ANNUAL REPORT

1989 - '90

kerala forest research institute

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April 1989 March 1990

Kerala Forest Research Institute
Peechi - 680 653, Kerala, India

KERALA FOREST RESEARCH INSTITUTE, PEECHI

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Contents

1. INTRODUCTION

During the year 1989-90, Dr. KSS Nair, Scientist-in-charge, Division of Entomology continued to hold additional charge of the Director.

The Institute received Rs 52.75 lakhs from the State Government as Grant-in aid and Rs 33.20 lakhs from other agencies against specific research projects (Ministry of Environment and Forests, Govt. of India; Social Forestry Project of Kerala Forest Department, International Development Research Centre of Canada [IDRC] etc.).

The Governing Body met twice during the year, on 16 October 1989 and 12 March 1990 and the Executive Committee met 3 times.

A notable event during the year was organisation by the Institute of a Training Workshop on Tropical Forest Ecosystem Conservation and Development for the benefit of participants from South and South East Asia with support from the Man and Biosphere Programme of the UNESCO and Govt. of India. More details are given elsewhere.

The year also saw the establishment of a Bamboo Information Centre (BIC-India) in the Institute Library as a 3-year Project supported by a grant of about Rs 23 lakhs from IDRC, Canada. This project envisages development of a database on Indian Bamboo literature for providing bibliographic and documentary services, preparation of a compendium on bamboos of India, etc. Further details are given under Divisional Reports.

2. INFRASTRUCTURE AND STAFF

No major civil work was undertaken during the year due to paucity of funds. Development projects like construction of a research scholars hostel; furnishing of the auditorium; and finishing work of the Teak Museum and Research Centre at Nilambur could not be pursued. Thanks to project specific funding from external sources, research projects did not suffer.

Based on the recommendations of a Committee constitued by the Executive Committee, the Division of Management was reorganised into Division of Statistics and Division of Economics and the Library was designated as a Division under the charge of the Librarian.

As on 31 March 1990 there were 150 regular employees 46 scientific, and 104 technical, administrative and supporting. (See Appendix I)

Shri.P.K. Balan, Registrar retired on superanuation on 31 March 1989 and Dr. T.G. Alexander, Scientist-in-charge, Soil Science Division held additional charge of the Registrar until 26 September 1989. Sri. Joseph K. John, Deputy Secretary to Govt. of Kerala joined the Institute on deputation and took charge as Registrar on 27 September 1989. Sri C.D. Johny who held the post of Deputy Registrar (Admn.) on deputation from Govt. of Kerala left the Institute on 26 June 1989. Shri P.V. Madhusudhanan, Range Officer, Kerala Forest Department joined the Silviculture Division of the Institute on deputation with effect from 12 July 1989.

3. HIGHLIGHTS OF RESEARCH PROJECTS COMPLETED DURING 1989-90

Highlights of the research projects completed during the year are given below under different subject heads. Details are given under the Divisional reports that follow. Highlights of ongoing projects are not dealt with here and may be found under Divisional reports.

PLANTATION FORESTRY

Reduced slash burning for raising teak plantations

An extensive field study in the Karulai Range of Nilambur Forest Division during 1981-85 showed that slash burning at the site of planting did not give a lasting advantage in terms of growth of teak or yield from taungya crops although a temporary reduction in weed growth occurred. Salvaging firewood of 10-30 cm girth over bark which is normally burned during pre-planting operations yielded a net revenue of Rs.756/- per ha in 1982 after meeting the labour charges of Rs.1,244/- for the operations. The study suggests a modification of the current practice to reduce the quantity of slash burned, in order to salvage all wood down to 10 cm girth over bark for use as firewood, depending on local conditions.

Search for resistance in teak against defoliator

Extensive search in Kerala for teak provenances resistant to the teak defoliator indicated that the commonly observed apparent resistance of isolated trees is due to what may be called 'phenological resistance'. Tender foliage is essential for initial establishment and survival of the teak defoliator and the phenological resistance results from asynchrony between the flushing time of trees and insect population cycles. This resistance is not of practical utility in protecting the plantations against the insect. The related genus *Tectona hamiltoniana*, however, was found to be resistant to the teak defoliator.

Stump planting in *Eucalyptus*

Methods were standardised for raising *Eucalyptus* plantation using stumps. Use of poly-potted seedlings is more convenient, but stump planting can be made use of for taking advantage of older seedlings left over in the previous year's nurseries. Treatment of the stems with boric acid prior to planting enhanced the rooting percentage, and storage of stumps in pits or shade enhanced the survival by inducing callus formation. Treatment methods were standardised for protection from termite damage and fungal infection.

