 5 | Good genetic stock purchasable | 10 | Requires additional resources | 8 | Requires additional resources | 8 | Requires additional staff | 8 | Requires employing fire watchers | 10 |
| Financial and economic viability | 5 | Viable | 8 | Viable | 8 | Not very good | 5 | Viable | 8 | Viable | 8 |
| Social and political acceptability | 5 | Acceptable | 10 | Not high | 7 | Difficult to implement | 5 | Not high | 5 | Acceptable | 5 |
| Most widespread effect | 5 | Has widespread effect | 10 | Effective | 7 | Effective | 7 | Effective | 7 | Has widespread effect | 10 |

Table 3.9. Computations in alternative analysis for plantations

| Criteria | Relative weight | Score | Weight * Score (Plant improvement) | Score | Weight * Score (High inputs) | Score | Weight * Score (Soil) | Score | Weight * Score (Illicit felling) | Score | Weight * Score (Fire control) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quickness of results | 10 | 5 | 50 | 10 | 100 | 8 | 80 | 8 | 80 | 8 | 80 |
| Institutional capacity to implement | 5 | 10 | 50 | 8 | 40 | 8 | 40 | 8 | 40 | 10 | 50 |
| Financial and economic viability | 5 | 8 | 40 | 8 | 40 | 5 | 25 | 8 | 40 | 8 | 40 |
| Social and political acceptability | 5 | 10 | 50 | 7 | 35 | 5 | 25 | 5 | 25 | 5 | 25 |
| Most widespread effect | 5 | 10 | 50 | 7 | 35 | 7 | 35 | 7 | 35 | 10 | 50 |
| Total Index of performance | | | 240 | | 250 | | 205 | | 220 | | 245 |

### 3.2.3. Industries

Figure 3.12 shows the cause and effect analysis performed for the key problem of decreasing outturn from industries. The immediate causes are identified as shortage of raw material, inferior processing technology employed, poor processing capacity, high input costs such as that of electricity/diesel, administrative snags such as annual renewal of license and several other operational difficulties. Low domestic production, inadequate funds of the entrepreneurs and ineffective regulations act as causes for the deteriorating situation. Deficient institutional capabilities and ineffective policies lead to the poor operational environment. Low industrial outturn gives lower returns for the entrepreneurs, results in increased imports, promotes unemployment and increased product costs. At the national level, this leads to economic recession, loss of foreign exchange, poverty and inflation.

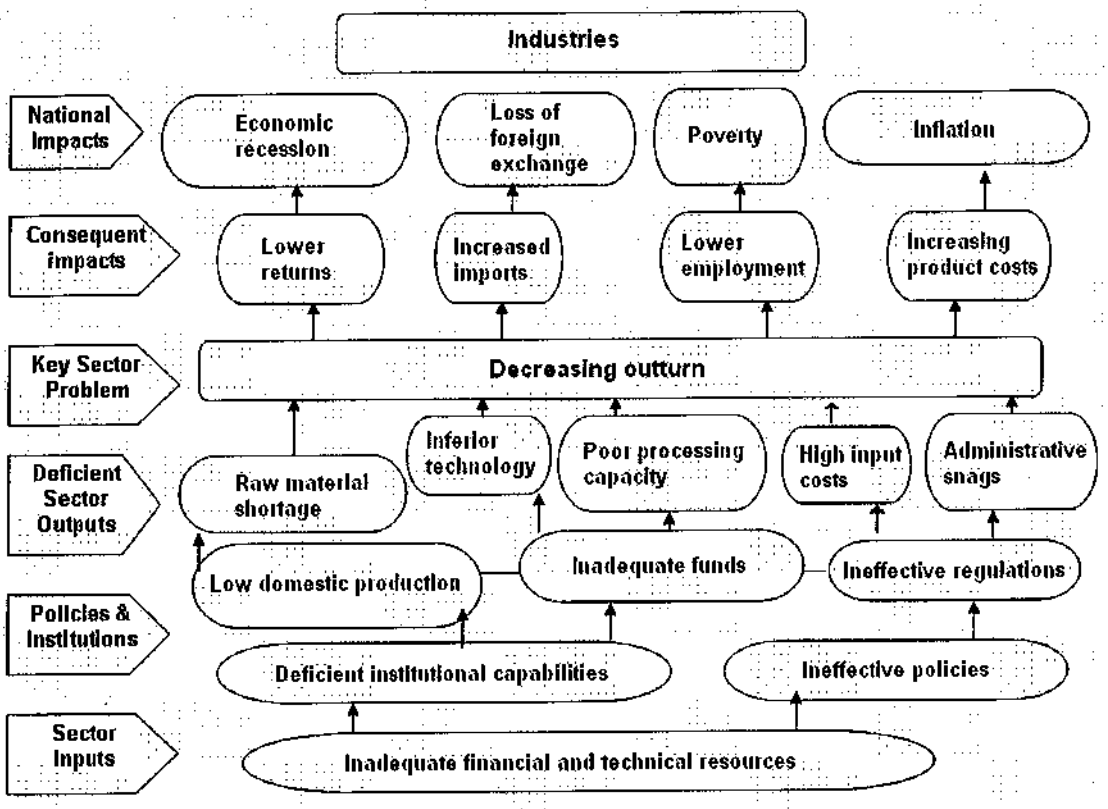



Figure 3.12. Key sector problem and cause and effect analysis for industries

In the presence of adequate financial and technical resources, institutional capabilities are strengthened. Coupled with good policies, this leads to higher domestic production of raw materials, and effective regulations. The resulting sector outputs are adequate raw materials, better processing technology, higher processing capacity, low input costs and absence of unwanted administrative controls. Increased outturn leads to higher returns, less imports, higher employment rates and decreasing product costs with consequent impacts at the national level (Figure 3.13).

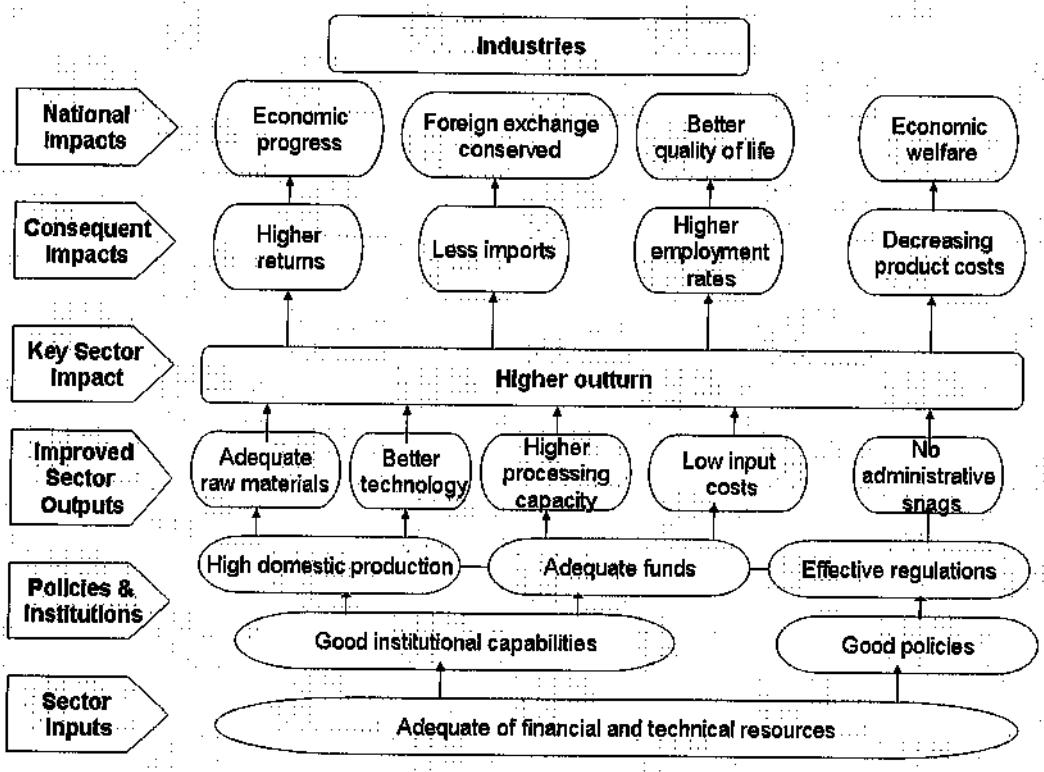



Figure 3.13. Objective tree for improvement of plantations

Increasing the plantation productivity, import of raw materials, enhancing processing capacity, reducing input costs and removing administrative snags are some of the options available (Figure 3.13). Alternative analysis conducted is depicted in Tables 3.10 and 3.11. Import of wood because of the quickness of the effect seems to be an effective strategy to tide over the shortage of raw materials and thus to increase the outturn from industries. Removing administrative snags will promote enthusiasm and confidence of the entrepreneurs. Increasing plantation productivity is a long-term strategy for enhancing domestic production. Reducing input costs like that of electricity and diesel charges, wages, among others may not be effective due to their inter-linkages with policy matters.

In the implementation of the project design process of ADB, there is a final step of setting performance targets and specifying monitoring mechanism with a statement of assumptions and risks. Since these tasks are highly location-specific, no attempt is made to describe them here. It may be noted that the scores used for the alternative analysis were just for the purpose of illustration. In actual, several people could be made to provide such scores and the decisions could be based on the average of such scores. It will then be a collective but informed opinion.

Table 3.10. Performing an alternative analysis for industries

| Criteria | Relative weight | Increasing productivity levels of plantations | Score | Import of raw materials | Score | Enhancing processing capacity | Score | Reducing input costs | Score | Removing administrative snags | Score |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quickness of results | 10 | Long-term solution | 5 | Very quick effect | 10 | Quick effect | 8 | Quick effect | 8 | Quick effect | 8 |
| Institutional capacity to implement | 5 | Ensured within the present setup | 10 | Possible within the present setup | 10 | Requires additional resources | 5 | Requires govt. subsidies | 5 | Requires Policy changes | 5 |
| Financial and economic viability | 5 | Requires additional input | 5 | Involves extra cost | 5 | Requires additional funds | 5 | Has problems | 5 | Viable | 8 |
| Social and political acceptability | 5 | Acceptable | 8 | Not high | 5 | Acceptable | 8 | No problems | 8 | Acceptable | 8 |
| Most widespread effect | 5 | Has widespread effect | 10 | Effective | 7 | Not very Effective | 5 | Very Effective | 10 | Has widespread effect | 10 |

Table 3.11. Computations in alternative analysis for industries

| Criteria | Relative weight | Score | Weight * Score (Productivity) | Score | Weight * Score (Import) | Score | Weight * Score (Capacity) | Score | Weight * Score (Input costs) | Score | Weight * Score (Admn. snags) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quickness of results | 10 | 5 | 50 | 10 | 100 | 8 | 80 | 8 | 80 | 8 | 80 |
| Institutional capacity to implement | 5 | 10 | 50 | 10 | 50 | 5 | 25 | 5 | 25 | 5 | 25 |
| Financial and economic viability | 5 | 5 | 25 | 5 | 25 | 5 | 25 | 3 | 15 | 8 | 40 |
| Social and political acceptability | 5 | 8 | 40 | 5 | 25 | 8 | 40 | 5 | 25 | 8 | 40 |
| Most widespread effect | 5 | 10 | 50 | 7 | 35 | 5 | 25 | 10 | 50 | 10 | 50 |
| Total Index of performance | | | 215 | | 235 | | 195 | | 195 | | 235 |

## 4. Supply and demand for forest products

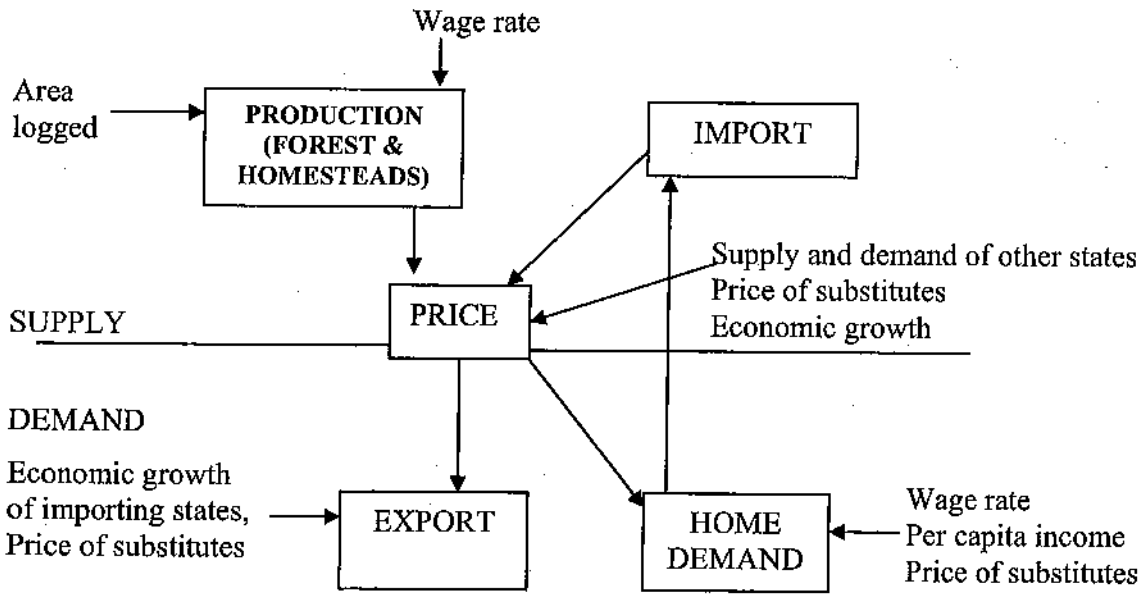
Krishnankutty (1990) and Krishnankutty *et al.* (2005) had assessed the wood balance situation in Kerala for the respective years and made some projections. However, the methods employed had not been based on a thorough econometric approach. Hence, attempts were made to develop an econometric model and make projections of demand and price of some forest products based on such a model.

### 4.1. Teakwood

As a first case, teakwood was considered. After some reflection, the following model was proposed for describing the supply-demand situation for teakwood in Kerala.

**Supply-Demand Model for teakwood in Kerala**

***Flow Chart***




***Model- functional form***

$$H_t = f(P_t, W_t, Yk_t, Sk_t, H_{t-\theta}) \quad (4.1)$$

$$X_t = f(P_t, Yw_t, X_{t-\theta}) \quad (4.2)$$

$$Qf_t = f(A_t, Qf_{t-\theta}) \quad (4.3)$$

$$Qh_t = f(P_t, W_t, Qh_{t-\theta}) \quad (4.4)$$

$$Qf_t + Qh_t = X_t + H_t - I_t \quad (4.5)$$

***Definition of variables***

$H_t$ = Domestic consumption of teakwood ($m^3$) or its proxy at time $t$
$X_t$ = Quantity of teakwood exported from Kerala at time $t$ ($m^3$)
$Qf_t$ = Quantity of teakwood supplied from forests at time $t$ ($m^3$)
$Qh_t$ = Quantity of teakwood supplied from homesteads and estates at time $t$ ($m^3$)
$I_t$ = Quantity of teakwood imported to Kerala at time $t$ ($m^3$)
$P_t$ = Price of teakwood in Kerala at time $t$ (Rs/$m^3$)
$A_t$ = Teak plantation area logged in Kerala at time $t$ (ha)
$Sk_t$ = Price of substitutes of teakwood in Kerala at time $t$ (Rs/unit)
$W_t$ = Government approved wage rate in Kerala at time $t$ (Rs/day)
$Yw_t$ = Per capita income of wood importing states at time $t$ (Rs/annum)
$Yk_t$ = Per capita income of Kerala at time $t$ (Rs/annum)
$\theta$ = Period of lag (year)

Time series data were gathered on the relevant variables from various sources such as Kerala Forest Department and Directorate of Economics and Statistics for the period 1980-81 to 2004-05. Data on import and export were obtained from check posts of the Kerala Forest Department. A few terminal missing values were replaced by their predicted values through time series analysis. Domestic consumption of teakwood was obtained indirectly as follows.

$$H_t = Qf_t + Qh_t + I_t - X_t \qquad (4.6)$$

Where

$H_t$ = Domestic consumption of teakwood ($m^3$) or its proxy at time $t$
$X_t$ = Quantity of teakwood exported from Kerala at time $t$ ($m^3$)
$Qf_t$ = Quantity of teakwood supplied from forests at time $t$ ($m^3$)
$Qh_t$ = Quantity of teakwood supplied from homesteads and estates at time $t$ ($m^3$)
$I_t$ = Quantity of teakwood imported to Kerala at time $t$ ($m^3$)

Quantity of teakwood supplied from homesteads and estates was found out from the cutting permits and transit passes issued by the Forest Department. However, there were doubts regarding whether this could be an underestimate of the true production from homesteads and estates. Comparison with a more realistic value from Krishnankutty *et al.* (2005) for the year 2000-01 indicated that the true value could be four times than the recorded. Hence, the whole series was multiplied by four to match with the true values. However, later, the scaling had to be upgraded to a factor of 10 instead of 4 due to the non-negativity constraints on consumption. Moreover, the data on production from homesteads were missing for the first 12 years from 1980-81. Graphs of data for the remaining 13 years against time did not show any trend and so the first 12 figures were replaced by the average of the remaining figures in the series.

Wage rate was taken as that of carpenter engaged for construction works in urban areas. Missing values in between the series were replaced through interpolation of the neighboring values. A few terminal missing values in the time series for wage rate and per capita income were substituted by the last available value for the particular variable.

All the economic variables were deflated by dividing them by the Wholesale Price Index (WPI) reported by the Ministry of Commerce and Industry in 2009 with base year as 1993-94.

Before proceeding with the modelling procedure described above, an analysis of the trend and periodicity was carried on production, price of timber and related variables over the past years, the results of which are reported below.

***Trend analysis on production and price of timber***

Production of teakwood from different sources in Kerala during 1980-2004 is depicted in Figure 4.1.

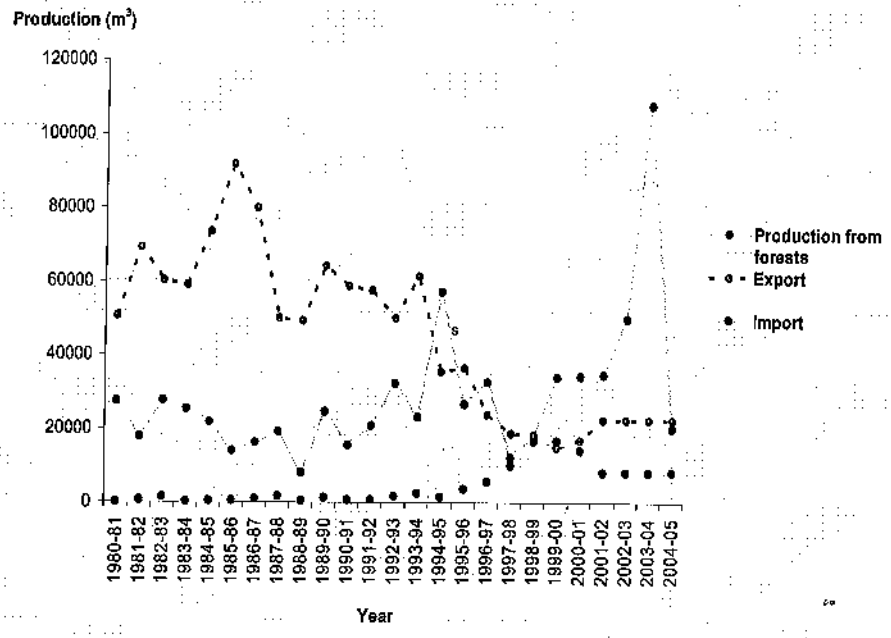



Figure 4.1. Production of teakwood from different sources in Kerala during 1980-2004

Supply of teakwood from forests for the first 10 years from 1980-81 has been more or less stable after which it showed an increasing trend although alternating over years. Similarly, quantity exported remained stable till 1990-91 which showed a drastically declining trend for the remaining period. Import of wood which was stable during 1980-81 to 1990-91 showed a very gradual increase for the remaining period.

The trends in deflated prices of different species of timber are shown in Figure 4.2. The real price of teak depicted increase from 1980 to 1997 after which there was a clear decline. Lowering real prices for teakwood could be taken as an indication of lowering demand for the same. However, the decreasing export and increasing import indicate efforts to adjust for the deficiency in supply. Some balancing was also occurring due to larger release of teakwood from the forests. In the case of other species, there was a

gradual increase in real price throughout but for the flattening or slight decline observed after 1997.

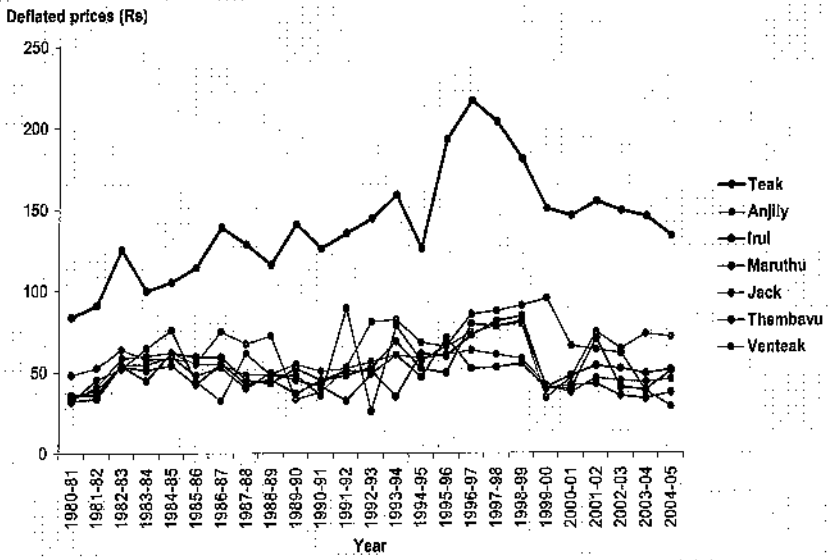



Figure 4.2. Real prices of teak and other timber during 1980-2004

Figure 4.3 shows the changes in per capita income of Kerala and neighbouring states during the period 1980-2004. There was a gradual decline in the deflated per capita income in Kerala. So was the case with that of Tamil Nadu and Karnataka. However, this need not reflect the true economic situation in these states because of the remittance from migrants abroad which is not fully accounted.