NATURAL FORESTS AND CONSERVATION

Floristic studies in Pooyamkutty

A Study of the flora of the Pooyamkutty area showed that there are 340 species of flowering plants in the area belonging to 99 families- 82 dicots and 17 monocots. Among them 115 species were found to be endemic to Peninsular India.

Addition to Herbarium

During the year 289 specimens were accessioned to the KFRI Herbarium, making up a total collection of 1415 specimens of flowering plants.

Butterflies and moths of Silent Valley

In a study of the butterflies and moths of Silent Valley, a total of 500 species were collected of which 340 were identified - 95 species of butterflies and 245 species of moths. Of these 13 species are very rare and 5 are from the list of protected species. The 160 unidentified species belong to micro-lepidoptera for which taxonomic knowledge is poor and some of these are likely to turn out to be new species. The study has thrown light on the lepidopteran species diversity in the different habitats within Silent Valley.

Establishment of an Orchidarium

Although the best way to conserve the species is to conserve its habitat, this is not always practicable. In order to conserve the rich variety of orchids known to occur in the Western Ghats, an Orchidarium was established in the Institute in which field collected specimens of naturally occurring species are maintained under suitable conditions. About 100 species out of nearly 200 species of orchids known in Kerala have been collected and 84 of them are maintained in the Orchidarium. Our collections, unlike those in the TBGRI do not include exotic ones, the purpose of our Orchidarium being maintenance of a germ plasm collection. This will prevent their disappearance due to the progressive degradation of natural forests.

WILDLIFE

Studies on Lion-tailed macaque

In a study of the endangered lion tailed macaques (LTM) in about 2000 ha of evergreen forests in the southern part of the Silent Valley and Attappady reserves, 13 troups with about 171 individuals were encountered. Canopy continuity was found to be a limiting factor restricting the movement of LTM populations.

Based on the study, recommendation has been made to add the Panthanthodu Forest Beat of Attappady RF Block I to the Silent Valley National Park to ensure a large viable population of LTM in the National Park.

WOOD UTILIZATION

Saw Milling Industry in Kerala

A techno-economic study of sawmilling industry in Kerala showed that the industry which has been growing steadily in terms of production and number of units until 1980 is facing serious problems since 1984, consequent to the ban on clear-felling resulting in severe shortage of wood raw material. The study suggests the need for modernisation of the saw-mills in order to improve the turn-over and the quality of sawn wood. Low-cost automation and use of improved saws are suggested. The study also brings out the need for integration of saw milling with other industries for optimum utilisation of saw milling products and residues, particularly joinery and furniture making units as well as particle board manufacturing units. The study recommends imparting training in saw doctoring to individual saw-millers; more liberalised import of timber from other countries and discouraging establishment of new saw-milling units in the State.

SOCIO-ECONOMICS

The Reed Resource of Pooyamkutty

Based on a of the study of collection records of Hindustan Newsprints Ltd., Kerala State Bamboo Corporation Ltd. and other reed users it has been estimated that about 23500 metric tonnes of reed are extracted annually from the Pooyamkutty area. Of this, about 7000 tonnes are used by the traditional reed workers generating over 20 lakh mandays work annually. The study thus indicated that Pooyamkutty is a major reed source in Kerala.

Human settlements in Pooyamkutty project area

A study of the human settlements in the Pooyamkutty Hydroelectric Project area indicated that there are 3 settlements - a tribal settlement of Muthuvans at Kurathikudi, a mixed settlement at Metanappara and one non-tribal settlement at Anakulam, together comprising about 773 persons living within the area to be submerged on commissioning of the Ist Phase of the project. In addition, construction of the power house at Pinavur will lead to displacement of 152 persons belonging to Muthuva, Araya and Ulladan tribes. Thus a total of about 925 persons will be displaced by the first phase of the proposed Pooyamkutty Hydroelectric Project.

4. LIST OF RESEARCH PROJECTS IMPLEMENTED

A. COMPLETED PROJECTS

A.1 REPORTS PUBLISHED

1. Econ 06/85 : **A techno-economic study of saw-milling industry in Kerala** (KFRI Research Report No. 60).

   PK Muraleedharan, KM Bhat (Economics & Wood Science)

2. Silvi 05/81 : **Studies on the effect of slash burning on planting site for teak** (KFRI Research Report No. 61)

   KC Chacko, S Sankar, RC Pandalai and UN Nandakumar (Silviculture and Soil Science)

3. Entom 12/82 : **Search for natural resistance to the insect pests *Hyblaea puera* in teak** (KFRI Research Report No. 62)

   KSS Nair, S Kedharnath, Mathew P Koshi, VV Sudheendrakumar, K Mohanadas, RV Varma and George Mathew (Entomology & Genetics)

4. Silvi 04/81 : **Studies on stump as planting material for *Eucalyptus tereticornis* plantations** (KFRI Research Report No. 63)

   KC Chacko, VV Sudheendrakumar, C Mohan, T Surendran and E Muhammad (Silviculture, Entomology, Pathology and Physiology)

5. Bot 02/79 : **Establishment of orchidarium in the institute campus** (KFRI Research Report No. 64).

   N Sasidharan, MS Muktesh Kumar, VPK Nambiar and C Renuka

6. Genl 03/85 : **Long-term environmental and ecological studies of Pooyamkutty Hydroelectric Project - pre-construction stage analysis** (Report submitted to the sponsors, Dept: of Environment and Forests, Govt. of India).

   K Balasubramanyan, S Sankar, P Vijayakumaran Nair, Mammen Chundamannil (Ecology, Soil Science, Wildlife and Economics).

7. KFRI 105/87 : **(Entom) Studies on lepidopteran fauna of silent valley** (Report submitted to the sponsors, Department of Environment and Forests, Govt. of India)

   George Mathew (Entomology)

8. KFRI 107/87 : **(Soils) Soil and plant community relationship in wet evergreen forests of silent valley** (Report submitted to the sponsors, Department of Environment and Forests, Govt. of India)

   M Balagopalan (Soil Science)

9. KFRI 112/87 : **(Wild) Feeding and ranging patterns of lion-tailed macaque (*Macaca silenus*) in silent valley** (Report submitted to the sponsors, Department of Environment and Forests, Govt. of India)

   KK Ramachandran (Wildlife)

10. KFRI 118/87 : **(Wild) Community ecology of birds in silent valley** (Report submitted to the sponsors, Department of Environment and Forests, Govt. of India)

    EA Jayson (Wildlife)

11. KFRI 121/87 : **(Ecol) Establishment of permanent sample plots for long-term monitoring of ecological processes** (Report submitted to the sponsors, Dept. of Environment and Forests, Govt. of India)

    K Balasubramanyan, (Ecology)

A.2. REPORTS UNDER PREPARATION

1. Bot 04/82 : **Establishment of herbarium in the institute** (January 1983 - December 1988) -

   N Sasidharan (Botany)

2. Bot 07/85: **A study on the tree legumes endemic to the western ghats of Kerala** (October 1985 - September 1988).

   N Gopalakrishnan Nair (Botany)

3. Bot 08/85 : **Distribution of important tree species in Kerala forest** (Southern Circle) (October 1985 -September 1988).

   N Gopalakrishnan Nair (Botany)

4. Ecol 01/79 : **Preparation of a soil-cum-vegetation map of the forests of Trichur Division** (January 1980 - December 1983)

   K Balasubramanyan, ARR Menon, Thomas P Thomas (Ecology & Soil Science)

5. Ecol 04/80 : **Phenological studies in representative evergreen forests of Kerala** (April 1980 - March 1984)

   K Balasubramanyan (Ecology)

6. Ecol 07/86 : **Vegetation analysis and mapping of parambikulam wildlife sanctuary** (April 1986 - March 1988).

   ARR Menon (Ecology)

7. Econ 02/82 : **A socio-economic study of farm forestry with speccal reference to Kerala** (April 1980 - September 1984)

   CTS Nair, CN Krishnankutty, Mammen Chundamannil, and AR Rajan

8. Econ 05/84 : **History oo forest management in Kerala** (October 1984 - March 1987)

   CTS Nair, and Mammen Chundamannil (Economics)

9. Entom 13/84 : **Biology and ecology of teak trunk borer, *Cossus cadambae* Moore and its control** (October 1984 - September 1987)

   George Mathew (Entomology)

10. Pathol F02/79 : **Epidemiology and control of diseases in *Eucalyptus* caused by *Cylindrocladium* species in Kerala** (January 1979 - January 1984)