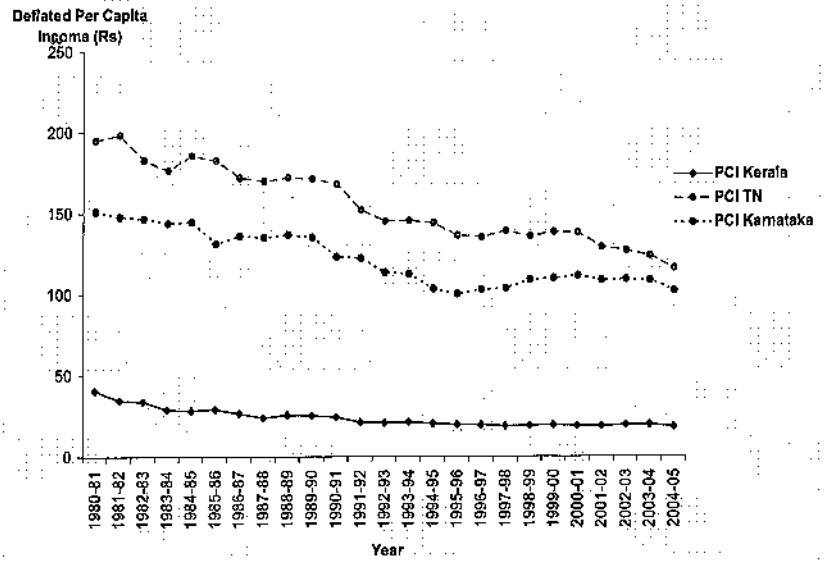



Figure 4.3. Deflated per capita income of Kerala, Tamil Nadu and Karnataka

Wages of urban carpenter was taken as a proxy to labour cost towards construction. As seen from Figure 4.4, there was an upward trend in the wage of carpenter during 1980-2004 although some long term cycle seemed to be operating on the series. One reason for the increasing trend in labour cost is the boom in construction activity coupled with shortage of skilled labour. Increase in the construction activity could lead to higher demand for timber. Figure 4.5 depicts the population of Kerala during 1980-2004 which showed an increasing trend during this period.


Figure 4.4. Deflated wage of urban carpenter in Kerala during1980-2004

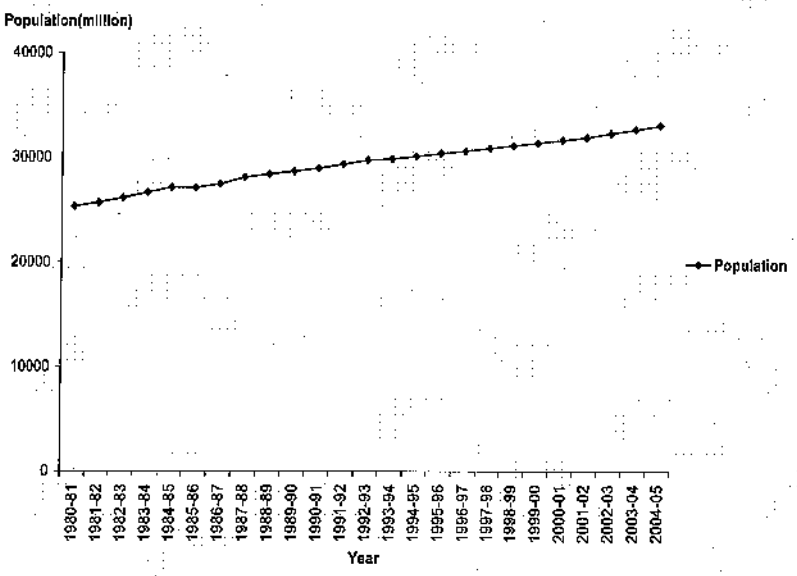



Figure 4.5. Population in Kerala during1980-2004

The WPI during 1980-2004 is shown in Figure 4.6. WPI was steadily increasing throughout the period.

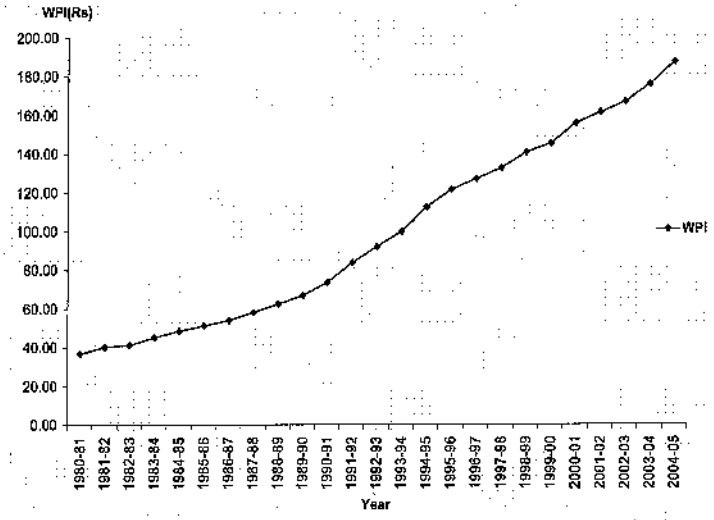



Figure 4.6. Wholesale Price Index during 1980-2004

The compound growth rate worked out for each series mentioned above are shown in Table 4.1.

Table 4.1. Compound annual growth rate timber price, production and related variables in Kerala

| Variable | Compound growth rate (%) |
|---|---|
| Teak production from forests | 3.2 |
| Teak export | -6.3 |
| Teak import | 1.74 |
| Teak price | 2.2 |
| Anjily price | 0.8 |
| Irul price | 0.9 |
| Maruthu price | -0.4 |
| Jack price | 1.1 |
| Thembavu price | 0.9 |
| Venteak price | -0.2 |
| PCI of Kerala | -2.8 |
| PCI of TamilNadu | -2.0 |
| PCI of Karnataka | -1.7 |
| Wages of urban carpenter | 2.6 |
| Population | 1.1 |
| Wholesale price index | 7.2 |

In short, the trend that has been emerging was that since 1990-91, there was enhanced supply of teakwood from forests coupled with larger import and less export showing the increasing domestic demand for teak. This resulted in larger real prices up to 1997 after

which there was a clear decline perhaps due to prohibitive costs and availability of substitute timbers. Since per capita income does not take into account the migrants's remittance, its values may not be indicative of fluctuations in demand for teak. Increases in the population and construction activity have contributed to increased consumption of teakwood.

***Periodicity in production and price of timber***

The periodicities in the time series data on teakwood production, price and related variables were examined using spectral analysis. Spectral analysis is concerned with the exploration of cyclical patterns of data. Spectral analysis of a series yields a description of that series in terms of the cycles of different periods or frequencies that generate the series. Spectral analysis is almost entirely model free. With this, an estimate of the spectrum over a range of frequencies can be obtained and periodic components in a noisy environment can be separated out. Spectral analysis is carried out in the frequency domain. It describes the variations in a series in terms of cycles of sines and cosines at different frequencies. Thus, the spectrum decomposes the variance into the components contributed by each frequency and in each series, thus, cycles of differing length can be identified. In the spectral analysis, the objective is to identify the predominant cycles.

In the case of univariate series, for all $t$, the series $X_t$ can be represented by

$$X_t = a_0^x + \sum_{K=1}^{q}(a_K^x \cos 2\pi f_K(t-1) + b_K^x \sin 2\pi f_K(t-1)) \qquad (4.7)$$

where $t=1, 2, ..., N$

$$a_0^x = \overline{X}, \qquad \overline{X} = \sum_{t=1}^{N} X_t / N$$

$$a_K^x = \frac{2}{N}[\sum_{t=1}^{N}(X_t \cos 2\pi f_K(t-1))]$$

$$b_K^x = \frac{2}{N}[\sum_{t=1}^{N}(X_t \sin 2\pi f_K(t-1))]$$

$$f_K = \frac{K}{N}$$

$q = N/2$, if $N$ is even

$= (N-1)/2$, if $N$ is odd

Frequency, $f_K = K/N, K = 1,..., q$, Period, $1/f_K = N/K, K = 1,..., q$

Fourier cosine coefficient, $a_K^x, K = 1,..., q$

Fourier sine coefficient, $b_K^x = (a_K^x - ib_K^x)(a_K^x + ib_K^x)$

Periodogram, $I_K^x = [(a_K^x)^2 + (b_K^x)^2]N/2, K = 1,..., q$

Spectral density estimate, $s_K^x = \sum_{j=-p}^{p} w_j I_{K+j}^x$, where $2p+1=m$ (number of spans)

and $I_{-K}^x = I_K^x, K = 1,..., q$, $I_0^x = I_1^x, I_K^x = I^x{}_{N+1-K}$ for $K>q$

$w_{-p}, w_{-p+1}, ..., w_0, w_1, ... w_p$ are the periodogram weights defined by different data windows.

The periodogram or spectral plot is the principal focus of this analysis. A spectral plot is a graphical picture of how much of a variables' variance is explained at each frequency. The frequency of a variable is the number of times a sinusoid oscillates per unit of time, or the number of times a wave completes a full cycle per unit of time. The reciprocal of this is the period in the data, which is, how many units of time it takes for a specific wave to oscillate once, or complete a full cycle. Instead of analyzing the variation from one time point to the next, it analyzes the variation of the series as a whole into periodic components of different frequencies. Smooth series have stronger periodic components at low frequencies while random variation spreads the component strength over all frequencies. Series that include missing data cannot be analyzed with this procedure. Spectral plots procedure can be used to identify any periodicity in the data.

The periodogram of a series shows its energy or variance at each of the Fourier frequencies. In order to determine this value, the cyclic pattern in the series is expressed at each frequency as a weighted sum of a sine term and a cosine term having that frequency. The value plotted on the periodogram, for any given frequency, is the sum of the squares of the two weights (sine and cosine) at that frequency. Spectral decomposition is a re-expression of the original series as coefficients of these sines and cosines at the Fourier frequencies. We can apply various smoothing transformations to the periodogram terms to reduce their variance. Smoothing transformations for a periodogram are called windows. We can define a window by choosing the shape and the number of terms (or span) of the group of neighboring points that are to be averaged together. The smoothed periodogram is called the spectral density estimate. The spectral density was seen to be more useful than the periodogram for uncovering the underlying structure, because the spectral density smoothes out the fluctuations that are caused by the non-periodic component of the data.

Cross spectral analysis allows one to determine the relationship between two time series as a function of frequency. Cross-spectral analysis is the bivariate extension of spectral analysis and relates to pairs of equal frequencies. It measures the strength of the statistical association of waves of equal cycles corresponding to any two economic variables. It is employed to measure the extent to which the series are inter-related and to determine the type of lead-lag structure involved. The interpretation of the cross spectrum is based on two measures: coherence and phase angle. The coherence measures the square of the correlation coefficient between the corresponding frequency components of the two series. The coherence statistic (which applies to any two waves of equal cycles) can take a value between 0 and 1 and is analogous to the R-squared of regression. Coherency value of unity indicates complete dependence of one series on the other, whereas a coherency value of zero refers to no dependence of one series on the other. It measures the proportion of variance in one frequency as explained by the other. The second measure phase angle indicates the lead-lag relation between the two series. If it is positive, $X(t)$ leads $Y(t)$; if negative, $Y(t)$ leads $X(t)$. The phase angle is meaningful only at frequencies which have large coherence values.

In the case of bivariate series, for $X_t$ and $Y_t$

$$X_t = a_0^x + \sum_{K=1}^{q}(a_K^x \cos 2\pi f_K t + b_K^x \sin 2\pi f_K t) \quad t = 1,\ldots,N \tag{4.8}$$

$$Y_t = a_0^y + \sum_{K=1}^{q}(a_K^y \cos 2\pi f_K t + b_K^y \sin 2\pi f_K t) \tag{4.9}$$

Cross-Periodogram of $X$ and $Y$,

$$I_K^{xy} = \frac{N}{2}(a_K^x - ib_K^x)(a_K^y + ib_K^y) \tag{4.10}$$

$$= \frac{N}{2}\{(a_K^x a_K^y + b_K^x b_K^y) + i(a_K^x b_K^y - b_K^x a_K^y)\}$$

Real$(I_K^{xy})$, $(RC)_K = \frac{N}{2}(a_K^x a_K^y + b_K^x b_K^y)$

Imaginary$(I_K^{xy})$, $(IC)_K = \frac{N}{2}(a_K^x b_K^y - b_K^x a_K^y)$

Co-spectral density estimate, $C_K = \sum_{j=-p}^{p} w_j (RC)_{K+j}$

Quadrature spectrum estimate, $Q_K = \sum_{j=-p}^{p} w_j (IC)_{K+j}$

Cross-amplitude values, $A_K = (Q_K^2 + C_K^2)^{1/2}$

Squared coherency values, $K_K = \frac{A_K^2}{s_K^x s_K^y}$

Gain values, $G_K = \{A_K / s_K^x$ (gain of $Y_t$ over $X_t$ at $f_K$)

$= A_K / s_K^y$ (gain of $X_t$ over $Y_t$ at $f_K$)

Phase spectrum estimate, $\psi_K = \tan^{-1}(Q_K / C_K)$ if $Q_K>0$, $C_K>0$, $Q_K<0$, $C_K>0$

$= \tan^{-1}(Q_K / C_K) + \pi$ if $Q_K>0, C_K<0$

$= \tan^{-1}(Q_K / C_K) - \pi$ if $Q_K<0, C_K<0$

SPECTRA procedure of SPSS was used to perform the spectral analysis. The series to be analyzed should be stationary and any non-zero mean should be subtracted out from the series which was achieved through first order differencing and specifying the CENTER option. The option WINDOW specifies a spectral window to use when the periodogram is smoothed to obtain the spectral density estimate. In the present case, *Tukey-Hamming* window with a span of 5 was used for smoothing. For Tukey-Hamming window, the weights are given by

$$W_K = 0.54D_p(2\pi f_k) + 0.23D_p(2\pi f_k + \frac{\pi}{p}) + 0.23D_p(2\pi f_k - \frac{\pi}{p}) \text{ for } k=0,\ldots,p.$$

where, $p$ is the integer part of the number of spans divided by 2

The Dirichlet kernel, $D_q(\theta) = 2q+1$, $\theta = 0,\pm 2\pi,\pm 4\pi,\ldots$

$$= \frac{\sin((2q+1)\theta/2)}{\sin(\theta/2)} \quad \text{otherwise}$$

where $q$ is any positive real number.

For the present case, the main purpose of the spectral analysis was to find cyclical behaviour if any in the variables teak production, export, import and the price of teak and substitute species and also to identify whether there exist any co-movements between teak price and the remaining variables. Substitute price was obtained by taking the average of the price of substitute species such as anjily, irul, maruthu, jack, thembavu and venteak. The results of the analysis are depicted below (Figures 4.7 to 4.11).

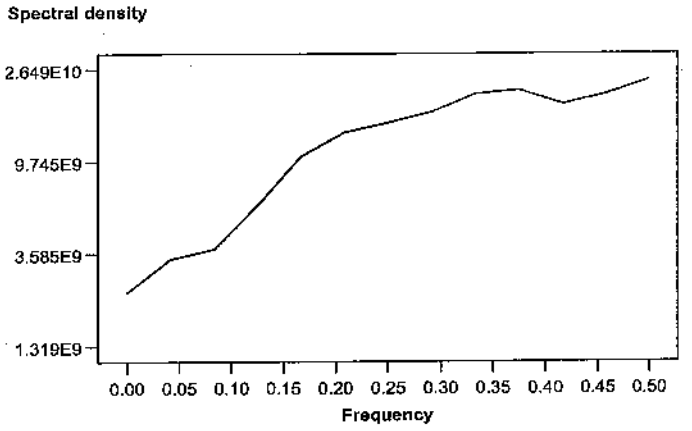



Figure 4.7. Spectral density for production of teakwood from forests

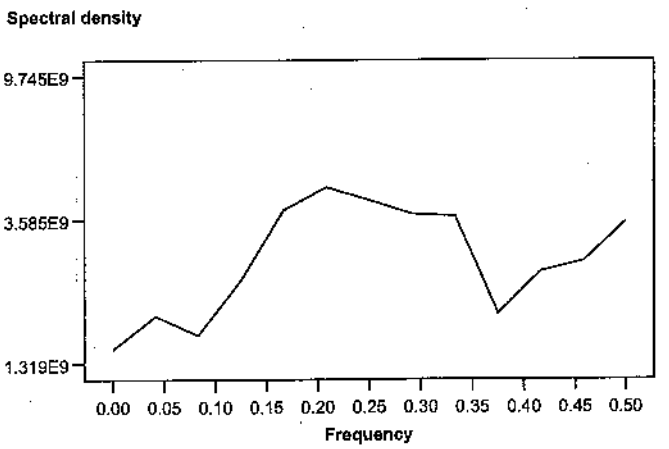



Figure 4.8. Spectral density for export of teakwood

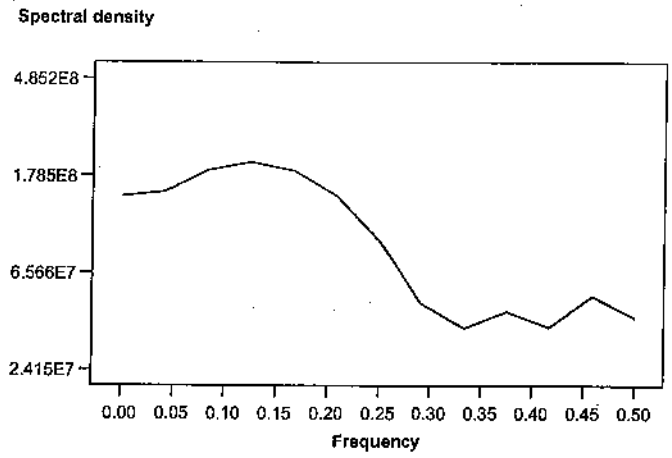



Figure 4.9. Spectral density for import of teakwood

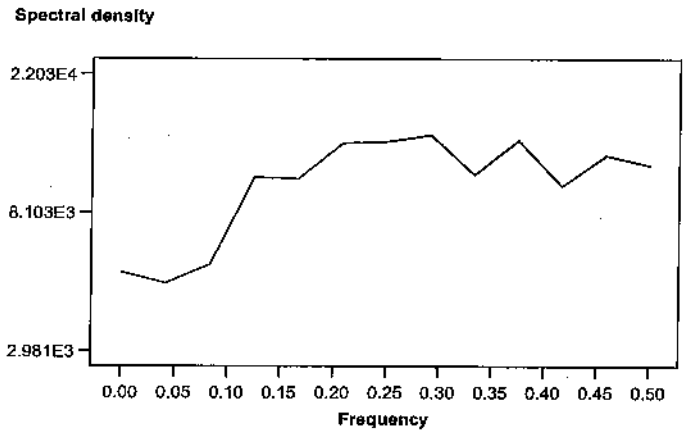



Figure 4.10. Spectral density for teak price

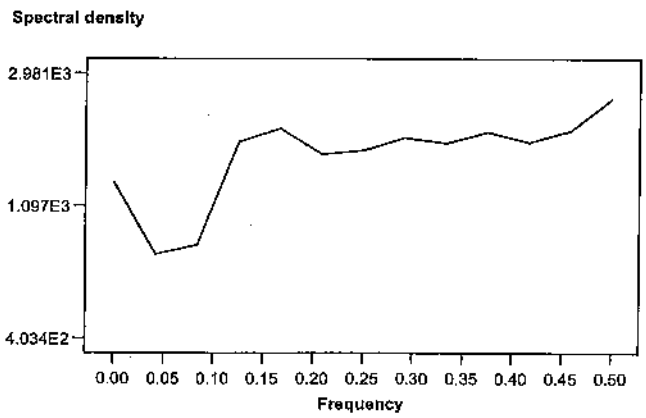



Figure 4.11. Spectral density for price of substitute timbers

The results of spectral analysis show that production of teakwood from forest has no significant peaks and hence there is no cyclical pattern. For the quantity exported, a peak was suggestive corresponding to the frequency 0.20 i.e., there was a cycle with period of five years. But in the case of quantity imported there were no significant cycles. The spectral analysis of teak price revealed peaks around the frequency of 0.30 i.e., a cycle of length around three years. Since there is a noticeable peak at the frequency 0.175, roughly, a five year cycle is observed in the case of substitute price. On the whole, some market adjustment mechanism seems to be operating with a cycle of three to five years.

Cross-spectral analysis performed gave the following results (Figures 4.12 to 4.15 and Tables 4.2 to 4.5).

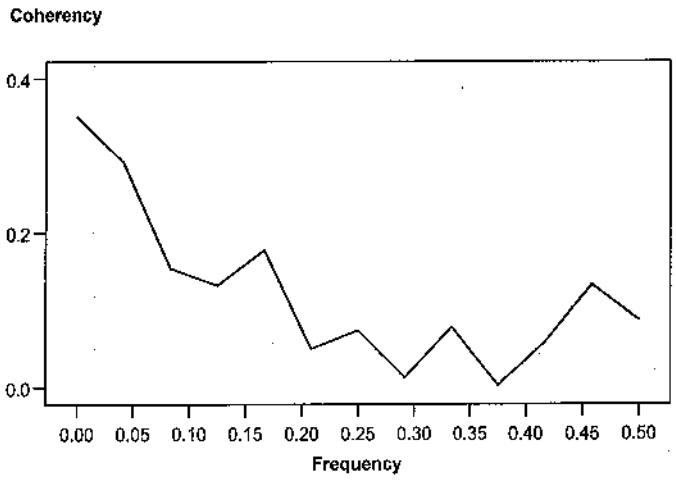



Figure 4.12. Coherency of teak production from forest and price

Table 4.2. Summary of cross-spectral analysis statistics for production from forests and teak price

| Frequency | Period | Coherency | Phase value |
|---|---|---|---|
| 0.21 | 4.80 | 0.05 | -1.35 |
| 0.25 | 4.00 | 0.07 | -1.74 |
| 0.29 | 3.40 | 0.01 | -1.87 |
| 0.33 | 3.00 | 0.08 | -0.22 |
| 0.37 | 2.67 | 0.002 | 0.17 |

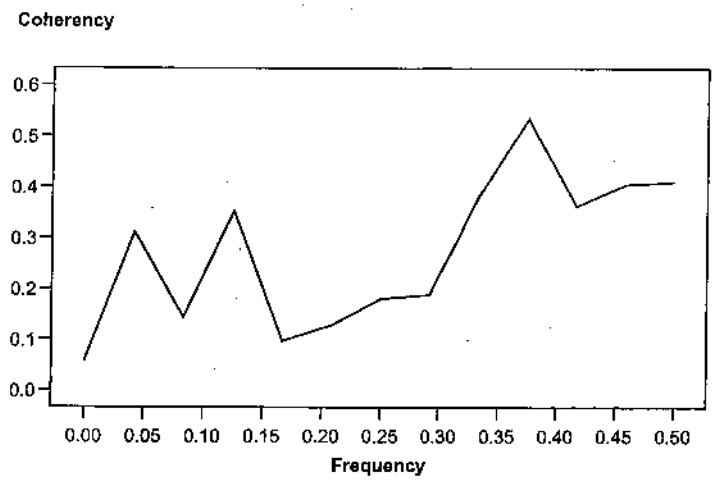



Figure 4.13. Coherency of teak price and export

Table 4.3. Summary of cross-spectral analysis statistics
For teak export and price

| Frequency | Period | Coherency | Phase value |
|---|---|---|---|
| 0.21 | 4.80 | 0.13 | 1.15 |
| 0.25 | 4.00 | 0.18 | 0.77 |
| 0.29 | 3.40 | 0.19 | 0.86 |
| 0.33 | 3.00 | 0.38 | 0.40 |
| 0.37 | 2.67 | 0.53 | 0.44 |

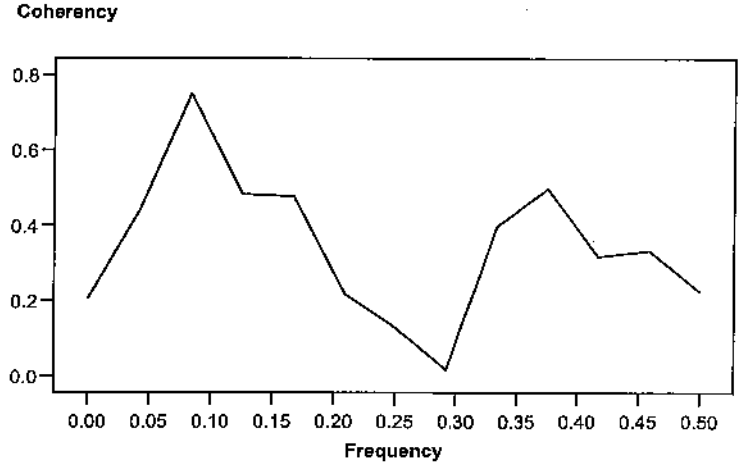



Figure 4.14. Coherency of teak price and import

Table 4.4. Summary of cross-spectral analysis statistics for import and price of teak

| Frequency | Period | Coherency | Phase value |
|---|---|---|---|
| 0.21 | 4.80 | 0.22 | -2.14 |
| 0.25 | 4.00 | 0.13 | -2.25 |
| 0.29 | 3.40 | 0.02 | 0.04 |
| 0.33 | 3.00 | 0.40 | 0.37 |
| 0.37 | 2.67 | 0.50 | -0.003 |

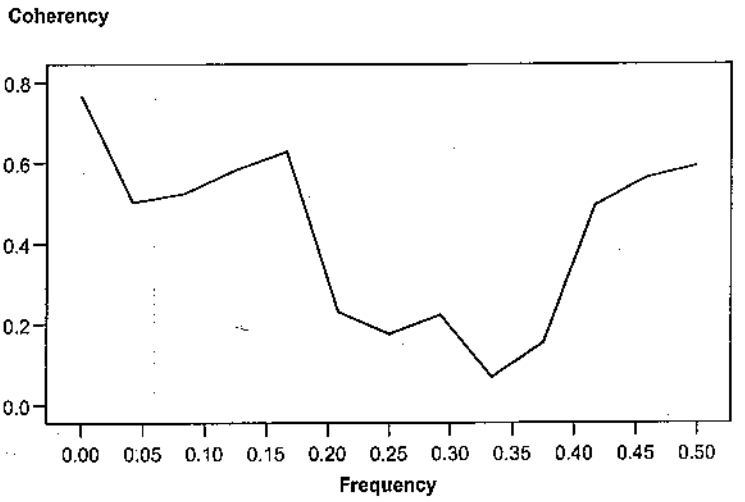



Figure 4.15. Coherency of teak price and substitute price

Table 4.5. Summary of cross-spectral analysis statistics for teak price and substitute price

| Frequency | Period | Coherency | Phase value |
|---|---|---|---|
| 0.21 | 4.80 | 0.23 | -1.03 |
| 0.25 | 4.00 | 0.17 | -0.86 |
| 0.29 | 3.40 | 0.22 | -0.95 |
| 0.33 | 3.00 | 0.07 | -0.31 |
| 0.37 | 2.67 | 0.15 | -0.10 |

There were no common cycles observed between teak production and price. Moreover, coherency for teak price and production was very low. For teak price and export the coherency was 0.53 and corresponding phase value is 0.44. The positive phase value indicates that export leads teak price. In other words, teak price is influenced by changes happening in export. In the case of import and teak price the phase value was -0.003 which shows that domestic teak price is inducing import. The highest coherency value for teak price and substitute price was 0.23 for a common cycle of five years. The phase value of -1.03 between the series shows that teak price was leading substitute price.

***Future trends through the supply-demand model for teakwood***

Each equation in the overall model (Equations 4.1 to 4.4) was refined based on a preliminary regression using step-wise method for elimination of unwanted variables but the results were modified by causative arguments when applicable. For example, production from forests was found not affected by any variable in the candidate set and hence the previous year's production was forced in, in the equation. For any particular equation, variables other than those listed in Equations 4.1 to 4.4 were also used as candidate regressors in the step-wise regression procedure.

The refined set of equations were brought to the framework of a simultaneous equations model and the parameters were estimated through three-stage least squares. PROC SYSLIN of SAS was used for the estimation of parameters. Fitting of Equations 4.1 to 4.4 or its alternative forms using regressors selected based on step-wise regression however did not yield good results in the sense that predicted values of price and demand were far from actual values. Hence, the following consolidated model form was adopted for further work after some trial and error.

Demand: $H_t = f(P_t, Pl_{t-1}, Yr_{t-1})$
Supply : $H_t = f(P_{t-1}, H_{t-1})$

Where $H_t$ = Consumption of teakwood ($m^3$) in Kerala at time $t$
$P_t$ = Price of teakwood in Kerala at time $t$ (Rs/$m^3$)
$Pl_{t-1}$ = Population of Kerala at time $t$-1
$Yr_{t-1}$ = Per capita income of Karnataka (Rs) at time $t$-1
$P_{t-1}$ = Price of teakwood in Kerala (Rs/$m^3$) at time $t$-1

Consumption ($H_t$) and teak price ($P_t$) were taken as endogenous variables. The intercept terms were excluded from the equations. As indicated earlier, the parameters were estimated using three-stage least squares executed through PROC SYSLIN of SAS. The results of the model fitting are given below (Table 4.6).

Table 4.6. Estimates of parameters of the supply-demand model obtained using three-stage least squares

| Dependent variable | Variable | Parameter estimate | Standard error |
|---|---|---|---|
| Demand : $H_t$ | $P_t$ | -412.893 | 197.219 |
| | $Pl_{t-1}$ | 8.947 | 1.577 |
| | $Yr_{t-1}$ | -980.145 | 177.395 |
| Supply : $H_t$ | $P_{t-1}$ | 308.703 | 71.732 |
| | $H_{t-1}$ | 0.489 | 0.115 |

The system weighted $R^2$ was 0.92 (92%). As seen from Table 4.6, the demand of teakwood in Kerala is highly influenced by the current price of teak, lagged population and lagged per capita income of Karnataka. Similarly, the supply of teakwood is found to be influenced by lagged values of consumption and price of teakwood. The reduced form parameter estimates are given in Table 4.7.

Table 4.7. The reduced form parameter estimates

| | $Pl_{t-1}$ | $Yr_{t-1}$ | $P_{t-1}$ | $H_{t-1}$ |
|---|---|---|---|---|
| $P_t$ | 0.0217 | -2.3738 | -0.7477 | -0.0012 |
| $H_t$ | 0 | 0 | 308.7031 | 0.4888 |

The reduced form coefficients can be used for the projection of teak demand and teak prices. Wherever required, the values of predictor variables required for projection of demand and price were obtained using the compound growth rate for each variable. The projected values are given below (Table 4.8).

Table 4.8. Projected teak demand and price

| Year | Teak price ($Rs/m^3$) | Teak demand ($m^3$) |
|---|---|---|
| 2004-05 | 25,494 | 129,927 |
| 2005-06 | 42,877 | 105,521 |
| 2006-07 | 19,537 | 119,243 |
| 2007-08 | 20,340 | 119,285 |
| 2008-09 | 20,280 | 122,911 |
| 2009-10 | 20,428 | 125,605 |
| 2010-11 | 20,513 | 128,544 |

Comparison with the actual values available for the year 2004-05 indicated that the deviations were of the order 1.83 per cent for teak price and 11.42 per cent for teak demand from the actual values of 25,036 $Rs/m^3$ and 116,609 $m^3$ for teak price and teak demand respectively.

Figures 4.16. and 4.17 show the future trends for price and demand graphically. The figures show a generally increasing trend for both teak prices and demand beyond 2004-05, but for the yearly alternating fluctuations in both the cases.

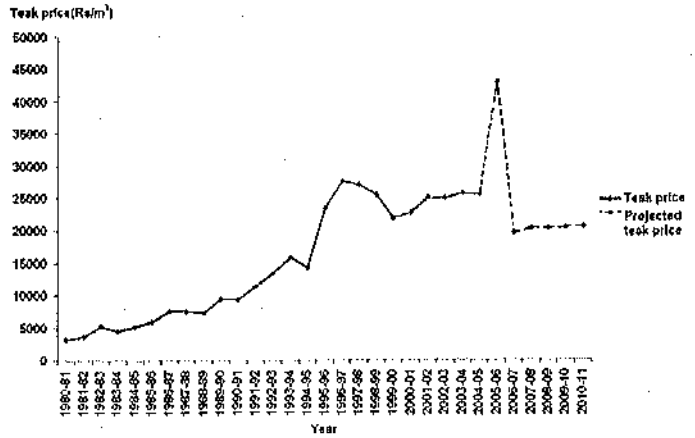



Figure 4.16. Projected teak price

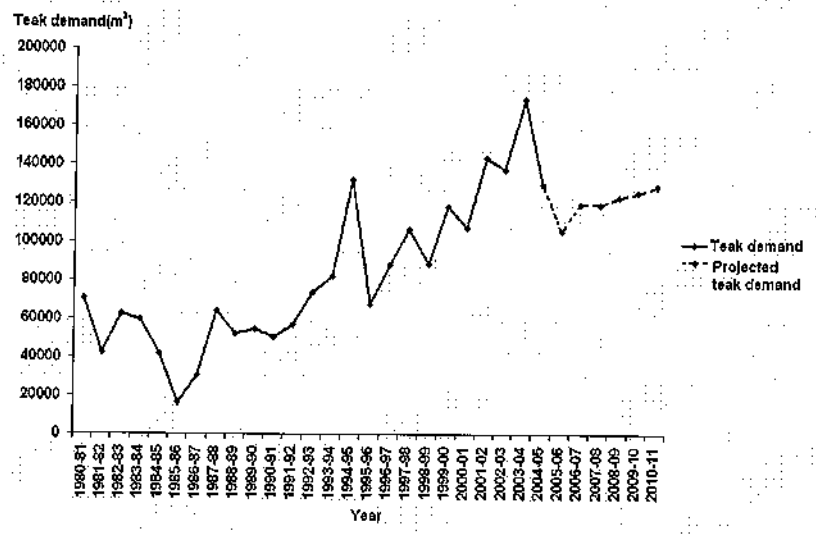



Figure 4.17. Projected demand for teakwood

It has been observed that other than the variables considered in the study, many other variables related to residential building construction, construction of office buildings, and fixed capital formation could affect the demand and price of timber products but such detailed modeling attempts would call for new studies.

## 4.2. Pulpwood

Hindustan Newsprint Ltd. (HNL) is the only processing unit for pulpwood in the State of Kerala. Hence, all data related to utilization of pulpwood were obtained from that firm. The time series data gathered consisted of the following.

(i) Annual supply of different kinds of raw material from government and other sources including KFDC for the period from 1982-83 to 2008-09.
(ii) Consumption of raw materials for the period from 1983-84 to 2008-09.
(iii) Production of newsprint from the year 1983-84 to 2008-09.

Supply refers to the material received during the extraction season 1st September to 31st May in each year and production and consumption figures are for the corresponding financial year. From 1983-84 to 1999-2000, the forest raw material figures were in Bone Dry Metric Tonne (BDMT) i.e., in 0 per cent moisture content basis. From 2000-2001 onwards figures were in net weight. The net weight figures were converted to dry weight by multiplying with 0.65. The supply figures except that for bamboo were in 50 per cent moisture content, which were converted to dry weight by multiplying with 0.50. The net weight figures for bamboo were converted to dry weight by multiplying with 0.65.

***Pattern of consumption of pulpwood and newsprint production***

The pattern of total consumption of pulpwood and corresponding production of newsprint from HNL for the period 1983-84 to 2008-09 is depicted in Figure 4.18. There was a

gradual increase in the consumption of pulpwood over the years which naturally reflected on the production of newsprint as well. At any time of the period under reference, the industry was facing a lag except during 1996-97 when a dip could be seen.


Figure 4.18. Total consumption of pulpwood and newsprint production

HNL uses different types of raw material such as wood, bamboo, reed and waste paper. The wood consists mainly of eucalyptus, acacia and mangium. Figure 4.19 allows us to see the contribution of each type of raw material to the total consumption in terms of percentage over time. This chart thus illustrates the annual change in the consumption pattern in respect of different types of raw material.

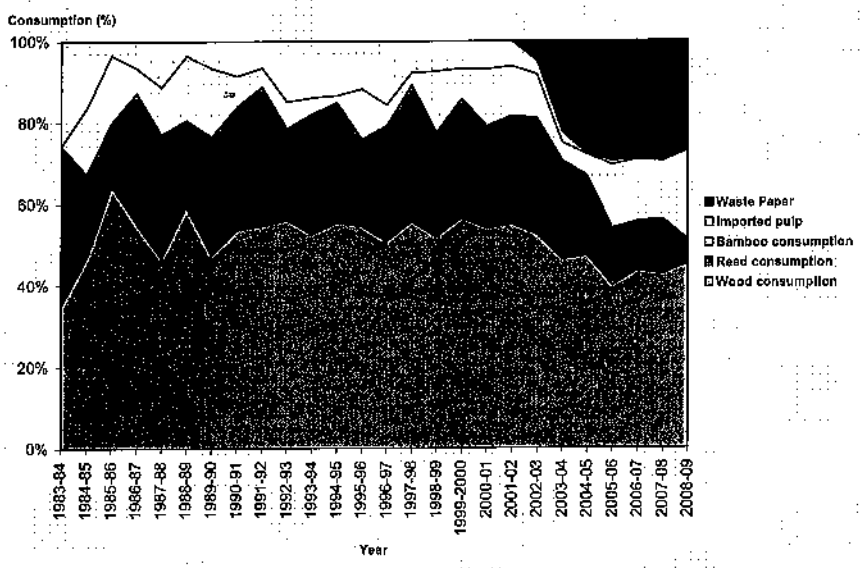



Figure 4.19. Consumption of different types of raw materials

Nearly 40 to 50 per cent of the total consumption consisted of wood. The next important material was reed but over the years, the percentage contribution came down drastically. Instead, bamboo was getting increasingly utilized. The use of imported pulp, although was prevailing in the earlier period, came down to almost nil by 2003. Since that period, waste paper was getting increasingly used reaching to almost 25 per cent of the total consumption by 2008.

Figure 4.20 to 4.21 give a more detailed pattern with respect to raw material supply from government sources. The wood supply from 1986-87 to 1991-92 from government sources, including eucalyptus, acacia, mangium and other woods matched with the consumption but in the later years, there was a gap (Figure 4.20).


Figure 4.20. Supply and consumption of pulpwood

Figure 4.21 shows the pattern of consumption of reed which maintained an almost stable level. During the period 1992-94, there was an excess supply of reed which went to the factory's buffer stock for the later years.

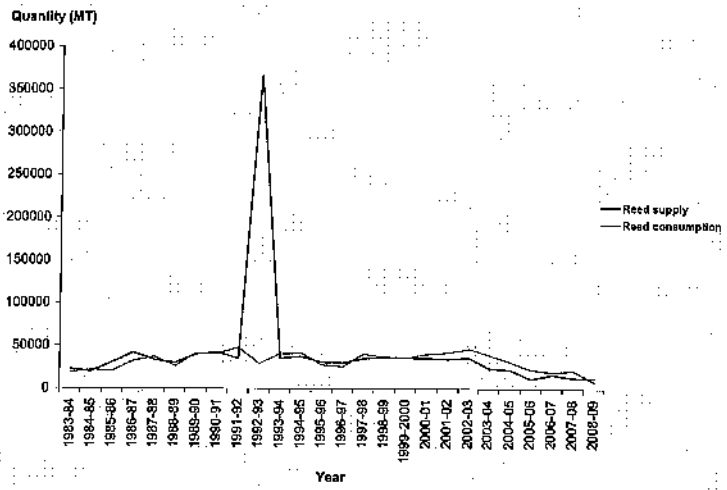



Figure 4.21. Supply and consumption of reed

Figure 4.22 depicts the mode of consumption and supply of bamboo. There was no supply of bamboo from government sources till 1999-2000 and the requirement had to be met by procurement from private sources during that period.

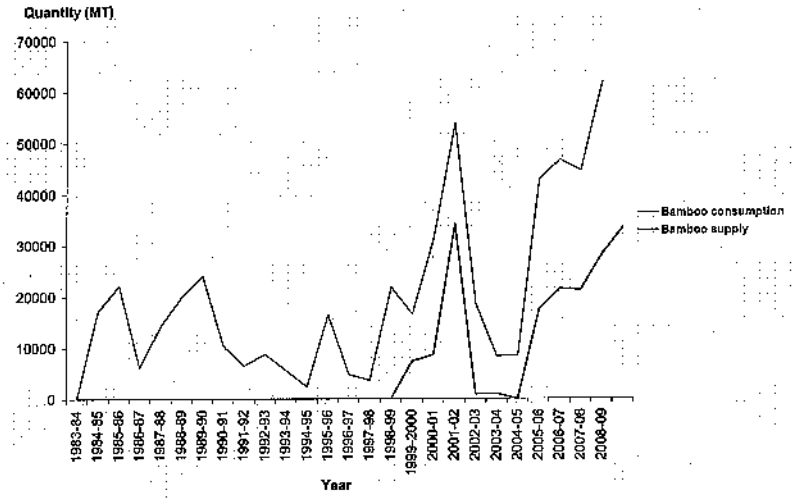



Figure 4.22. Supply and consumption of bamboo

***Forecasting of pulpwood consumption in Kerala***

For the present study, the consumption data for the period 1983-84 to 2008-09 were used. Forecasting of pulpwood consumption was carried out using Autoregressive Integrated Moving Average (ARIMA) model introduced by Box and Jenkins in 1960s. There are three basic components to an ARIMA model: autoregression (AR), differencing or integration (I), and moving average (MA). This procedure consists of three steps which are identification, estimation, and diagnosis. An ARIMA model is typically expressed as ARIMA ($p$, $d$, $q$) where $p$ is the order of autoregression, $d$ is the order of differencing (or integration), and $q$ is the order of moving average involved. Given a time series $\{Y_t = 1 \le t \le n\}$, mathematically, ARIMA model is written as

$$(1-B)^d Y_t = \mu + \frac{\theta(B)}{\phi(B)} a_t$$

where $t$ indexes time

$\mu$ is the mean term

$B$ is the backshift operator; that is, $BX_t = X_{t-1}$

$\phi(B)$ is the autoregressive operator, represented as a polynomial in the back shift operator: $\phi(B) = 1 - \phi_1 B - ... - \phi_p B^p$

$\theta(B)$ is the moving-average operator, represented as a polynomial in the back shift operator: $\theta(B) = 1 - \theta_1 B - ... - \theta_p B^p$

$a_t$ is the independent disturbance, also called the random error.