    JK Sharma and C Mohan (Pathology)

11. Pathol F04/86 : **Sapstain fungi of some commercially important timbers and their possible ccntrol** (January 1986 - December 1988)

    EJ Maria Florence (Pathology)

12. Pathol NF06/86 : (Coord). **Evaluation of microbial pathogens as biocontrol agents against insect pests of *Ailanthus* and teak** (January 1986 - December 1988)

    MI Mohamed Ali, RV Varma and VV Sudheendrakumar (Pathology & Entomology)

13. Silvi 01/79 : **Silviculture and management of fast growing indigenous hardwood species with multiple end uses** (January 1977 - January 1982)

    CS Venkatesh and KC Chacko (Silviculture and Genetics)

14. Silvi 06/81 : **Estimation of quantity of *Eucalyptus* seeds for sowing in nurseries** (October 1981 - September 1983)

    E Mohammed, KC Chacko, RC Pandalai, UN Nandakumar (Silviculture)

15. Silvi 07/81 : **Establishment of bambooteaux** (October 1981 - September 1986)

    KC Chacko, T Surendran, and NG Nair (Silviculture, Physiology and Botany)

16. Silvi 08/84 : **Polyurethane foam sheet for raising forest tree seedlings** (July 1984 - December 1986)

    KC Chacko, RC Pandalai (Silviculture)

17. Soils 12/84 : **Nutrient partitioning in an evergreen ecosystem** (April 1984 - December 1987)

    S Sankar (Soil Science)

18. Soil 14/84 : **Ex-situ decomposition of leaf litter of teak, eucalypt and *Albizia*** (January 1984 - December 1987)

    MV Mary (deceased) and KV Sankaran (Soil Science & Pathology)

19. Stat 02/77 : **A data bank for the forestry sector in Kerala** (January 1977 - December 1988)

    K Jayaraman and CN Krishnankutty (Statistics)

20. Stat 06/84 : **Statistical techniques in forestry research and forestry** (October 1984 - September 1987)

    K Jayaraman and P Rugmini (Statistics)

21. Wood 07/82 : **Establishment of axylarium** (April 1982 - March 1987)

    KM Bhat and R Gnanaharan (Wood Science)

22. KFRI 119/87 : **Demand and supply of wood in Kerala and their future trends** (October 1987 - September 1989)

    CN Krishnankutty (Statistics)

B. ONGOING PROJECTS

1. 101/1987 : (Entom) **Development of a management strategy for the teak defoliatior, *Hyblaea puera*** (April 1987-March 1992)

   KSS Nair, VV Sudheendrakumar, K Mohanadas, KC Chacko and MS Jayaraman (Entomology and Silviculture)

2. 102/1987 : (Soils) **Soil technology packages for enhancing productivity in teak plantations of Kerala** (April 1987 - March 1992)

   TG Alexander (Soil Science)

3. 103/1987 : (Entom) **Spatial and temporal distribution of *Ailanthus* pests, *Eligma narcissus* and *Atteva fabriciella*** (April 1987 - March 1990).

   RV Varma (Entomology)

4. 104/1987 : **Tree improvement of *Eucalyptus* for disease resistance and higher productivity** (April 1987 - December 1995)

   JK Sharma, M Balasundaran, EJ Maria Florence, EP Indira, T Surendran, KM Bhat, KC Chacko and RC Pandalai (Pathology, Genetics, Physiology, Wood Science and Silviculture).

5. 106/1987 : (Pathol) **Decay in standing trees in natural forests** (April 1987 - March 1992)

   C Mohan (Pathology)

6. 108/87 : **Silviculture, Management and utilisation of bamboo resources in Kerala** (April 1987 - March 1991)

   Director, R Gnanaharan, CN Krishnankutty, MS Muktesh Kumar, KC Chacko, KK Seethalakshmi, Thomas P Thomas (Wood Science, Statistics, Botany, Silviculture, Physiology and Soil Science)

7. 109/87 : (Wood) **Management and utilization of bamboo resources in Kerala** (April 1987 - March 1991)

   Director, KM Bhat, TK Dhamodaran, K Jayaraman, C Mohan, PK Muraleedharan, UN Nandakumar, C Renuka, KK Seethalakshmi (Wood Science, Statistics, Pathology, Economics, Silviculture, Botany and Physiology).