To determine the order of differencing $d$, the time series must be checked for nonstationarity. If nonstationarity is indicated, differencing or other transformations must be performed prior to further analysis. The required order of differencing determines $d$. To determine the AR and MA orders $p$ and $q$, inspection of the Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) of the series (or differenced series, if called for) is performed. It can be shown that, in theory, the number of significant ACF spikes at lags greater than zero equals the order of the moving average component, $q$. In a similar way, the number of significant PACF spikes at lag orders greater than zero indicates the order of the autoregressive component, $p$. Model comparisons are usually based on Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC).

The analysis was carried out using SPSSPC software. Following the above methods, ARIMA (2, 1, 0) was identified as the most suitable model. Statistical significance of the estimated coefficients was tested by using $t$-test. The estimated parameters for the model are given in Table 4.9.

Table 4.9. Estimated parameters of the model

| Parameters | | Estimates | Std Error | $t$ | P |
|---|---|---|---|---|---|
| Non-Seasonal Lags | AR1 | -0.425 | 0.217 | -1.957 | 0.063 |
| | AR2 | -0.457* | 0.185 | -2.463 | 0.022 |
| Constant | | 3218.403 | 2191.948 | 1.468 | 0.156 |

*Significant at P= 0.05

The adequacy of the ARIMA (2, 1, 0) model was checked using the plots of ACF and PACF of the error series created by ARIMA. No correlations exceed the 95 per cent confidence limit and also the Box-Ljung statistic for the ACF function was not statistically significant at any lag.

The projections made for the six years after 2008-09 showed further increase in total consumption of raw materials in HNL (Figure 4.23). This should happen provided the general production/processing environment does not undergo any drastic changes. However, this was not the case as the discussion with the Management Unit of the factory revealed that the unit is currently in a production crisis due to competition from other newsprint manufacturing units in the country. Earlier there was a restriction that the newsprint consumers within the State have to buy the newsprint from HNL. With the removal of that restriction, the buyers got a wide choice. The high production cost of HNL was preventing them from lowering the price of their products. With the result, the products were remaining in the factory lying unsold. In turn, the unit was unable to utilize the raw material that was piling up. Currently, an intervention from the Government is called for.

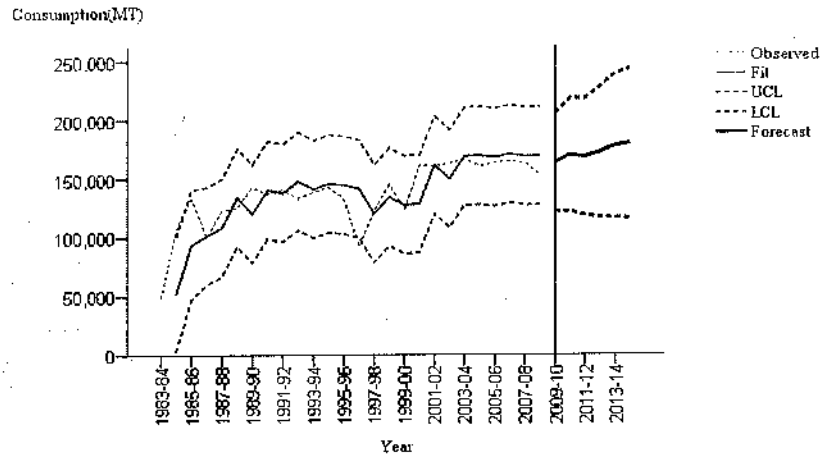



Figure 4.23. Predicted consumption figures for HNL based on time series analysis

***Forecasting of newsprint production from HNL***

In this case, production data for the period 1983-84 to 2008-09 were used. Forecasts were generated using ARIMA model as described earlier. The analysis was carried out using SPSSPC software. Here also ARIMA (2, 1, 0) was identified as the most suitable model. Statistical significance of the estimated coefficients was tested by using *t*-test. The estimated parameters for the model are given in Table 4.10.

Table 4.10. Estimated parameters of the model

| Parameters | | Estimates | Std Error | *t* | P |
|---|---|---|---|---|---|
| Non-Seasonal Lags | AR1 | -0.483* | 0.201 | -2.404 | 0.025 |
| | AR2 | -0.370 | 0.200 | -1.849 | 0.078 |
| Constant | | 1858.000 | 1078.000 | 1.724 | 0.099 |

*Significant at P=0.05

The adequacy of the ARIMA (2, 1, 0) model was checked using the plots of ACF and PACF of the error series created by ARIMA. No correlations exceed the 95 per cent confidence limit and also the Box-Ljung statistic for the ACF function was not statistically significant at any lag.

The projections made for the next six years after 2008-09 showed further increase in the production of newsprint (Figure 4.24). However, this is not in accordance with the current crisis faced by the management, the reasons for which were discussed earlier in this report.

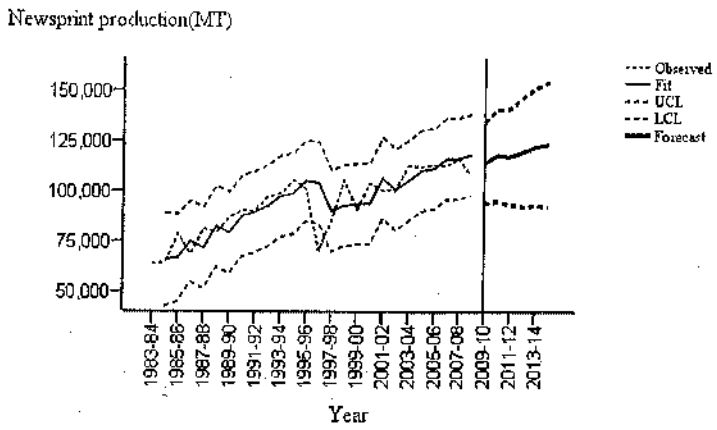



Figure 4.24. Predicted newsprint production figures for HNL based on time series analysis

## 5. Forest-based industries of Kerala

Status of some of the major forest-based industries viz., ecotourism, sawmilling and raw drug manufacturing industries is examined herewith.

### 5.1. Ecotourism

The outdoor recreation system with its economic parallels identifies certain comparisons between the recreation economy and market economy. Ecotourism is not a market to be taken lightly considering the fact that it is the fastest growing market in the tourism industry. Ecotourism development has the potential to make an economic impact via income generation, increasing the foreign reserve of the State, developing the basic infrastructures and creating new avenues for the employment. It also provides avenues for the sustainable development of the remote rural areas. In Kerala, major tourism destinations are broadly classified as beaches, backwaters, water bodies, waterfalls, hill stations, Wildlife Sanctuaries (WLSs) & National Parks (NPs) and culture including festivals.

**Tourism status in Kerala**

The domestic tourist flow in Kerala shows an increasing trend during 1981 to 2002 and the growth during the period highlights that the domestic visitor flow during 2002 was 28.6 times higher than that of the 1981. During the period 1981 to 1990, the growth rate indicates that the domestic visitor flow in the State during 1990 was 3.4 times higher than that of the 1981, while the growth rate during the 1991 to 2002 was 494 per cent. The domestic tourists constitute on an average 95 per cent of the total tourist flow during the period 1980 to 2002 and the foreign tourists constitute the rest 5 per cent during the given period.

A comparative analysis of pre-reform period and post-reform period was conducted in order to identify how the domestic tourism sector of the State reacted to the national initiative of the new economic policy in 1991. Figure 5.1 shows the three-year moving averages of domestic tourist flow during the pre-reform and post-reform periods. There has been a significant difference in the domestic tourists flow since the inception of new economic policy in 1991. The growth rate of domestic visitor flow during the initial years of the new economic policy (1991 to 1996) implies that compared to the visitor flow in 1991, 1996 registered 3.7 times higher amount of domestic visitor flow. While in the second part of the policy period (1997 to 2002) the rate of growth was only 21 per cent implying that 2002 registered only a meager amount (0.2 times) of increase compared to the domestic tourist flow in 1997. Thus, in the second part of the post policy period, the domestic tourist flow showed a relatively stagnant trend at a higher level of domestic tourists flow. In the pre-reform period, it is observed that the growth rate was higher during the just preceding period of new economic policy. During 1986 to 1990, the growth rate was 92 per cent, while it was only 70 per cent during the period 1980 to 1985 of the pre-reform period. The new economic reform of 1991 based on the globalization,

liberalization and privatization has increased the growth rate of domestic tourists' flow in Kerala.

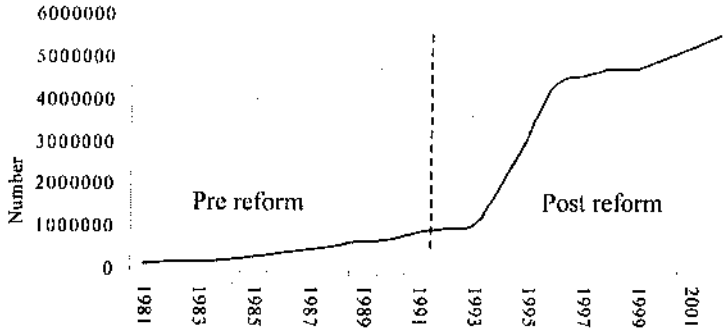



Figure 5.1. Three year moving average of domestic tourists in Kerala

The foreign tourist arrival to Kerala shows an increasing trend during the period 1981 to 2002, indicating that the number of tourist flow of 2002 is 9.5 times higher than that of the 1981. The growth rate of foreign tourist arrival during 1981 to 1991 was 221 per cent, while it decreased slightly to 188.5 per cent during the period 1992 to 2002. The foreign tourists constitute 11 per cent of the total tourist flow in 1980 then it decreased to 7 per cent in 1990 and 4 per cent in 2000.

The average annual visitors flow during the pre-reform (1980-1990) and post-reform (1991-2003) were 40,556 and 169,234 respectively. Figure 5.2 depicts an impressive difference in the foreign tourist arrival to Kerala since the inception of the new economic policy of 1991. During the initial years (1991 to 1996) of the reform, the increase in the foreign tourist arrival is higher than that of the second part of the post-reform period (1997 to 2003). During the period 1991 to 1996, the foreign tourist arrival increased by 155 per cent, while during the 1997 to 2003 it was only 62 per cent. The analysis of the pre-reform period indicated that the growth rate of foreign tourists arrival was higher during the 5 year period just preceding the reform period (1985 to 1990) compared to the earlier 5 year period 1980 to 1984. The growth rate during the 1985 to 1990 and 1980 to

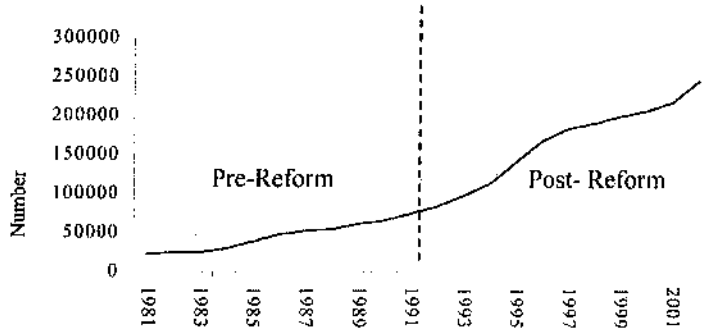



Figure 5.2. Three year moving average of foreign tourist arrival to Kerala

1984 were 56 and 12 respectively. The new economic policy process has thus had certain positive impact on the foreign tourist arrival to the State and the growth rate of the foreign tourists was normalized at a higher level of visitation during the second part of the post-reform period.

The foreign and domestic tourist arrival to Kerala during 2008 indicated an increase of 16.11 per cent and 14.28 per cent respectively over the previous year (Economic Review, 2009).

***Kerala tourism and travel***

The transportation and tourism sectors are interdependent in a tourism-based economy. In Kerala, the foreign tourists adopt different modes of travel such as air, sea, road and rail. During the period 1996 to 2003, on an average, 65 per cent of the foreign tourists used the road & rail transportation facilities, while 31 and 4 per cent used air and sea respectively. The mean values of foreign tourists who used road and rail, air and sea are 138,886, 66,144 and 7,138 respectively. Figure 5.3 depicts the mode of travel of foreign tourist to Kerala and it is noted that there is a positive growth rate in the number of foreign tourists availing road & rail and airways while the number of foreign tourists using the sea mode remain almost constant.

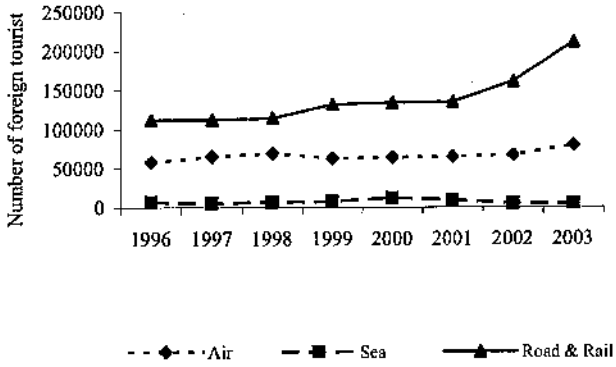



Figure 5.3. Mode of travel of foreign tourists to Kerala

***District-wise tourism development in Kerala***

In Kerala, southern districts attract more foreign tourists compared to the northern districts. In the district-wise foreign tourist arrival to Kerala during 2000-04 six districts, namely, Thiruvananthapuram, Idukki, Ernakulam, Alappuzha, Kottayam and Kollam together constituted 95 per cent of the foreign tourist arrival. Moreover Thiruvananthapuram and Idukki together accounted for more than half of the total foreign tourists arrival during the period. Wayanad, Thrissur, Kozhikode, Kannur and Malappuram districts together registered 5 per cent of the foreign tourist arrival to the State during the period 2000-04. There is high regional disparity in the foreign tourists

arrival in the State (Figure 5.4). In the district wise foreign tourist arrival in Kerala in 2008, Thiruvananthapuram district recorded the maximum number (234,797), an increase of 21.08 per cent over the previous year (Economic Review, 2009).

In the domestic tourism of the State (Figure 5.5), Thrissur district occupied the first place with 24 per cent of the domestic tourists during the period 2000-04 followed by Idukki (15%) and Thiruvananthapuram (14%). Here also, the northern districts lag behind in the distribution of tourism benefits. The lowest share of tourism development goes to Pathanamthitta with 1 per cent of domestic tourist flow during the period 2000-04.

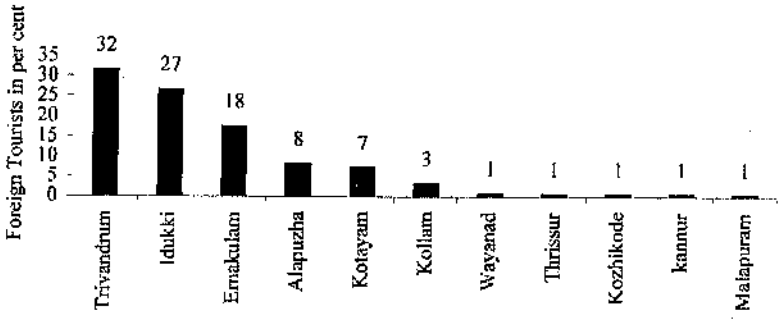



Figure 5.4. District wise foreign tourist arrival in Kerala during 2000-04

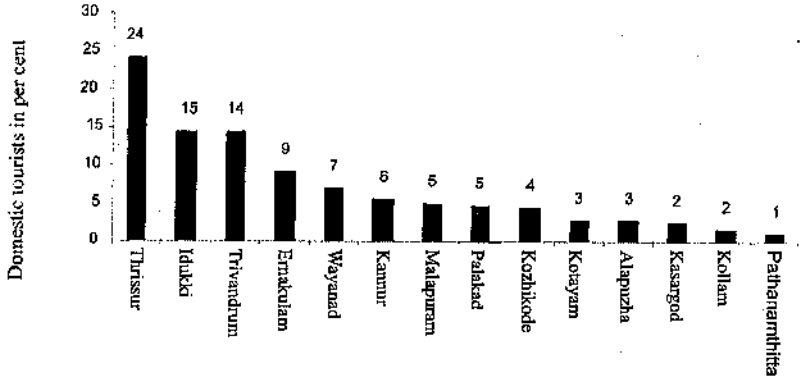



Figure 5.5. District wise classification of domestic tourism in Kerala (2000-04)

In the district wise domestic tourist arrival in Kerala in 2008, Thrissur district recorded the maximum number (1,671,174), an increase of 8.06 per cent over the previous year (Economic Review, 2009).

***Nature of tourism***

Tourism in the State is seasonal in nature and is classified as lean season (monthly visitation is less than 5 per cent), moderate season (5 to 10 per cent of visitation) and peak season (above 10 per cent monthly visitation). The seasonality of domestic and

foreign tourism in the State is estimated based on the monthly averages of visitors flow during the period 2000-04. Based on this classification, June and July are the lean season of foreign tourist arrival to Kerala, the moderate season includes March, April, May, August, September, and October while the peak season includes November, December, January and February (Figure 5.6).

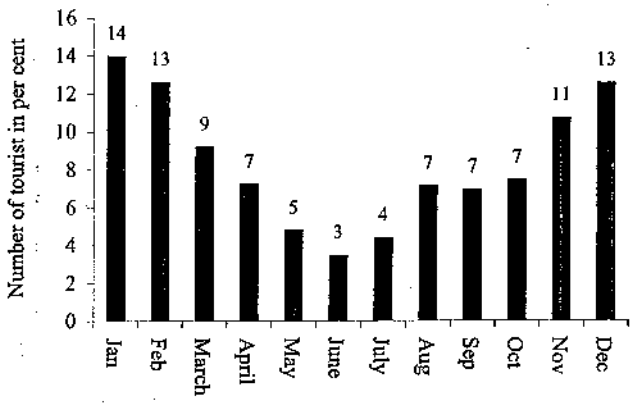



Figure 5.6. Seasonality of foreign tourist arrival to Kerala

As far as domestic tourism is concerned (Figure 5.7), January to March depicts a decreasing trend, then an increase is noted during the period March to May after which a sudden decrease is noted from May to June period, from June onwards the data projects an increasing trend up to December.

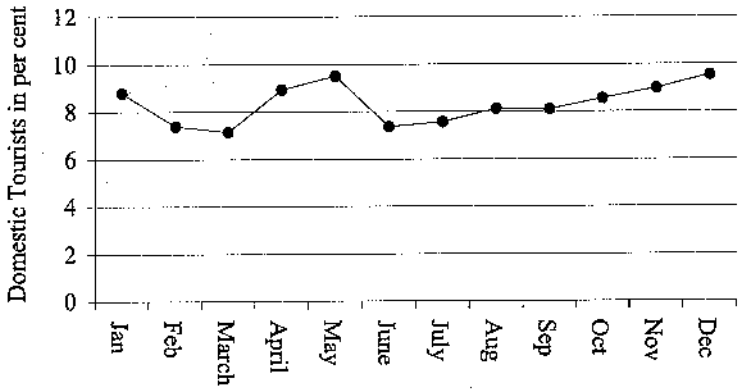



Figure 5.7. Seasonality of domestic tourism in Kerala during the period 2000-04

***The economic impact***

The primary motivator of an area/region to promote tourism is the expected economic improvement. A fast growing tourism sector has both positive as well as negative

economic impacts. The positive economic impact indicates foreign exchange earnings, contributions to government revenues, employment generation, infrastructural investment and improvements of quality of living standards, and income generation for the low income groups. The economic impact of tourism in terms of earnings shows an increasing trend over the years. In 2008 the total revenue generated from tourism comes to Rs.13130 crore, showing an increase of 14.84 per cent over the previous year and the tourism contribution to states GDP is 7.70 per cent (Economic Review, 2009). The global economic recession is also foreseen as affecting Kerala tourism. It is assessed that the net impact would be around 30 per cent reduction in business turnover, a drop of about 25 per cent in domestic business and roughly 35 per cent in international business (Economic Review, 2009).

**Ecotourism in Sanctuaries and National Parks of Kerala**

State forests provide a range of opportunities for recreational pursuits that add to those available on other public lands, such as picnicking, camping, trekking, bird watching, nature walk, among others. Besides, wildlife tourism, they may also provide immense scope for nature and adventure tourism. Development of ecotourism also offers opportunities for development of local economy and developing stakes of local people in preservation of natural resources.

Figure 5.8 illustrates the number of Protected Areas (PAs) in the State by year of formation. It is interesting to note that larger area is being brought under the PA category and this will positively impact conservation and protection of natural resources. Added to this is the strong conservation bias of the National Forest Policy whereby foresters are adopting a very cautious approach towards development of ecotourism. Conservation of the nature and natural habitats are given over-riding preference over development of tourism but many of the National Parks and Sanctuaries are already on international tourist maps. Although tourism activities are going on in most of the WLSs/NPs, the concept of ecotourism is given emphasis only lately.

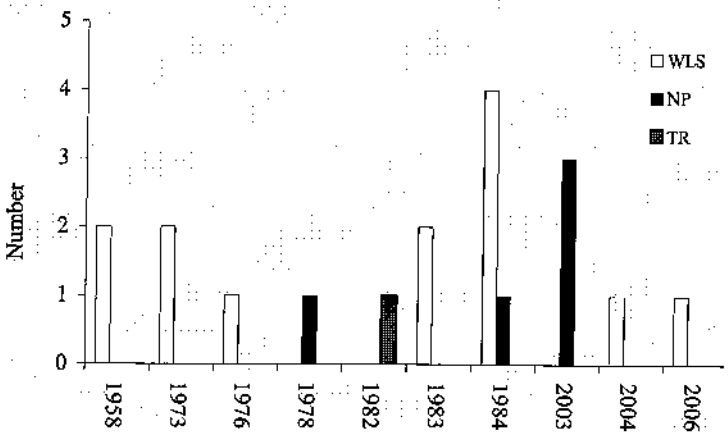
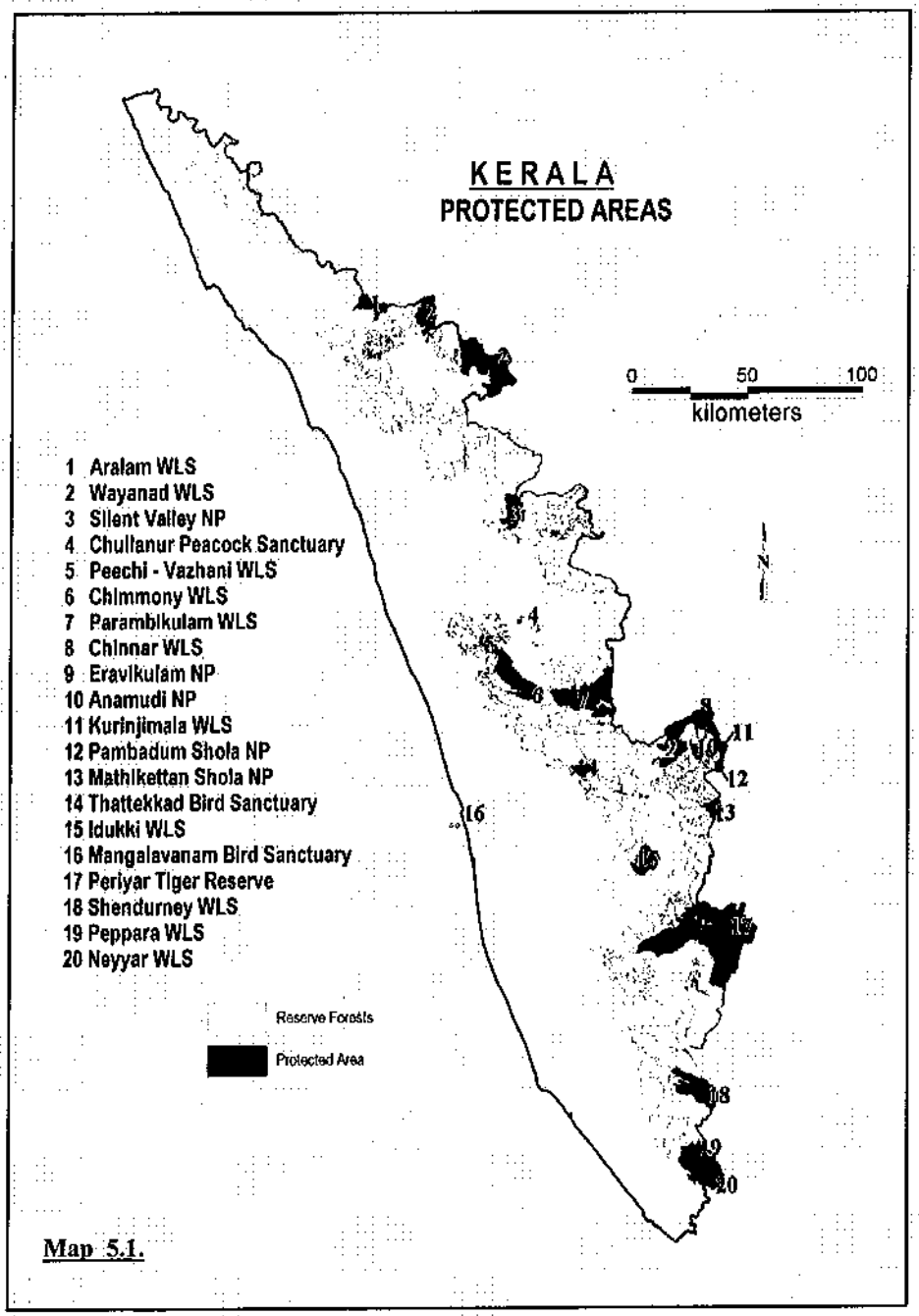



Figure 5.8. Formation of Wildlife Sanctuaries, National Park and Tiger Reserve

For the purpose of the proposed assessment of the status of ecotourism in the State, only the Protected Areas i.e., the WLSs and NPs in Kerala have been considered. The study area covers 14 WLSs, 1 Tiger Reserve and 5 NPs in Kerala (Map 5.1) with a total tourism zone of 158.85 $km^2$ .




Map 5.1.

This study is based on both secondary information such as visitors arrival, government revenue generated, employment created, zonation of protected area etc. and Primary information like social and economic aspects of the tourist, income and willingness to pay, tourist's preference, mode of travel etc collected by using questionnaire method. In the primary data collection the sample size is fixed at 1000 visitors. The study area covers 14 wildlife sanctuaries and 5 national parks. In the first stage of sampling 7 wildlife sanctuaries and 2 national parks were selected by unrestricted random sampling method. In the second stage the selected wildlife sanctuaries and national parks were divided into high tourism potential area and low potential area based on the past visitors flow and the total sample distributed between the high potential area and low potential area in the ratio of 2:1.

***Visitors' flow***

The visitors' flow to the WLSs and NPs depicts an increasing trend during the period 1998 to 2006 and the annual average visitors flow during the period was 663,255. The visitors' flow to the WLSs and NPs in 2006 registered a growth rate of 148 per cent compared to the visitors flow in 1997 (Figure 5.9).

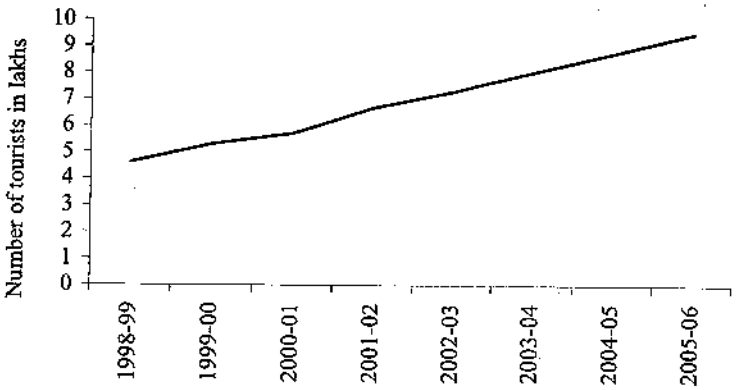



Figure 5.9. Three year moving average of tourists flow to WLS &NP

***Visitor profile and motivation***

In the gender-wise classification of the sample, males constituted the major share with 71.5 per cent and the females constituted only 28.5 per cent of the total sample. The age of the sample respondents varied between 16 and 80 with an average value of 30. The level of education indicated 38 per cent of the total to be graduates and 21 per cent post graduates. In the occupational structure of the sample, private sector occupied a prominent place with 33 per cent, the government, business and agriculture sectors occupied 15, 8, 6 per cent respectively. 17 per cent of the sample remained unemployed and 19 per cent came under the category of others, which include housewife and students. The senior citizens constituted 2 per cent of the sample. Leisure is the major motivation (68 per cent) followed by the study and business purposes (Figure 5.10). Nearly 53 per cent of the sample arranged their tour themselves and 9 per cent depended on the formal tour operators. In the visitors group, 41 per cent constituted friends group followed by

study group (30 %) and family (27 %) and individuals (2 %). The average travel distance of the sample tourists ranged between 1 hour and 6 days with an average 7.3 hours.

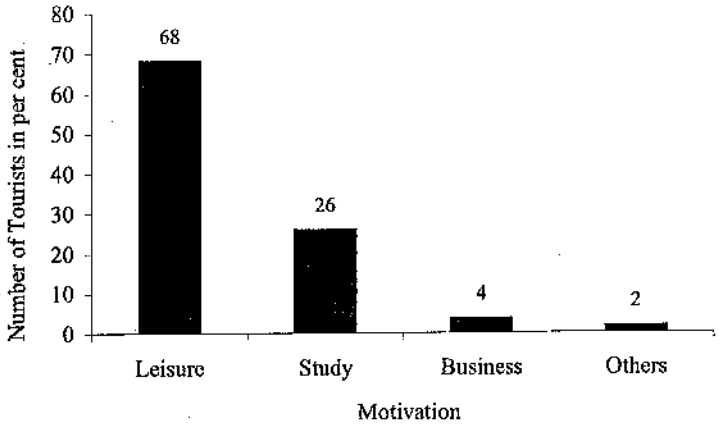



Figure 5.10. Motivation of the Tourists in the sample

In the mode of travel, 46 per cent used private tour coaches, 31 and 13 per cents used rented taxi and own vehicles respectively, the public transport was used by only 9 per cent of the sample. Around 31 per cent of the sample made some kind of shopping as part of their tour and the items in the shopping list included handicrafts, dress, ayurvedic products, and spices like cashewnuts, among others.

On the expenditure side of the tourism development, an individual tourist incurred expenditure on various heads such as food and accommodation, travel, shopping and recreation fee. Although the average expenditure was highest in the shopping category (Rs 1023) the number of tourists who incurred the shopping expenditure was low (321) (Figure 5.11). The average travel & accommodation expenditure was Rs 876 and large numbers of tourists have incurred food and accommodation expenditure. In the expenditure pattern average expenditure on the recreation was comparatively low with Rs 781. Of the total, 720 tourists in the sample enjoyed various recreation facilities offered at different rates.

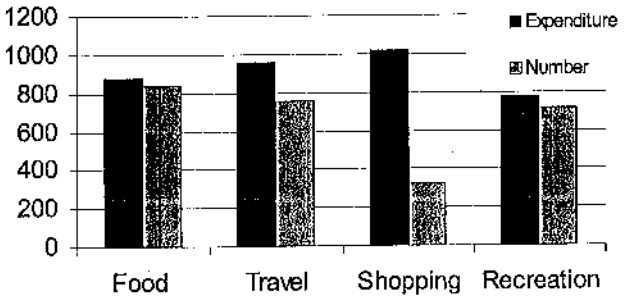



Figure 5.11. Average Expenditure and Number of Tourists

The overall ecotourism development in the Protected Areas depicts an increasing trend and the new economic policy of 1991 has accelerated the pace of ecotourism development. With increasing urbanization and focus on wildlife and natural ecosystems, ecotourism could be a viable alternative for the sustainable management of the forests. Ecotourism development and the economic development of the ecotourism areas (WLSs & NPs) are positively related. Labour intensive methods of ecotourism management by incorporating the local community will enhance the distribution of income to the lower sections of the society on the one hand and ensure environmental sustainability on the other. Ecotourism development poses various threats to the conservation of natural resources and developing efficient *site-specific* management strategies is the need of the hour. Ecotourism as a sector in the WLSs and NPs of the State can thus be linked to economic development by identifying and assessing its advantages in the development of local economies.

### 5.2. Sawmilling industry

The major wood-based industries in the State are sawmilling, manufacturing of packing cases, plywood, splints and veneers, pulp and paper, wooden furniture and fixtures. There are around 4000 wood-based industrial units, which depend not only on forests but also on homegardens and estates, for their wood requirements. The sawmilling industry is one of the most important forest-based industries in Kerala. The bulk of sawn wood originating from either internally produced or imported wood passes through these units and thus the sawmills have a key role as an intermediary between the producers and the consumers. Whether the industry is viable, what is the size of the industry, whether the units are well equipped to meet the sawmilling requirements of the customers, what constraints are faced by the industry, what is the extent of employment generation and what technological standards are kept by the industry are important questions one could ask on the subject.

#### *Survey design*

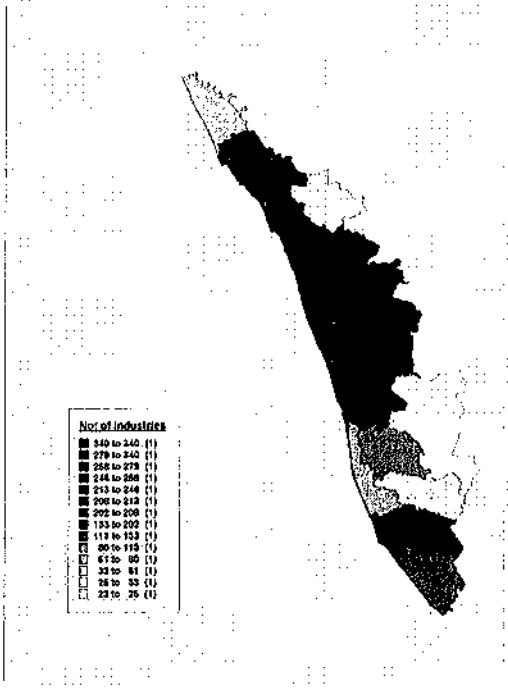
A survey was planned to generate information about the industry. The list of sawmilling units in the State was obtained from the office of the Director of Factories and Boilers at Thiruvananthapuram. Some of the population characteristics like spatial distribution and distribution in different size categories were worked out from the data.

For the sample survey, a total of 216 sawmilling units i.e., about 10 per cent were selected through stratified sampling scheme taking small units (employing less than 10 workers) and large units (employing 10 or more workers) as strata. Out of the 216 units selected, 185 were small units and 31 were large units. The data were collected by visiting each selected sampling unit. The questionnaire contained questions about the type of operations, year of inception, annual production capacity and outturn, details about the employees, type of timbers used and their sources, fuel consumption and problems faced by the units. Data were collected by direct interview of the owners and employees of the units.

***Distribution over Districts and size categories***

As on 2006, there were totally 2214 sawmilling units registered under the Factories and Boilers Department of the Kerala State. The District-wise distribution of the units is given in Figure 5.12.

Highest number of the sawmilling units are located in Palakkad District (340). Other districts in this respect are Kozhikode (279), Ernakulam (258), Malappuram (246), Kollam (213), Thrissur (208) and Kannur (202). In total, 69 per cent of sawmilling units were concentrated in these Districts. In the other seven Districts, Thiruvananthapuram (133), Kottayam (113), Alappuzha (80), Kasaragod (61), Pathanamthitta (33), Wayanad (25) and Idukki (23) the number of sawmilling units were less than 150. The restriction that prevailed regarding to the location of sawmills (no sawmilling units must be located within 5 km distance from the boundary of the forest) limited number of sawmills in Pathanamthitta, Wayanad, and Idukki.

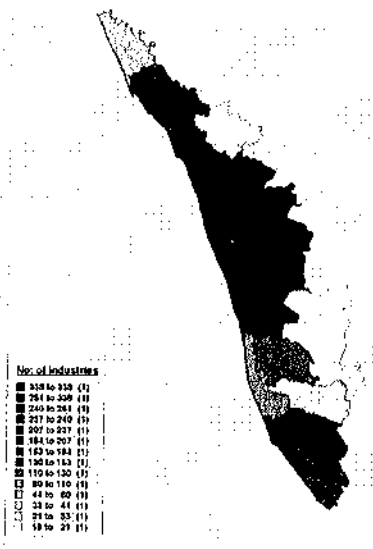



| District | Number of units |
|---|---|
| Palakkad | 340 |
| Kozhikode | 279 |
| Ernakulam | 258 |
| Malappuram | 246 |
| Kollam | 213 |
| Thrissur | 208 |
| Kannur | 202 |
| Thiruvananthapuram | 133 |
| Kottayam | 113 |
| Alappuzha | 80 |
| Kasargod | 61 |
| Pathanamthitta | 33 |
| Wayanad | 25 |
| Idukki | 23 |
| Total | 2214 |

Figure 5.12. Map showing the distribution of saw milling units in different Districts

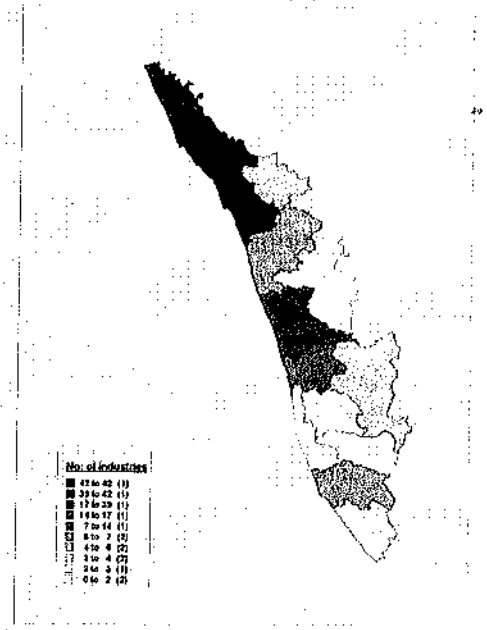
As per the officially accepted norms, the sawmilling units could be classed as small with less than 10 workers and large with 10 or more workers. According to this classification, 2067 units come under the first category (small units) and 147 units under the second category (large units). The distribution of these differently sized units are shown in Figures 5.13a and 5.13b. The small units are mainly concentrated in Palakkad, Eranakulam, Malappuram, Kozhikode, Kollam, Thrissur and Kannur Districts. Out of the

total 2067 small units, about 80 per cent are located in the above districts. The large units are mainly concentrated in Kozhikode, Kannur, Kasaragod and Thrissur Districts. About 75 per cent of large sawmilling units are concentrated in these Districts. In short, small units are more or less evenly distributed in different parts of the State; whereas the large units are situated more in the northern Districts.



| District | Number of units |
|---|---|
| Palakkad | 338 |
| Kozhikode | 237 |
| Ernakulam | 251 |
| Malappuram | 246 |
| Kollam | 207 |
| Thrissur | 194 |
| Kannur | 163 |
| Thiruvananthapuram | 130 |
| Kottayam | 110 |
| Alappuzha | 80 |
| Kasargod | 44 |
| Pathanamthitta | 33 |
| Wayanad | 21 |
| Idukki | 19 |
| Total | 2067 |

Figure 5.13a. Map showing the distribution of small sized units in different Districts



| District | Number of units |
|---|---|
| Kozhikode | 42 |
| Kannur | 39 |
| Kasargod | 17 |
| Thrissur | 14 |
| Ernakulam | 7 |
| Kollam | 6 |
| Malappuram | 6 |
| Idukki | 4 |
| Wayanad | 4 |
| Thiruvananthapuram | 3 |
| Kottayam | 3 |
| Palakkad | 2 |
| Alappuzha | 0 |
| Pathanamthitta | 0 |
| Total | 147 |

Figure 5.13b. Map showing the distribution of large sized units in different Districts

***Distribution by year of inception***

The distribution of the sample set of sawmilling units by the year inception is shown in Figure 5.14. This figure could not be worked out for the whole population because no such information was available in the records for all the units. As such, the year of inception had to be ascertained from the owners during the survey. It can be seen that the saw milling industry had its beginning as early as 1935 but caught up only in later years. There has been a steady increase in the number of registered units over the years but not after 1990. The ban on clear felling in 1985 and that on selection felling in 1987 contributed to the decrease to some extent. Since a major portion of timber comes from households, probably the ban on felling trees from forests did not have much impact. However, the recent restrictions on the issue of NOC by the Forest Department have made the series almost stagnant.

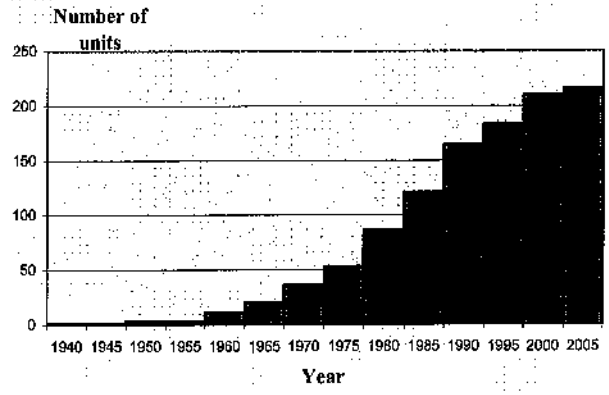



Figure 5.14. Histogram of sample set of sawmills based on year of establishment

***Production***

The State level mean annual outturn per unit was estimated as 882 (±37) $m^3$. The mean annual capacity worked out to 1305 (±35) $m^3$. In effect the capacity utilization was only 68 per cent implying that the sawmilling units could process much more wood than that is presently done. The status of the two strata is shown below.

Table 5.1. Outturn and capacity utilization in Kerala

| Types of units | Mean outturn ($m^3$) | Capacity ($m^3$) | Utilization (%) | Total outturn ($m^3$) |
|---|---|---|---|---|
| Small sized units | 806 | 1238 | 65 | 1666294 |
| Large sized units | 1958 | 2254 | 86 | 287860 |
| Overall | 882 | 1305 | 68 | 1954154 |

The large-sized units have been able to utilize their installed strength much more effectively when compared to small sized units. The total outturn of timber of the saw milling units in the State worked out to 1,954,154 $m^3$ for the year 2005-06. This figure has an importance by its nature. With the wide availability of sawmilling facilities in the State, any wood that is processed invariably goes through a sawmill. Hence the outturn of the sawmills should be indicative of the total supply of saw timber from different sources such as forests, homesteads, estates and through import. Of total outturn, the contribution of the small sized units is 85 per cent although by number, the small sized units comprise 93 per cent of the total strength.

***Source of timber***

The next question is from where the wood is coming to the sawmills. The mill owners either purchase the round wood to sell it after sawing or use it for making furniture. Timber is also brought by customers for sawing. The proportion under these three classes worked out to sawn timber sold (21%), used for furniture and fixtures (5%) and brought by customers (74%).

Mainly four sources could be identified for timber purchased by mill owners, viz., homesteads, import, forest depots and estates. The respective contributions from these sources are presented in Figure 5.15. The major sources of the timber used in furniture making and timber sales are homesteads (53%), import (34%), forest depots (12%) and estates (1%).