8. 110/87 : (Pathol) **Diseases of bamboos, reeds and canes in Kerala** (April 1987 - March 1991)

   C Mohan (Pathology)

9. 111/87 : (Wild) **Ecology and behaviour of sambar deer, *Cervus unicolorin* Parambikulam Wildlife Sancturary** (April 1987 - March 1990)

   PS Easa (Wildlife)

10. 113/87 : (Wood) **Wood properties of some lesser-known tree species of Kerala** (April 1987 - March 1990)

    KV Bhat (Wood Science)

11. 114/87 : (Bot) **Studies on selected indigenous species for future plantation programmes in Kerala** (April 1987 - August 1990)

    KKN Nair, MI Mohamed Ali, KC Chacko, ARR Menon, KV Bhat and George Mathew (Botany, Pathology, Silviculture, Ecology, Wood Science and Entomology)

12. 115/87 : (Genet) **Genetic improvement of *Ailanthus triphysa*** (July 1987 - June 1996)

    EP Indira (Genetics)

13. 116/87 : (Econ) **Human ecology and socio-economic interactions in tribal communities of Attappady** (August 1987 -December 1990)

    PK Muraleedharan and S Sankar (Economics and Soil Science)

14. 117/87 : (Ecol) **Regeneration studies on some important trees in a natural moist deciduous forest ecosystem** (August 1987 - April 1991)

    K. Swarupanandan and N Sasidharan (Ecology & Botany)

15. 120/87 : (Silvi) **Afforestation trials in Attappady** (August 1987 - December 1990)

    KC Chacko, RC Pandalai (Silviculture)

16. 122/89 : (Soils) **Growth response of seedlings of selected indigenous species to NPK input** (January 1989 - December 1991)

    TG Alexander, MP Sujatha (Soil Science)

17. 123/89 : (Wood) **Upgradation of rubberwood** (January 1989 - December 1991)

TK Dhamodaran, R Gnanaharan (Wood Science)

18. 124/89 : (Bot) **Species trials for reforestration of Pattikkad Hills** (March 1989 - November 1990)

NG Nair (Botony)

19. 125/89 : (Physiol) **Water blisters in teak** (January 1989 - December 1990)

Jose Kallarackal, KK Seethalakshmi, KV Bhat (Physiology and Wood Science)

20. 126/89 : (Pathol/Coord) **Litter dynamics, microbial associations and soil studies in *Acacia auriculiformis* plantations in Kerala** (March 1989 - November 1991)

KV Sankaran, M Balasundaran, Thomas P Thomas and MP Sujatha (Pathology and Soil Science)

21. 127/89 : (Physiol) **Studies on water use, assimilation and growth of eucalypts** (December 1989 - December 1992)

Jose Kallarackal and T Surendran (Physiology)

22. 128/90 : (Physiol) **Water use of selected indigenous and exotic trees** (February 1990 - January 1992)

Jose Kallarackal, CK Soman (Physiology)

23. 130/90 : (Silvi) **Demonstration cum research on multitier forestry through operations research** (January 1990 - Deecember 1992)

UN Nandakumar (Silviculture)

24. 131/90 : (Wild) **Distribution of mammals and birds in Chinnar Wildlife Sanctuary and Eravikulam National Park** (March 1990 - April 1992)

P Vijayakumaran Nair, KK Ramachandran, PS Easa and EA Jayason

5. REPORTS FROM DIVISIONS

BOTANY

COMPLETED PROJECTS

ESTABLISHMENT OF AN ORCHIDARIUM IN THE INSTITUTE CAMPUS (KFRI Research Report No. 64)

Nearly 200 species of orchids have been recorded from Kerala, but several of them have a restricted distribution. Urgent steps have become necessary for the protection of orchids, especially the rare and endemic species. Although the best way to conserve a species is to conserve its habitat, this is not always practicable in the case of orchids as each species has its own habitat preferences. In addition to in situ conservation, ex situ conservation is possible through establishment of orchidaria.

An orchidarium was constructed in the Institute as per design obtained from the National Orchidarium, Yercaud, for ex situ conservation and multiplication of indigenous orchids. About one hundred species were collected during the study period and 84 species are maintained in the orchidarium, including some rare and endemic species. Herbarium specimens were also prepared and incorporated into the Institute herbarium. The specimens were identified with pertinent literature and by comparing with authentic specimens. Suitable planting methods were adopted for growing the orchids in the orchidarium depending on their habit and habitat. In general, epiphytic orchids thrive well under cultivation. Among the orchids collected, five species are new records of occurrence for Kerala.