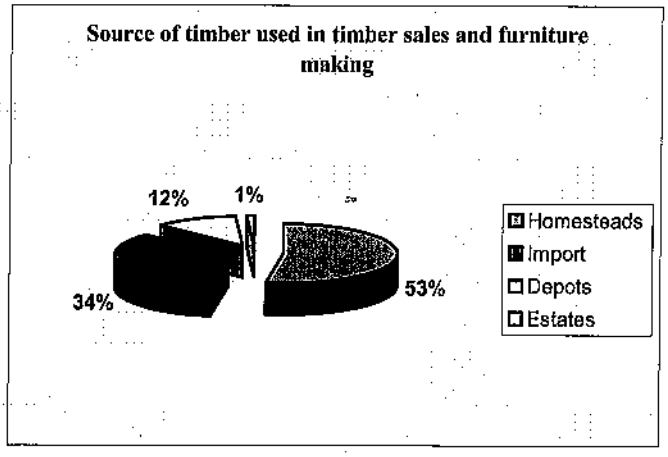



Figure 5.15. Source of timber used for direct sale and furniture making

Other than direct purchase, customers also bring wood for sawing. The sources of timber brought by customers for sawing are homesteads (92%), imports (4%), forests (2%) and estates (2%) (Figure 5.16). The overall source-wise partitioning of the wood processed through the sawmills is homesteads (81%), imports (12%), forests (5%) and estates (2%). In short, wood from homesteads forms the major source of timber for the sawmills. Other

than that from homesteads, the industry thrives on imported wood and wood from the forest depots partly.

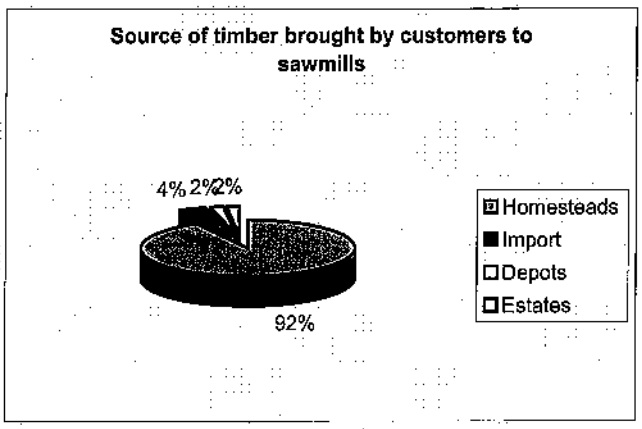



Figure 5.16. Source of timber brought by customers to sawmills

***Type of timber processed***

Analysis revealed that wood of about 42 species is processed by timber mills for direct sale and for making furniture. The major timber species used in timber sales and used for making furniture are teak (29%), pynkado (26%), jack (15%), anjily (6%) and mango (5%) (Figure 5.17). Out of the total timber species used in timber mills, about 80 per cent are of these five species. The most preferred species for house construction and furniture are definitely teak and pynkado.

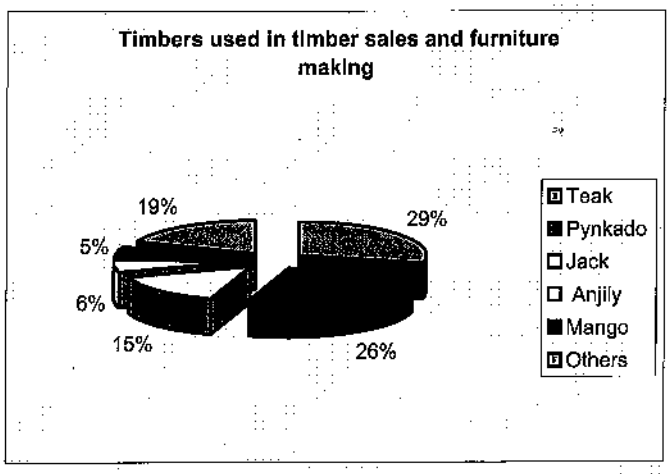



Figure 5.17. Species used in timber sale and furniture making

Customers bring about 53 species to sawmills for sawing. Out of these, the most commonly used timbers are of mango (28%), jack (23%), coconut (14%), anjily (9%) and teak (6%) (Figure 5.18). These five species constitute about 80% of the total timbers used for custom sawing.

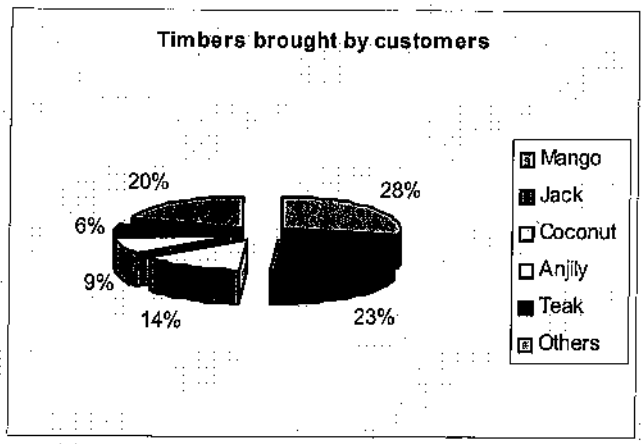



Figure 5.18. Species brought by customers to saw milling units

### *Number of workers employed*

The average number of full time employees per sawmill was estimated as 6.25 and the average number of part time employees was 0.73 per unit. In the case of small sized units, the average number of full time employees per sawmill was 5.84 and the average number of part time employees was 0.62 per unit. In large mills, the average number of full time employees per sawmill is 12 and the average number of part time employees is 2.18 per unit. An estimate of the total number of people employed in the sawmills is 15,460 including both full time and part time workers.

### *Constraints in sawmilling industry*

Interviews with the sawmill owners revealed some of the problems faced by them in running the mills (Table 5.2). On the whole, about 56 per cent of the owners indicated shortage of timber. This is consistent with the low capacity utilization (68%) that was realized. Problem with supply of electricity and high electricity charges are also major constraints. Many owners admitted of having problems in meeting the government formalities connected with different departments like the Department of Factories and Boilers which is the licensing authority and Forest Department which issues NOC. They also have frequent troubles with labour unions. Table 5.2 shows that large units have higher incidence of shortage of timber and more cases of labour issues but are able to afford the high fuel cost.

Table 5.2. Strata-wise percentage of sawmills under different constraints

| Constraints | Percentage of small units | Percentage of large units | Overall percentage |
|---|---|---|---|
| Shortage of timber | 56 | 62 | 56 |
| Problem with electricity supply | 48 | 45 | 48 |
| High electricity charges | 67 | 71 | 67 |
| Problems with government formalities | 42 | 48 | 43 |
| High cost of diesel and lubricants | 26 | 11 | 25 |
| Problems with labour | 10 | 24 | 11 |

*Future prospects*

The survey has revealed that the industry is more than equipped to handle the timber processing requirements of the State. In fact, shortage of timber is one of the problems experienced by the sawmill owners. Since there are limits to the availability of timber from domestic sources, liberalized import policy is the only means to improve the current situation in the industry.

Of late, there has been slack in the industry due to restrictions on issue of NOC to new entrepreneurs. Also, the mill owners face problem in getting the license renewed annually approaching different offices. A single window processing of the renewal applications is suggested for the purpose.

Bandsaw, resaw, saw bench, cross cutter and grinder are some of the essential equipments used in the industry. Lathe and planer are required for making furniture and fixtures. Although more advanced and efficient models of these equipments are available presently, the industry has not been very enthusiastic about using them because of the current shortage of raw material.

The sawmills require specialized and skilled labour. Organized labour force is quite demanding in their dealing with the management. Although per day rates are in force presently, rate per $m^3$ is preferable from the management side due to frequent power failures. The high labour charge including that for loading/unloading contributes to the high cost for processed wood. Unless the labour issues are settled effectively, the burden will ultimately fall on the consumers.

**5.3. Raw drug industry**

The growing demand of consumers for Complementary and Alternative Medicines to meet both their healthcare needs as well as dietary supplements have reawakened the medicinal plant-based raw drug industries in the present decade. Kerala has long heritage of use of herbal products not only as medicines but also for cosmetics, health, hygiene, toiletries, fragrance and food supplements. It is estimated that the demand for ayurvedic medicines in Kerala State alone is growing at a compound rate of 10-12 per cent per annum (Suneetha, 2004). Ayurvedic industry is contributing around 2.75 per cent to the Gross Value Asset and 3.13 per cent to the Net Value Asset to the manufacturing sector in Kerala, while the gross output comes around 0.70 per cent of the manufacturing sector (Harilal, 2009).

Many domestic industries have transformed their products from traditional form of powder, paste and small pills to capsules, tablets and syrups by adopting advanced technology in order to increase their market share. Currently, most of the leading ayurvedic firms have their retail outlets throughout Kerala and are moving in the direction of large scale and chained operation. The large manufacturing units like Arya Vaidya Sala cater to the needs in North Kerala (Malappuram, Kasaragod, Palakkad); Sitaram, Arya Vaidya Pharmacy and Vaidya Ratnam in Thrissur-Ernakulam belt; and

Nagarjuna herbal concentrates in South Kerala (Ernakulam and southward) while SD Pharmacy, Oushadhi and Pankajakasthuri cater to all regions of Kerala. In other states, nutraceuticals and cosmetics constitute bulk of the ayurvedic manufacturing sector, while in Kerala, medicinal preparations are dominant role (Harilal, 2009).

Raw drug manufacturing units in the State can be broadly classified into the formal and the informal sectors. The formal sector consists of small, medium and large manufacturing units. As per the classification carried out by Sasidharan and Muraleedharan (2008) based on the annual turnover of the raw drug industry units, there were 293 units under the small units category and 43 units in the medium sized and 20 units in the large sized category (Figure.5.19).The units with a turnover of less than one crore are termed as small, between 1 and 3 crores, as medium and more than 3 crores, as large.

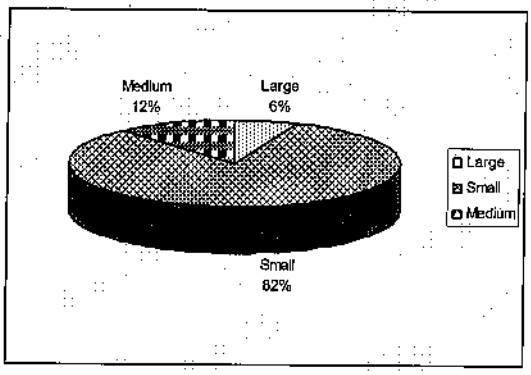



Figure 5.19. Distribution of raw drug units based on their size

A minimum of two units or 10 per cent, whichever is highest was selected at random from each size group. As per primary data estimates 107 raw drugs are used by small manufacturing units, 66 and 113 by medium and large manufacturing units respectively. For finding out the trend in the quantity utilized, three year moving average was taken. The annual consumption of major raw drugs by the medicine manufacturing units in Kerala was worked out. The data were further analysed to find out the consumption of raw drugs by the small, medium and large units of Kerala.

***Structure, nature, and size***

Small units manufacture only a few medicines and operate in a small area. These units are quite strong in their area of operation. There are a few small manufacturing units which cater to export markets only. These units can grow only up to a point beyond which they require modern methods of manufacture, distribution, research and technology. The medium manufacturing units are also established and they use modern methods for manufacture and distribution of medicines and they cater to both national and international markets. The large manufacturing units comprise the well-established manufacturers who operate in both domestic as well as international markets. Major players like Kottakkal Arya Vaidya Sala, Sitaram, Vaidyaratnam, Oushadhi, Nagarjuna

Herbal Concentrates, SD Pharmacy and Pankaja Kasthuri come under this category. These companies draw upon traditional knowledge and also have the ability to grow by accepting modern technology in manufacturing and marketing methods. There is yet another type of emerging units that concentrate mainly on nutraceuticals and cosmetics. These brands which are winning both the domestic and international markets use traditional systems as leads to new drugs either as standardised extracts or as pure isolated active ingredient, which have been scientifically validated.

The informal sector includes small manufacturing units run by practising ayurvedic experts (vaidyas). They manufacture only a few products to cater to the local needs. These self regulated entities grow on the basis of track record and credibility. They do not consider it necessary to scientifically validate their products and systems. It is estimated that the informal sector spread across the State comprises a market bigger than that of the organized sector and the total ayurveda market including such units is around Rs 45 billion. It is estimated that more than 350 small units are functioning in the informal sector in Thrissur District alone.

In Kerala there are 1121 licensed ayurvedic units out of which 2 are in the government sector and 1119 in the non governmental sector (Annual Report Ayush, 2007). There are 722 units which are GMP (Good Manufacturing Procedure) licensed and 399 are non GMP licensed pharmacies. The zonal distribution of the manufacturing units (Figure 5.20) indicates major concentration of units in the central zone (49 %) followed by southern (26 %) and northern zone (25 %).

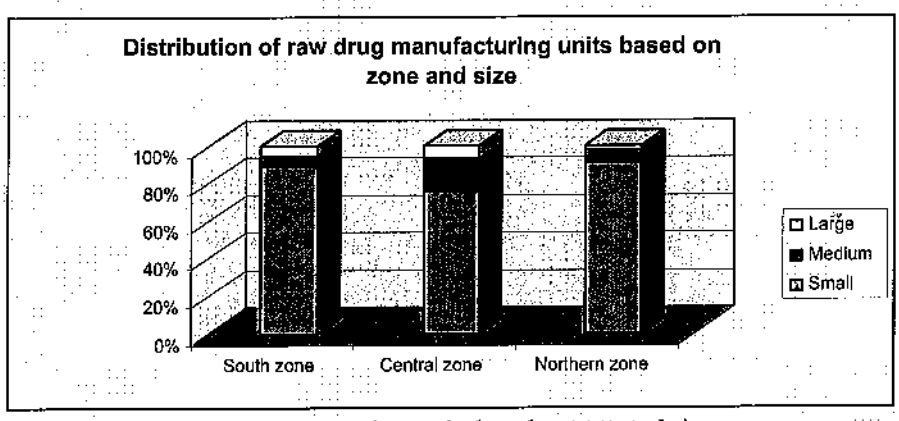



Figure 5.20. Raw drug units based on zone and size

There are about 356 raw drug manufacturing units common in the drug license list as well as Medicinal Plant Board list (Sasidharan and Muraleedharan, 2008). Highest numbers of units are located in Thrissur District followed by Ernakulum, Palakkad, Malappuram and Kollam. In fact, 64.61 per cent of the raw drug manufacturing units are concentrated in these districts. In the other nine districts, Thiruvananthapuram, Kozhikode and Kannur, Kottayam, Pathanamthitta, Alappuzha, Idukki, Wayanad and Kasaragod, the number of units was only 126. The small units are concentrated in the districts of Thrissur, Palakkad, Ernakulum, Kollam, Malappuram and Thiruvananthapuram. The large units are concentrated more towards the central districts.

The medium sized units were located in Thrissur, Ernakulam, Palakkad and Trivandrum Districts.

***Product profile***

Until a few years ago, medicines used in drug manufacturing firms were generally prepared by practising vaidyas themselves. But now the practise has been largely replaced by organized manufacturing units who absorb the technological changes to tap the opportunities available beyond India. More than 80 per cent of the drug industries in Kerala have set up high quality drug manufacturing facilities, including a majority of the leaders opting for WHO GMP certification. Unlike the traditional vaidyas who practised ayurveda as a divine vocation and were reluctant to see it as business, the corporate management professionals look at the business promotion of their firms. The large firms manufacture nearly 600-700 products, whereas the medium firms and small firms produce 250-300 and 50-100 products respectively (Table 5.3).

Table 5.3. Number of products manufactured by sampled units

| Sl.No | Raw drug manufacturing units | No. of Products |
|---|---|---|
| 1 | Large Manufacturing Units | 600-700 |
| 2 | Medium manufacturing units | 250-300 |
| 3 | Small manufacturing units | 50-100 |

With a new trade regime round the corner, many of the leading firms like Kottakkal Arya Vaidya Sala, Coimbatore Arya Vaidya Pharmacy, Kerala Ayurvedic Pharmacy Limited, Vaidyarathnam Thaikkattu Mooss Oushadhasala, Sitaram, Oushadhi among others, are concentrating on developing innovative, value added drugs and nutraceuticals with a global marketing perspective.

Two categories of medicines available in the market labelled as ayurvedic are classical ayurvedic formulations, which are prescribed in authentic ayurvedic texts (eg Arishtams, Kashayams, Lehyams, oils) and secondly, patent and proprietary formulations made of extract of herbs (Dhanukar and thatte,1998). Patent and proprietary medicines are defined as those formulations, which are produced and packaged, based on the classical texts, but not included under the classical formulations. For example, a large number of *Arishtas, Churnas, Rasayanas, Ghritas* and *Ras* are produced, packaged and marketed in modern galenic forms of tablets, capsules, powders, syrups, ointments or gels. Currently another category of products namely the Fast Moving Consumer Goods (FMCG)/Over the Counter Products (OTC) are capturing both the domestic and international market through aggressive marketing techniques. The OTC products are marketed directly and can be purchased without the prescription of physicians.

There are a large number of drugs used over the counter widely. These drugs use the herbs indicated as basic ingredients but not normally sold in the same form as ayurvedic medicines as in the Indian medicinal systems. These are used substantially without a prescription. Increase in business from OTC nutraceuticals and daily supplements have prompted the manufacturers to adopt the strategy of penetration to consumers' mind

through technologies like neuromarketing. The drug controllers plan to permit Schedule K drugs for sale not only at the chemists shop but also at groceries and departmental stores for unrestricted spread of healthcare products. The industries in Kerala are shifting their focus from the classical formulations to the nutraceutical market in India which is growing at a CAGR of 21.23 per cent (Cygnus Business Consulting Research, 2000). Pankaja Kasthuri is an example of a local brand achieving grand success through heavy duty campaigning. Pankaja Kasthuri has set up separate division to deal with OTC products which are nine in number, FMCG products which are seven in number and ethical formulations which are 10 in number. Proprietary and patented drugs have become an integral part of the large and medium raw drug units (Table 5.4). The small firms concentrate mainly on the classical formulations like Aristams, Kashayams, Lehyams, Choornams and oils.

Table 5.4. Distribution of manufactured products

| Sl.No | Raw drug manufacturing units | Classical products | Proprietary/ Patented products |
|---|---|---|---|
| 1 | Kottakkal Arya Vaidya Sala | More than 530 | - |
| 2 | Nagarjuna Herbal Concentrates | More than 500 | 65 |
| 3 | SD Pharmacy | More than 350 | 50 |
| 4 | Pankaja Kasthuri | More than 440 | 16 |
| 5 | Oushadhi | More than 450 | 17 |
| 6 | Deseeya Ayurvedic Pharmacy | More than 400 | 50 |

Source: *Primary data estimates*

***Profitability and growth***

Kerala is one of the few states where a government-owned ayurvedic drug manufacturing factory, Oushadhi, is making consistent profits (Figure 5.21). If we look into the trend of total sales and net profit of Oushadhi, it is of an increasing trend. The period from 2002 is marked by entry of non-drug ayurvedic products into the market through aggressive marketing techniques. The formation of the Confederation for Ayurvedic Renaissance-Keralam (CARe-Keralam) in order to promote Kerala as a global destination for sourcing ayurvedic products and services of internationally acceptable standards from 2000 onwards also proved to be a critical move that accounted for the consistent growth of the Ayurvedic sector.

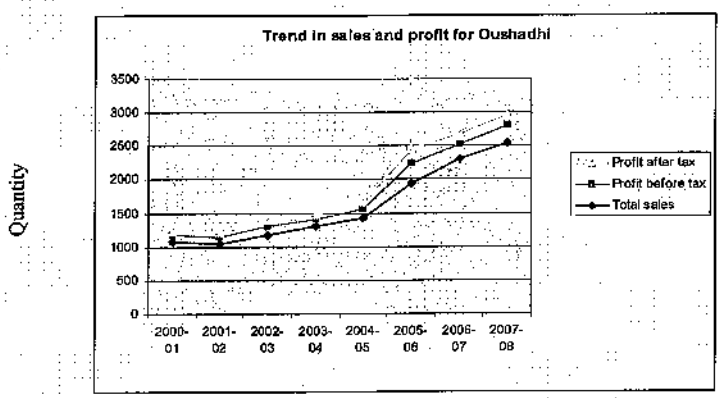



Figure 5.21. Trend in total sales and profit for Oushadhi (In lakh rupees)

***The economic impact of growing raw drug industry***

One of the most tangible links between the raw drug industry and the local communities is through the employment opportunities generated in these manufacturing units. It was estimated from the primary data that more than 60 per cent of the full time workers in small units are males. Female workers were engaged in less tiresome works. More than 90 per cent of the units, irrespective of their size, have engaged an ayurvedic medical practitioner as senior manager/special officer for supervision of activities in order to gain the confidence of the local community. The percentage change in employment of managerial staff between 2005 and 2009 revealed that the small units showed 70 per cent increase in male staff and 69 per cent increase in full time male workers (Table 5.5). The increase in the number of female managerial staff (200%) depicts the growing importance of women labour in the industry. There was 77 per cent increase in full time female workers in small units. In the case of medium units the increase in male managerial staff was 38 per cent while that of females were 25 per cent. Male full time workers increased by 54 per cent while female workers showed 60 per cent increase.

Table 5.5. Employment details of small and medium raw drug units

| Employee | Percentage change in average number of employees during 2005 and 2009 | | | |
|---|---|---|---|---|
| | Small | | Medium | |
| | Male | Female | Male | Female |
| Manager (Full time) | 70 | 200 | 38 | 25 |
| Workers (Full time | 69 | 77 | 54 | 60 |

The data from the large units was not forthcoming and so the employment opportunity could not be analysed for large units. Given the existing scenario, the growing number of units especially small and medium units will create ample employment opportunities in the coming years.

***Market propelled demand***

Trend in average quantity utilized by the small industry (Figure 5.22) indicates that there is an increase in the consumption of the major 10 species used by the small industries. Kurumthotti, kadukka and nellikka are the most consumed raw drugs by the small scale manufacturing units during the year 2009. Trend in average quantity of major species utilized by the medium industries shows that there is not much change in the quantity utilized during the period 2001 to 2008 (Figure.5.23). Kurumthotti comes first in the quantity utilized by the medium industries. The second major species utilized by the medium industries is nellikka. Among the 13 raw drugs identified as the major drugs utilized by large industries, kurumthotti comes first and sathavari comes second (Figure 5.24). These two drugs show fluctuations in the utilization during the period 2001 to 2008. However, in a comparison of the quantity utilized during 2001 to 2008, these two drugs show an increase in utilization. Two major raw drugs utilized by small, medium and large units are kurumthotti and nellikka. However there exists a marked variation

with regard to consumption of raw drugs in small, medium and large units, as the quantity and type of medicines prepared by them differ.

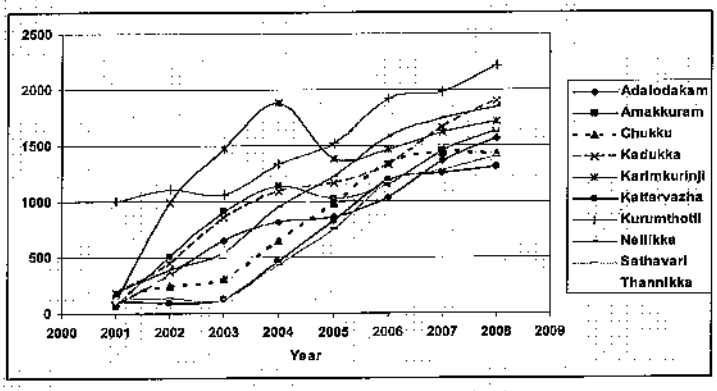



Figure 5.22. Trend in average quantity utilized by the small industries (2001-2008)

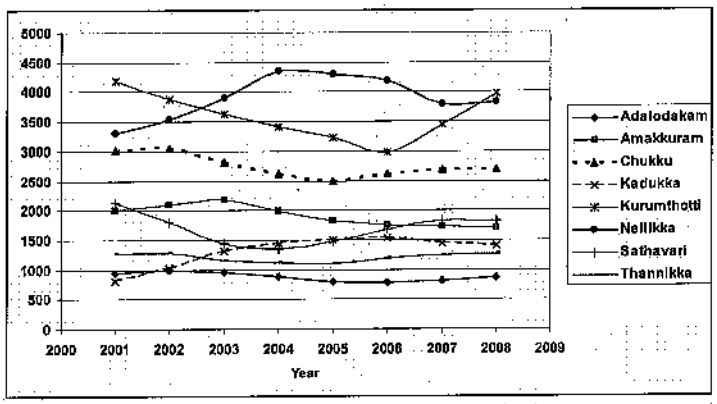



Figure 5.23. Trend in average quantity utilized by the medium industries (2001-2008)

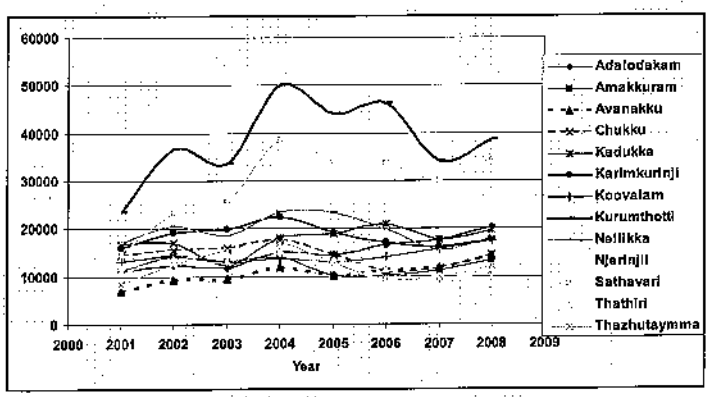



Figure 5.24. Trend in average quantity utilized by the large firms (2001-2008)

The promotion of health tourism has prompted the raw drug units, irrespective of their size, to open up massage parlours to cater to the needs of the growing demand for

panchakarma treatments by domestic and international clients. The use of kurumthotti for preparation of various massage oils has thus increased in raw drug industries. The widespread increase in the consumption of nellika, kadukka among others is due to the increase in demand for herbal tonics and cosmetics. It could be noted that the demand for raw drugs for medium industries is more or less constant with less variation over the years. One of the main reasons is that these firms mainly concentrate on a few products and they obtain patent/proprietorship over these products which may cause a substantial increase in the consumption of selected raw materials. After getting proprietorship many firms expand business of their proprietary medicines which can be formally marketed all over the country.

The growth in raw drug units can be attributed to the comparatively low infrastructure cost, access to raw material, simple manufacturing process and lack of standardization of quality and efficacy of medicines. The current consumer trends shows a gradual shift from medicine to beauty products due to growing concern over side effects of chemical-based products. Many firms have entered this segment with branded products in categories such as skin care, hair care, soaps and essential oils.

However, this market-propelled demand for natural medicines and green health products has created tremendous pressure on the natural resources. Annual consumption of 231 raw drugs by the ayurvedic medicine manufacturing industry in Kerala is about 17,899 tonnes (Sasidharan and Muraleedharan 2008). Forests and other natural ecosystems are the major sources (around 90%) of the overwhelming bulk of medicinal plants used by around 1000 small and medium scale industries. The consumption of raw drugs collected from forests is 44.94 per cent, non-forest areas 14.31 per cent, cultivation 13.58 per cent and imports 7.39 per cent (Sasidharan and Muraleedharan, 2000). The local tribal communities and rural poor are not benefited from the increased commercial activities as only a fraction of the total markets return reaches them. The market scenario in this sector has an oligopolistic structure with few big units dominating the market and thousands of small units having a wider social base contributing very little.

***The supply crisis***

The projected escalated demand for raw drug formulations, both domestically and internationally, is putting considerable pressure on the existing resource base. Analysis of the status of raw drug industry in Kerala projects an ever-increasing demand as the sales value of raw drugs and its collection charges depict an overall increasing trend during the period 1985-2004. The average quantity of raw drug collected during 2001-06 is 3,015 million tonnes. The average values per year of sales and collection charges are Rs 31,524,480 and Rs 25,219,520 respectively. The collection charge and sales value depict a decreasing trend during the period 2001-06. The primary causatives are high intensity of harvest in the previous years, overexploitation and unsustainable extraction, restricted collection (proposed by the Department) of certain items in the alternate years and product not in demand due to previous years' excess stock. Average annual sales value of Federation during the period 1984-2006 is Rs 19,052,318. During the same period the sales value of raw drug recorded an annual increase of Rs 1.9 millions. The sales price

component is estimated by dividing the sales value with the sales quantity of the corresponding period, similarly the price component of the NTFP collection is also estimated. The trend values of the price components of sales and collection of the raw drugs highlights that the administered price mechanism is responsive to the market price movements (Figure 5.25).

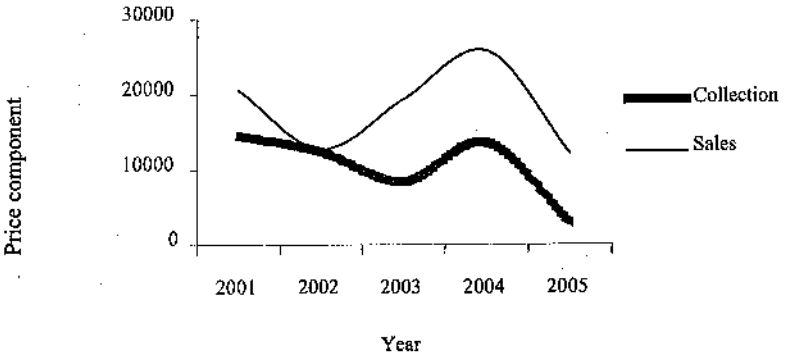



Figure 5.25. Trend line of price component of sales and collection values of NTFP

Given the rapidly increasing demand, there is tremendous pressure on the supply base. The uncontrolled unauthorized collection and sale of large quantities of plant material from forests has resulted in depletion of several medicinally important wild species. Various studies have indicated the risk of extinction of valuable species due to over exploitation. The soaring export market and increased domestic demand coupled with uncertainty and scarcity of raw materials, adulterated materials obtained through traders, and government restriction on export of some species collected from the wild has encouraged some of the big manufacturers to opt for cultivation. Overexploitation has been one of the impacts of market forces, which in turn has made many plant species endangered.

***Indicated constraints***

Major constraints identified by the units vary according to their size. Non-availability of quality raw materials was the major constraint for 42 per cent of the small units and 30 per cent of large units, whereas lack of efficient staff proved to be a constraint for 35 per cent of the medium units (Table 5.6). Lack of availability of quality raw materials, lack of appropriate government policy and fluctuation in price are the common constraints identified by these units.

Table 5.6. Unit-wise (%) under indicated constraints

| Rank | Small units | Medium units | Large units |
|---|---|---|---|
| 1 | Non availability of quality raw materials (42 %) | Lack of efficient staff (35%) | Quality raw materials are not available (30%) |
| 2 | Lack of fund for development to face competition (32 %) | High competition from large companies (24%) | Unfavourable Government policy (28%) |
| 3 | High competition from large companies (12%) | Unfavourable government policy (19%) | Increasing tax rate (19%) |
| 4 | Lack of efficient staff (10%) | Non availability of raw material in a prescribed manner (14%) | High production cost (13%) |
| 5 | Price fluctuations (4%) | Price fluctuations (8%) | Price fluctuations (10%) |

Source: *Primary data estimates*

The situation in raw drug industry can be depicted as a combination of three core scenarios viz., private sector dominance, market force dominance and growing informal sector. The private sector already dominates the raw drug industry in Kerala. The nature of technological changes, including development and adoption of new technology is determined by the market forces. The private sector has been in the forefront in adopting new technologies, initiating research and development. There may also be a segment of more organized informal sector catering to global demand through unauthorized harvesting and marketing of raw drugs. The informal sector is expected to grow especially if the formal sector fails to expand to meet the growing demand. The most unfortunate impact of globalization is qualitative in the sense that now the priority is not conservation for local healthcare, but for greater utilization of market opportunities. The medium and large units have established a bigger presence and are eyeing at product diversification and geographical expansion, not only within the country but even globally.

Although the inaction of many of the pharmaceutical companies indicates their apparent lack of concern about the depleting resources, some major players have initiated steps in the desired direction. Many companies in the private sector are engaged in nursery development, generation of planting material and seeds, development of agricultural techniques for cultivation of medicinal plants and also initiating and encouraging cultivation of medicinal plants by contracting them to farmers. The Arya Vaidya Sala (AVS) at Kottakkal, a leading manufacturer of ayurvedic products, in addition to maintaining two large herbal gardens has also undertaken research in the propagation of nine species with a view to cope up with declining availability of plant materials.

## 6. Interrelation between forestry and allied sectors

Forests and other natural resources provide the foundation on which the edifice of development and prosperity of the State is built. Forests provide humanity a multiplicity of goods and services. Forests especially in Kerala host enormous flora and fauna. Compared to forests, agriculture deals with a narrow set of domesticated species of plants and animals. Historically, all the easily accessible areas have been converted to agricultural lands. This was a necessity to feed the increasing human population. Much of forests are now confined to hilly tracts but remnants of them can be found in the plains in the form of sacred groves and mangroves. There exist profound interconnections between forests and agriculture as all the rivers which irrigate the agricultural lands originate and are sustained by the forests. A large number of industries are also dependent on forests. The dependence on forests for raw material for industries was of higher degree earlier but as conservation efforts caught up, the degree of exploitation has been on the decrease. Similar is the case with the service sector wherein the timber requirement of construction activity was being met to a large extent from forest plantations. An attempt is made here to examine some of the interactions between the forestry and allied sectors in the State in both physical and economic dimensions.

### *Land utilization*

Out of the total geographical area of 3.886 million hectares, the net area under cultivation during 2008-09 was 2.116 million hectares in the State. This forms only 54.46 per cent of the total area. About 27.83 per cent of the total area was forest, 11.63 per cent under non-agricultural use and 0.58 per cent barren and uncultivable land. Agriculture and forest sectors together accounted for over 82.29 per cent of the land area (Table 6.1).

Table 6.1. Land use pattern in Kerala during 2008-09

| Sl.No. | Classification of land | 2008-09* | Per cent of geographical area |
|---|---|---|---|
| 1 | Total geographical Area | 3,88,6287 | |
| 2 | Forest | 1,081,509 | 27.83 |
| 3 | Land put to non agricultural uses | 451,815 | 11.63 |
| 4 | Barren and uncultivated land | 22,587 | 0.58 |
| 5 | Permanent pastures and grazing land | 223 | 0.01 |
| 6 | Land under miscellaneous tree crops | 5,510 | 0.14 |
| 7 | Cultivable waste | 91,830 | 2.36 |
| 8 | Fallow other than current fallow | 44,939 | 1.16 |
| 9 | Current fallow | 71,492 | 1.84 |
| 10 | Net area sown | 211,6382 | 54.46 |
| 11 | Area sown more than once | 585,752 | 15.07 |
| 12 | Total cropped area | 270,2134 | 69.53 |
| 13 | Cropping intensity | 127.68 | |

** Provisional*

*Source: Economic Review 2009, Directorate of Economics and Statistic, Kerala*

An idea of the physical orientation of the major land use categories can be obtained from Figure 6.1.

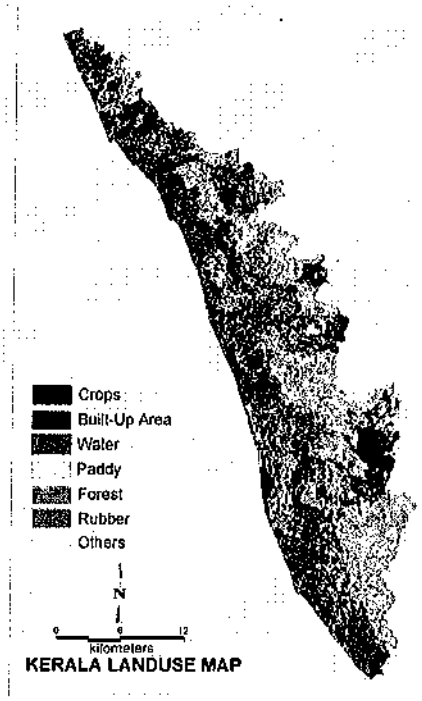



Figure 6.1. Land use map of Kerala

***Domestication of wild species of forest***

Domestication of plants and animals was necessary for the evolution of agriculture. It transformed the profession of the early humans from hunting and gathering to settled agriculture. Majority of the population in Kerala are dependent directly or indirectly on agriculture for their livelihood. The main crops grown in the State are paddy, coconut, pepper, cashew, cassava, and plantation crops like rubber. Kerala's is an agrarian economy. Cash crops, like coconut, rubber, tea and coffee, pepper and cardamom, cashew, areca nut, nutmeg, ginger, cinnamon, cloves and the like, give the agriculture of Kerala a distinct flavour.

Human society will continue to depend on biodiversity of wild relatives of cultivated crops or domesticated animals, apart from those that are already domesticated. In addition to this, dependence on biological diversity for food, fibre, fuel, shelter, medicine and several other day-to-day needs would last forever. Therefore, maximum attention needs to be given to the conservation of species diversity in nature. Variations within a species are not extensively conserved, mainly because of lack of understanding of the variability or uniqueness of the variations existing within a species, either in the natural or under domesticated conditions. It is the genetic diversity which exists within a particular species that allows the species to adapt to varied environmental conditions. The livestock, fruits, vegetables, grains, pulses, among others of Kerala are all derived from the diverse and healthy natural resources of our ecosystems. Wild plants and animals have been in

the path of diversification for thousands of years due to changes in ecosystems in which they lived. While some of them are cultivated or domesticated, some of the obsolete varieties (in the case of plants) and breeds (in the case of animals and birds) are sources of important genetic material to improve the strains or breeds presently grown. Most of the improved varieties used today are synthetic or hybrid types, derived by incorporating useful genes or selections made to produce better quality of products or forms with longer shelf life or having better resistance to insect pests or diseases and adaptation to varied environments.

To a certain extent, home gardens and sacred groves also contribute their share in conserving the biodiversity whether domesticated or wild. However, there have been limited studies to understand the inter-dependence of different components of these two systems. Degradation and transformation of the agricultural ecosystem, land conversions, introduction of exotics, narrowing of the genetic base of traditional crop species and mechanized farming have negatively affected the richness of the agribiodiversity of the State and removed several wild relatives of crop plants, many of which are seen only in the forested highlands of the State.

***Comparative economy***

Forestry and wildlife play an important role in the economy of the State. The tax revenue obtained from the export of herbs and herbal byproducts has made a great contribution to the foreign exchange earning.

During 2008-09, the contribution from primary, secondary and tertiary sectors to the NSDP at constant (1999-2000) prices constituted 11.75 per cent, 24.76 per cent and 63.48 per cent respectively (Table 6.2). Over time, the contribution from primary sector has been decreasing and secondary sector slightly increasing but that of the tertiary remained almost same level.

Table 6.2. Contribution of the different sectors to the NSDP during 2008-09

| Sector | At constant price (Lakh Rs) | Percentage |
|---|---|---|
| Agriculture | 1,100,447 | 9.14 |
| Forestry and Logging | 137,156 | 1.14 |
| Fishing | 117,855 | 0.98 |
| Mining & Quarrying | 59,691 | 0.50 |
| **SUB TOTAL OF PRIMARY** | **1,415,149** | **11.75** |
| Manufacturing | 78,2178 | 6.50 |
| Electricity, Gas &Water Supply | 105,562 | 0.88 |
| Construction | 2,093,243 | 17.38 |
| **SUB TOTAL OF SECONDARY** | **2,980,983** | **24.76** |
| Transport, Storage & Communication | 1,515,834 | 12.59 |
| Trade, Hotel & Restaurant | 2,821,016 | 23.43 |
| Banking & Insurance | 750,497 | 6.23 |
| Real estate ownership, Business, legal | 981,548 | 8.15 |
| Public Administration | 508,022 | 4.22 |
| Other Services | 1,067,357 | 8.86 |
| **SUB TOTAL OF TERTIARY** | **7,644,274** | **63.49** |
| NSDP at factor cost | **12,040,406** | **100.00** |

*Source: Central Statistical Organization (2010)*

For Kerala, the share of agriculture in the NSDP was 9.14 per cent during 2008-09, forestry and fisheries sector contributed 1.14 per cent and 0.98 per cent to the total State income, which together constitute the primary sector (Table 6.3). Contribution of these sectors to the NSDP indicated a continuous decline in the State.

Table 6.3. Contribution of forestry, agriculture and fisheries sector to the NSDP

| Year | NSDP of forestry and Logging (Lakh Rs) | Per cent contribution of forestry sector to the NSDP | Per cent contribution of agriculture to the NSDP | Per cent contribution of fisheries to the NSDP |
|---|---|---|---|---|
| 1993-94 | 109,518 | 2.4 | 20.9 | 3.2 |
| 1994-95 | 119,920 | 2.4 | 21.2 | 3.1 |
| 1995-96 | 105,571 | 2.1 | 20.6 | 2.6 |
| 1996-97 | 109,960 | 2.1 | 20.2 | 2.8 |
| 1997-98 | 106,776 | 2.0 | 18.9 | 2.2 |
| 1998-99 | 111,497 | 1.9 | 18.0 | 2.2 |
| 1999-00 | 118,124 | 1.9 | 17.1 | 2.2 |
| 2000-01 | 114,125 | 1.8 | 17.0 | 2.1 |
| 2001-02 | 120,367 | 1.8 | 16.4 | 2.1 |
| 2002-03 | 129,242 | 1.8 | 15.6 | 1.9 |
| 2003-04 | 132,994 | 1.7 | 14.3 | 1.8 |
| 2004-05 | 121,081 | 1.5 | 14.4 | 1.5 |
| 2005-06 | 122,387 | 1.3 | 13.4 | 1.3 |
| 2006-07 | 127,894 | 1.2 | 11.5 | 1.2 |
| 2007-08 | 131,642 | 1.2 | 9.8 | 1.0 |
| 2008-09 | 137,156 | 1.1 | 9.1 | 0.9 |

*Source: Central Statistical Organization (2010)*

### *Impact of agricultural development on forests*

Land has many uses but its availability is limited. After the First World War, forests were cleared on a large scale in many countries to produce more food in response to increasing population pressure. The increasing demand for agricultural products and forest products forced man to resort to destruction of forests and conversion of the forest land into agricultural land. For instance, the massive food production drive, as part of an all India effort known as 'Grow More Food Campaign', was followed by a colonization programme in Travancore. The colonization scheme alone took up over 20,000 hectares benefiting about 10,000 persons in Devikulam and Peerumade Taluks. The post-war boom in prices of cash crops was another reason for attraction of migrant farmers to the forests. Also encroachment into reserved forests got accelerated during 1950s. There was a steady stream of government programmes encouraging settlements in the forests from early 1940's up to early 1970's so that it was inevitable that a spill over in the nature of 'encroachments' would take place. Various Commodity Boards such as Rubber, Coffee, Tea and Cardamom supported the expansion of these crops traditionally raised in forested areas. In fact, there was no consistent policy on forest land use by the State Government that statements to the effect

that no more forest lands will be assigned to encroachers after each regularization order, was never taken seriously by the farmers (Chundamannil, 1993).