FLORISTIC STUDIES IN THE POOYAMKUTTY HYDROELECTRIC PROJECT AREA (Component of Project KFRI Gen 03/85. Report submitted to Department of Environment and Forests, Govt of India)

In the submergible and catchment areas of the proposed Pindimedu dam, a total of 340 taxa of angiosperms were recorded which belonged to 99 families of 82 dicots and 17 monocots. Among them 115 species belonging to 47 families were those endemic to Peninsular India which come to 34 % of the total floristic elements. The rest of the flora belong to categories like Peninsular Indo-Srilankan,Indian, Indo-Malayan and pluri-regional species.

In the Anamalai - Manali region, there were 171 taxa of flowering plants characteristic to the flora of the region. Of them, 35.6% were those endemic to Peninsular India and the remaining 64.4% were of Indian, Peninsular Indo - Sri Lankan, Indo-Malayan or pluri-regional in their distribution. Among the Peninsular-Indian endemics, more than 50% were those species confined to the southern portion of the Western Ghats. Representation of Peninsular Indo-Sri Lankan elements were also high in this region, showing the affinity of the flora of this part of the Western Ghats to that of Sri Lanka.

ESTABLISHMENT OF HERBARIUM IN THE INSTITUTE (Project Bot 04/82)

Collection of specimens were continued from forests of Trichur and Vazhachal. During the year 289 more specimens were incorporated in the Herbarium making a total collection of 1415 specimens. The report is under preparation.

STUDY ON THE TREE LEGUMES ENDEMIC TO THE WESTERN GHATS OF KERALA (Project Bot 07/85)

The report is under preparation.

DISTRIBUTION OF IMPORTANT TREE SPECIES IN KERALA FOREST (Southern Circle) (Project Bot/85)

The report is under preparation.

ON-GOING PROJECTS

BOTANICAL STUDIES OF SELECTED INDIGENOUS TREE SPECIES (Component of project KFRI 114/87)

During the reporting period exhaustive field surveys were undertaken in various forest ranges and specimens collected to authenticate the distribution of species and also to serve as material for taxonomic studies and variation analysis. Herbaria of the Forest Research Institute, Coimbatore and Botanical Survey of India, Coimbatore were also consulted and data on the above mentioned aspects gathered.

DISTRIBUTION,ECOLOGY AND GERMPLASM COLLECTION OF REEDS (Component of project KFRI 108/87)

Notes were prepared on the distribution of reeds in the Kerala Forests. The distribution of *Ochlandra* spp. has been plotted. Identification and herbarium work is in progress.Data on reed density, annual growth in terms of number of culms per clump, clump formation and microclimatic details were collected from the permanent plots established at Kollathirumedu and Peruvannamuzhi.

Reed collections were made from Kakkayam, Chandanathodu, Thirunelli Begur, Thura, Kallar, Achenkoil, Thenmala, Arienkavu, and Palaruvi. Herbarium as well as planting materials were collected. So far eight species of *Ochlandra* has been collected from Kerala. Of over 60 live collection made of *Ochlandra* species 25 clumps have survived.

TAXONOMIC SURVEY AND ESTABLISHMENT OF A LIVE COLLECTION OF INDIGENOUS AND EXOTIC SPECIES OF RATTANS (Component of project KFRI 109/87)

The Western Ghats was surveyed for its cane wealth. Extensive collection trips were made in Karnataka State, Periyar Wildlife Sanctuary in Kerala and Tinneveli and Nagercoil Forest Divisions of Tamil Nadu. Five species from Karnataka proved to be new.

Phenological data of the species collected were recorded.

Seed collections were made from Dibru, Namphai and Tinkopani Reserve Forests in Assam and Namchik, Namgoi, Lalpul and Jairampur Reserve Forests in Arunachal. Mature fruits and suckers were collected for different species. Taxonomical collections were also made from this region.Two species, *Calamus caesius* and *C. gamblei* were added to the germplasm collection.

SPECIES TRIALS FOR AFFORESTATION OF PATTIKKAD HILLS (124/89)

The following species were raised in the nursery : *Terminalia crenulata, T. bellerica, Tamarindus indicus, Enterolobium cyclocarpum, Careya arborea, Zizhyphus jujuba, Xylia xylocarpa, Pongamia pinnata, Alstonia scholaris, Sterculia urens, Pterocarpus marsupium* and *Bridelia retusa*. Thousand seedlings of Casuarina and 500 seedlings of *Emblica* were planted. Selected seedlings were given fertilizer and water to study their effect on survival.