The Private Forest (Vesting and Assignment) Act of 1971, provided for the vesting in the Government of private forests in the State of Kerala and for the assignment thereof to agriculturists and agricultural labourers for cultivation. This act facilitated conversion of forests to agriculture. The take over of the private forests under the KPF (Vesting and Assignment) Act as a land reform measure enabled the government to confiscate the forests without having to pay any compensation to the owners. The owners were allowed to retain private forests up to the limit provided in the Kerala Land Reforms (KLR) Act for personal cultivation.

The declining ratio of forests-to-agricultural lands and the increased intensity of land-use increased the pressure on remaining forests due to unauthorized cutting of trees (for firewood, charcoal and for making agricultural implements), overgrazing and collection of fodder, green leaf manure, litter and non-timber forest products. In addition, the local people frequently set fires in the forests for promoting grass growth that benefits the grazers by enriching soil fertility of the crop fields in the fringe areas through post-fire ash transport in rains, facilitating easier extraction of non-timber forest products and so on.

Agricultural land use changes affected the forest ecosystems of Kerala in two major ways; first, a conspicuous shrinkage of the State's forest cover and, second, the loss of structural integrity of the remaining forests. Changes in land use in the 'forest-cleared areas' have great impact on economy and ecology. Balance of the ecosystem will be affected by degradation of land and deforestation. Continuous decay of natural resources poses severe threats to the very survival of millions of human beings.

***Role of forests in agriculture***

Forestry sector is an important ingredient in the economic and social fabric of a country. The importance of agriculture sector is more pronounced in developing countries of the tropics. Forests in the tropics play a very significant role in regulating water cycle and in conserving soils. Forests are important in maintaining the agricultural stability by protecting watersheds and rendering environmental services. Forest is the foster mother to agriculture and is crucial for maintaining and improving the productivity of agricultural land. The demand for forest products and services in tropical countries increased rapidly in the recent past with the growth of population and rural economy.

Forests greatly affect watersheds. Trees, small plants and forest litter absorb rainwater, reducing erosion and runoff. When rain falls on bare ground, the full force of raindrops can wash soil into streams, making them muddy. But when rain falls on the forest, it drips down through leaves and branches to the forest floor. The forest canopy, as well as layers of plant litter under trees, protects the soil from the full force of rain. Tree roots hold the soil in place so that it does not wash away. Thus, forests help to retain the water in the soil.

The loss of forest cover and conversion to other land uses can adversely affect freshwater supplies. Watershed conditions can be improved by the proper management of the

forests. Forests can have important role in supplying freshwater. Healthy forests can strongly influence the quality of water yielded from watersheds, provide greatest soil stability and prevent high erosion of soil.

Forests and trees greatly contribute to maintaining the ecological balance. The integration of trees within agricultural schemes sustains crop production by improving soil fertility. Trees help to control water and wind erosion and they recycle vital nutrients, such as nitrogen back into the soil. Trees also grow where agricultural crops might fail, allowing production on marginal lands.

Climate change and forests are intrinsically linked. As globally important storehouses of carbon, forests play a critical role in influencing the Earth's climate. As forest ecosystems change and move in response to climate changes, they will become more vulnerable to disturbances. Deforestation especially by burning, releases a great amount of stored $CO_2$ into the atmosphere, contributing to global warming. Deforestation does have a role in small floods and topsoil erosion by eliminating the buffering and soil-anchoring effects of forests. With forest loss, the local community loses the system that performed valuable services like ensuring the regular flow of clean water and protecting the community from flood and drought. The forest acts as a sort of sponge, soaking up rainfall brought by tropical storms while anchoring soils and releasing water at regular intervals. This regulating feature of tropical rainforests can help moderate destructive flood and drought cycles that can occur when forests are cleared.

***Dependence of industries on forests***

Certain industries are largely dependent on forest produce or forest area *per se*. The chief industries centered on forests are sawmilling and related industries, ecotourism and raw drugs industries. The survival of these industries is dependent either on the forest produce or the forest sites.

Forest plantations serve as an important source of raw material to the wood-based industries. Teak is the major species planted, followed by mixed plantations and eucalypts. Major forest produce includes timber, bamboo, reeds and firewood. Their total production shows a declining trend from 1993-94 onwards (Table 6.4). The quantity of timber produced in 1999-2000 is 44,519 $m^3$ against 19,246 $m^3$ in 1997-98 and 26,664 $m^3$ in 1998-99. The quantity of timber produced in 2008-09 was 50,301 $m^3$ (round log). Reeds and bamboo showed sharp decline in supplies during the period 1999-2000. The number of bamboos and reeds produced were 18.98 lakhs and 186.80 lakhs respectively. These are species which can be promoted under farm forestry with people's participation (Economic Review 2009). All other forest products were showing varying trends during the period 1995-96 to 2007-08.

Table 6.4. Forest Products of Kerala

| Year | Timber (round logs) ($m^3$) | Timber (round poles) (no.) | Timber (sawn & squared) ($m^3$) | Fire-wood (t) | Jungle wood poles (no.) | Sandal wood (kg) | Bamboo (no.) | Reeds (no.) | Carda-mom (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 1995-96 | 61430 | 361179 | 30 | 45336 | 64 | 133847 | 1339741 | 49615070 | 3155 |
| 1996-97 | 51972 | 683391 | 4 | 29877 | 289 | 103523 | 4829421 | 56840410 | 1233 |
| 1997-98 | 19246 | 287243 | 2 | 11291 | 7054 | 171252 | 2338472 | 63239268 | 1717 |
| 1998-99 | 26664 | 275050 | 10 | 18424 | 670 | 17762 | 2068407 | 62708610 | 2758 |
| 1999-00 | 44519 | 455389 | 7 | 14191 | ... | 97028 | 627805 | 39576143 | 4249 |
| 2000-01 | 31299 | 129349 | 3 | 8105 | 212 | 405 | 1390456 | 49047940 | 4687 |
| 2001-02 | 38915 | 245254 | 9 | 11182 | 2397 | 23968 | 1305620 | 32610487 | 2911 |
| 2002-03 | 62591 | 433670 | 11 | 19085 | 7696 | 10099 | 151722 | 33076299 | 3739 |
| 2003-04 | 116281 | 753025 | 126 | 31575 | 10464 | 88817 | 946626 | 42945235 | 1145 |
| 2004-05 | 45012 | 438611 | 45 | 10636 | 14196 | 54622 | 1272444 | 34190835 | 11018 |
| 2005-06 | 42706 | 377953 | 603 | 13955 | 21131 | 78555 | 1824596 | 22901309 | 1808 |
| 2006-07 | 26774 | 296013 | 17 | 12748 | 21221 | 3159 | 1237030 | 21403530 | 2053 |
| 2007-08 | 48628 | 352896 | 23 | 12676 | 2044 | 17537 | 1551168 | 14352181 | 38 |
| 2008-09 | 50301 | 294289 | 299 | 9218 | 21450 | 30809 | 1897907 | 18680386 | 0 |

*Source: Kerala Forest Department (2009)*

Table 6.4 cont...

| Year | Ayurvedic herbs (kg) | Spices (kg) | Fibre (kg) | Grass other than fodder (kg) | Incense plants (kg) | Vegetable oil seeds (kg) | Bee's wax (kg) | Honey (kg) | Medicinal Plants (kg) |
|---|---|---|---|---|---|---|---|---|---|
| 1995-96 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 1996-97 | 842452 | 163535 | 11955 | 28875 | 114052 | 6080 | 2603 | 72161 | 36148 |
| 1997-98 | 7089938 | 236113 | 75725 | 25650 | 73023 | 3374 | 1338 | 71214 | 32770 |
| 1998-99 | 440829 | 46122 | 17650 | 30875 | 110401 | 5811 | 345 | 21376 | 30178 |
| 1999-00 | 887082 | 108221 | 12410 | 19500 | 122214 | 12168 | 986 | 41734 | 52646 |
| 2000-01 | 580243 | 54371 | 8300 | 3675 | 98061 | 7408 | 1190 | 47976 | 38322 |
| 2001-02 | 484000 | 107371 | 16667 | 11700 | 222608 | 12741 | 924 | 39566 | 48270 |
| 2002-03 | 397442 | 58465 | 8168 | 5425 | 108637 | 5282 | 204 | 36846 | 35539 |
| 2003-04 | ... | ... | ... | ... | ... | ... | ... | ... | ... |
| 2004-05 | 1060962 | 21278 | 60310 | 10046 | 84292 | 26266 | 1079 | 59464 | 78881 |
| 2005-06 | 1688681 | 2502 | 64874 | 14767 | 74062 | 50511 | 947 | 56983 | 41402 |
| 2006-07 | 1112701 | 2998 | 16527 | 71244 | 71722 | 42806 | 854 | 207390 | 56865 |
| 2007-08 | 863650 | 208 | 23525 | 22859 | 67424 | 17861 | 775 | 239119 | 21987 |
| 2008-09 | ... | ... | ... | ... | ... | ... | ... | ... | ... |

*Source: Kerala Forest Department (2009)*

*Employment generated by forest sector*

Kerala is generally known as a labour-friendly State. As per 2001 population Census, 63.4 per cent of the population was in the age group of 15-59 who constitute the labour force. Out of India's total main workers, 2.6 per cent are Keralities.

The forests provide shelter and means of livelihood for the hill tribes. They provide employment to people mainly for women and tribal people. NTFP has a major role in generating employment opportunities in the forestry sector. Sometimes in the remotest areas, the forest is the only source of employment and income. The scope of employment in the forestry sector largely depends on government's attitude towards the people living around forests. Participatory Forest Management (PFM), which recognizes the role of local people in management of forest, was started in the late 80's and was initially known as Joint Forest Management (JFM). Increase of employment in this sector to some extent would depend on the successful spread of PFM.

The number of persons employed in agriculture, hunting, forestry and fishing in public and private establishments in Kerala has been showing a continuous decline in the past (Table 6.6). In 2009, it was only 7.03 per cent while in the year 2000 it was 8.91 per cent of the total employment.

Table 6.5. Employment in public and private establishments in Kerala

| Year | No. of persons employed in agriculture, hunting forestry & fishing | Per cent contribution to total employment |
|---|---|---|
| 2000 | 109,287 | 8.91 |
| 2001 | 108,966 | 8.77 |
| 2002 | 102,681 | 8.46 |
| 2003 | 110,072 | 9.09 |
| 2004 | 97,713 | 8.11 |
| 2005 | 85,178 | 7.47 |
| 2006 | 83,203 | 7.55 |
| 2007 | 81,863 | 7.37 |
| 2008 | 80,080 | 7.17 |
| 2009 | 79,642 | 7.03 |

*Source: Economic Review (2008,2009)*

According to Census 2001, the total workers in Kerala were 7,985,820. Plantation, livestock, forestry, fishing, hunting and allied activities together contributed 1,366,470 workers to the total number of workers in which 1,049,760 were males and 316,710 were females.

*Forestry sector outlook*

Forests and forestry are becoming an increasingly larger issue in the context of the current scenario of global warming and related environmental concerns. There are social and economic changes that exert pressures on the forest resources and at the same time, some changes are creating new opportunities for forests and trees to contribute to development. It has been repeatedly emphasized that forests play a large role not only in maintaining the environmental stability but also for meeting the several economic and socio-cultural objectives put forth by the increasing population. Forest sector has inter-linkages with many other sectors and is subject to government policies and regulations implemented from time to time. The major issues that are currently discussed in relation to forest sector are forest degradation, climate change, social and environmental services provided by the forests and sustainable forest management many of which are highly relevant even locally.

Forests which are estimated to occupy about 11,033.39 $km^2$ or 28.39 per cent of the total land area in Kerala –is undergoing continual changes largely owing to social, economic, political and institutional factors. The growing economic considerations resulted in the neglect of social and environmental considerations leading to high rate of forest loss. Concern over meeting environment services has resulted in more natural forests being set aside as PA. Even with an increase in the extent of PAs there are no comparable improvements in management programmes. The declining ratio of forests-to-agricultural lands and the increased intensity of land-use increased the pressure on remaining forests due to unauthorized cutting of trees (for firewood, charcoal and for making agricultural implements), overgrazing and collection of fodder, green leaf manure, litter and non-wood forest products. The contribution of the primary sector (agriculture, fishery and forestry) to the NSDP indicates a continuous decline in the State. The dominance of a growing informal sector means that the official statistics on production, consumption and trade tends to be incomplete.

There are several factors impacting the forestry sector in Kerala. The key driving forces are demographic, social, economic, political, institutional changes, especially the decentralisation of administration, the increasing emphasis on transparency in the affairs of the public and private sectors, as well as the predominant role played by the society in protecting the environment. Forests will be fundamentally influenced by international developments such as integration of the economy, investment flow, technological changes and changes in trade pattern.

A key feature of Kerala economic transition is the growth of the informal sector in both rural and urban areas. Poor performance of the formal economy has increased the dependency on informal sectors like collection and trade of fuel wood, timber, NTFP's, among others. In the absence of adequate capacity to manage and regulate the liberalization policies we have not been able to capture the full benefits from the use of the natural resources. Some of the possible outcomes for Kerala forests are indicated in Table 6.6.

Table 6.6. Possible outcomes for Kerala forests

| Key indicators | Future scenario |
|---|---|
| Forest cover | Afforestation programmes at more than the current rates. |
| Area under SFM | Effective expansion of area under SFM. |
| Forest plantations | Emphasis on fast growing species. |
| Trees outside forests | Increase in tree planting schemes,<br>Expansion of tree planting in private lands in response to growing local demand. |
| Fuel wood | Not a main source of energy,<br>Major developments enabling alternate sources of energy like LPG. |
| NTFP | Rapid depletion of several products due to increased demand,<br>Domestication efforts linked to commercially important products. |
| Ecotourism | Accelerated pace of ecotourism development,<br>Threat to ecosystem,<br>Labour intensive methods of ecotourism management benefits local communities. |
| Environmental service | Effective watershed management,<br>Conservation of Biodiversity. |
| Poverty alleviation | Key role in meeting basic needs of the poor, largely through the growing informal sector. |

## 7. Conclusions and recommendations

(i) Projections of NSDP of forest sector for future years indicated an increasing trend for production from forest sector in the immediate future.

(ii) The sector analytic approach forwarded by ADB was found useful in decision making with respect to handling certain key problems in forest sector like increasing forest degradation, decreasing plantation productivity and decreasing outturn in the case of industries.

(iii) The future trends for price and demand worked out showed a generally increasing trend for both teak prices and demand beyond 2004-05 but for the yearly alternating fluctuations in both the cases.

(iv) A study on the periodic behaviour of production and price of teakwood indicated some market adjustment mechanisms operating with a cycle of 3 to 5 years.

(v) The pulpwood requirements in the State although predicted to be on the increase based on historical data, the industry seemed to be lagging due to severe competition from related units. Government intervention may be needed in this front.

(vi) The tourism traffic to Kerala depicts an increasing trend over the years. The domestic tourists constituted on an average 95 per cent of the total tourist flow during the period 1980-2002 and the foreign tourists constituted the rest 5 per cent.

(vii) The overall ecotourism development in the PAs depict an increasing trend and the new economic policy of 1991 has accelerated its pace. Ecotourism growth on the one hand can provide employment generation and at the same time poses various threats to the fragile ecosystem. Developing efficient site specific management strategies is the need of the hour.

(viii) Shortage of raw material is the major constraint faced by the sawmilling industry. Since homesteads continue to be the major source of wood, tree planting in homesteads needs to be promoted by appropriate legal and policy changes.

(ix) The situation in raw drug industry can be depicted as a combination of three core scenarios, private sector dominance, market force dominance and growing informal sector.

(x) Forest is the foster mother to agriculture and is crucial for maintaining and improving the productivity of agricultural land. However, the forests and agriculture instead of having mutually supportive roles were having competing roles leading to decline of both.

(xi) The forests play an important role in the economy of the State but the percentage contribution of forestry sector to the NSDP in monetary terms indicated a continuous decline in the State.

(xii) A few of the industries viz., sawmilling, raw drug industries and ecotourism are much dependent on forest produce/forest sites. Forests also provide employment to the people mainly for women and tribal people inside or in the fringes of forests in a significant manner.

(xiii) Efforts are to be taken to stop further degradation of forests through conservation measures but the production aspect is not to be totally ignored.

(xiv) The situation in the forestry sector can be depicted as a combination of market force dominance and a growing informal sector. The role of government in producing wood will decline as this function is increasingly taken over by the market forces and the informal sector. The public sectors role will be limited to policy-making, regulatory functions and the provision of goods and services that the private sector is unlikely to provide.

(xv) The informal sector will continue to dominate the forestry activities. As there are a large number of operators in the informal sector which is often much larger than the formal sector there is a need to consider its development as a distinct scenario. The importance of market forces will increase as they take advantage of the emerging opportunities for trade in forest products.

(xvi) The key driving force affecting the forestry sector will be agriculture. Trade liberalisation and consequent changes in imports/exports are expected to affect the pattern of agriculture and subsequently the forestry sector.

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## Appendix

Key data used for estimating parameters of the supply-demand model for teakwood

| Year | Production From forests ($m^3$) | Production from homesteads ($m^3$) | Export ($m^3$) | Import ($m^3$) | Teak-wood price ($Rs/m^3$) |
|---|---|---|---|---|---|
| 1980-81 | 27528 | | 50596 | 198 | 3092 |
| 1981-82 | 17901 | | 69198 | 677 | 3670 |
| 1982-83 | 27700 | | 60317 | 1609 | 5180 |
| 1983-84 | 25411 | | 59182 | 313 | 4527 |
| 1984-85 | 21865 | | 73652 | 495 | 5107 |
| 1985-86 | 14091 | | 91780 | 604 | 5873 |
| 1986-87 | 16300 | | 80032 | 1122 | 7508 |
| 1987-88 | 19222 | | 50043 | 1817 | 7476 |
| 1988-89 | 8099 | | 49352 | 476 | 7251 |
| 1989-90 | 24735 | | 64356 | 1384 | 9432 |
| 1990-91 | 15583 | | 58847 | 765 | 9299 |
| 1991-92 | 20927 | | 57684 | 863 | 11352 |
| 1992-93 | 32429 | 35750 | 50196 | 1804 | 13326 |
| 1993-94 | 23240 | 47103 | 61509 | 2587 | 15859 |
| 1994-95 | 57289 | 43591 | 35648 | 1602 | 14197 |
| 1995-96 | 26766 | 29378 | 36618 | 3837 | 23472 |
| 1996-97 | 32817 | 29269 | 23194 | 5451 | 27567 |
| 1997-98 | 12307 | 41068 | 19074 | 10891 | 27049 |
| 1998-99 | 18338 | 28533 | 16138 | 17183 | 25445 |
| 1999-00 | 33973 | 32983 | 15835 | 15613 | 21838 |
| 2000-01 | 34320 | 30225 | 18780 | 14668 | 22754 |
| 2001-02 | 34667 | 49199 | 6200 | 7490 | 24944 |
| 2002-03 | 49927 | 40586 | 7930 | 7490 | 24872 |
| 2003-04 | 107892 | 31973 | 7930 | 7490 | 25660 |
| 2004-05 | 20169 | 44227 | 7930 | 7490 | 25036 |

| Year | Area logged (ha) | Wage of carpenter (Urban) Rs/day | PCI of Kerala* (Rs) | PCI of Karnataka (Rs)** | WPI |
|---|---|---|---|---|---|
| 1980-81 | 298.80 | 19.33 | 1508 | 5587 | 36.92 |
| 1981-82 | 161.70 | 22.87 | 1406 | 5978 | 40.36 |
| 1982-83 | 249.00 | 30.68 | 1414 | 6090 | 41.40 |
| 1983-84 | 256.20 | 35 | 1324 | 6537 | 45.32 |
| 1984-85 | 214.50 | 37.97 | 1387 | 7040 | 48.55 |
| 1985-86 | 138.00 | 40.67 | 1505 | 6760 | 51.33 |
| 1986-87 | 370.30 | 45.39 | 1450 | 7375 | 54.04 |
| 1987-88 | 183.90 | 50.08 | 1401 | 7878 | 58.15 |
| 1988-89 | 122.50 | 51.92 | 1610 | 8548 | 62.43 |
| 1989-90 | 107.50 | 53.98 | 1697 | 9051 | 66.87 |
| 1990-91 | 116.30 | 56.67 | 1813 | 9107 | 73.73 |
| 1991-92 | 251.40 | 61.25 | 1792 | 10280 | 83.86 |
| 1992-93 | 402.70 | 70.92 | 1943 | 10504 | 92.29 |
| 1993-94 | 402.70 | 76.5 | 2136 | 11286 | 100.00 |
| 1994-95 | 786.94 | 91.47 | 2315 | 11677 | 112.60 |
| 1995-96 | 284.20 | 113.85 | 2410 | 12236 | 121.60 |
| 1996-97 | 1253.60 | 134.87 | 2496 | 13129 | 127.20 |
| 1997-98 | 384.20 | 150 | 2518 | 13800 | 132.80 |
| 1998-99 | 874.22 | 159.17 | 2687 | 15364 | 140.70 |
| 1999-00 | 379.61 | 172.21 | 2861 | 15979 | 145.30 |
| 2000-01 | 965.35 | 184 | 2981 | 17376 | 155.70 |
| 2001-02 | 1020.06 | 187 | 3051 | 17543 | 161.30 |
| 2002-03 | 653.62 | 187 | 3277 | 18269 | 166.80 |
| 2003-04 | 579.21 | 187 | 3462 | 19163 | 175.90 |
| 2004-05 | 458.82 | 187 | 3462 | 19163 | 187.30 |

*Per capita income of Kerala
**Per capita income of Karnataka