REGENERATION STUDIES ON SOME IMPORTANT TREES IN A MOIST DECIDUOUS FOREST ECOSYSTEM (Component of project KFRI 117/87)

See under Ecology for details.

ECOLOGY

COMPLETED PROJECTS

VEGETATIONAL STUDIES IN THE POOYAMKUTTY HYDROELECTRIC PROJECT AREA (Component of project KFRI Gen 03/85. Report submitted to Department of Environment and Forests, Govt. of India)

The moist deciduous forests in and around Pooyamkutty area were found to be in a highly degraded state. This degradation is predominantly due to repeated annual fires. Most of these forests are poorly stocked.

The semievergreen forest at Pinavoor is the most diversified vegetation encountered within the project area with a potentiality towards reaching the climax. It is also one of the few low lying semievergreen forests encountered in Kerala. The only patch of evergreen forest within the submergible area is encountered at Anakulam. Although the stocking level is poor this area still retains its evergreen nature. Construction of a power house will destroy these typical ecosystems.

ESTABLISHMENT OF PERMANENT SAMPLE PLOTS FOR LONG TERM MONITORING OF ECOLOGICAL PROCESSES (KFRI 121/87. Report submitted to Department of Environment and Forests, Govt. of India).

Twelve plots of 50 m x 50 m size have been laid out in four localities viz. Panthanthodu, (with the dominants of *Cullenia exarillata* and *Palaquium ellipticum*) Aruvampara, (with Litsea sp. and *Pterocarpus, ellipticum*) and Chembotti (with *Cullenia exarillata*, *Palaquium ellipticum* and *Mesua ferrea*). 5483 trees spread over these twelve plots have been mailed with aluminium number plates at breast height. The basal area of all the individuals have been calculated. It varies from 48 to 80 m^2 per hectare. The individuals were also classified according to their girth classes. Although all the four areas had been worked in the past, at Panthanthodu and Chembotti individuals above 180 cm are still available. Aruvampara and Punnamala have been heavily worked in the past.

PREPARATION OF A SOIL-CUM-VEGETATION MAP OF THE FORESTS OF TRICHUR DIVISION (Project Ecol 01/79)

The report is under preparation.

PHENOLOGICAL STUDIES IN REPRESENTATIVE EVERGREEN FORESTS OF KERALA (Project Ecol 04/80)

The report is under preparation.

VEGETATION ANALYSIS AND MAPPING OF PARAMBIKULAM WILDLIFE SANCTUARY (Project Ecol 07/86)

The mapping work of the project was completed. The vegetation map, vegetation density map, drainage, physical contour, locality map showing sample sites and plantation map of the area were prepared in 1:50000 scale and 15 copies each were handed over to Kerala Forest Department. The final report with the supplementary information on vegetation structure is under preparation.

ONGOING PROJECTS

ECOLOGICAL STUDIES ON SELECTED INDIGENOUS TREE SPECIES (Component of Project KFRI 114/87)

Regeneration data from Northern and Central Kerala region were collected by establishing permanent sample plots at Bavali and Peruvannamuzhi in Wynad region and Thellikkal, Kuriyarkutty and Vazhani in Central region. Periodical observations of regeneration status were made from these sample plots and also from other places of Kerala in Southern region. The structural aspects of forests, phenological observations etc. were also noted alongwith growth parameters of seedlings. The periodical data acquisition is in progress.

STUDIES ON SOME IMPORTANT TREES IN A MOIST DECIDUOUS FOREST ECOSYSTEM (Component of project KFRI 117/87)

Based on the guideline provided by species-area curve, the size of releve for sampling moist deciduous forests was determined as 0.5 ha. Accordingly, regeneration surveys were conducted in eight 0.5 ha. samples of differing degrees of disturbance so as to get a general idea of the regeneration status of moist deciduous forests. Computations of population means suggest deficits of regeneration population in many sites.

Monthly phenological observations of 172 marked trees were made for the past two years, so as to understand the constraints at the flowering and fruiting stages. Species like *Xylia xylocarpa, Terminalia paniculata, T. crenulata, Lagestroemia microcarpa, Grewia tiliifolia*, etc. have regular circannual flowering and fruiting periodicities while others like *Dalbergia sissoides, Terminalia bellirica, Alstonia scholaris* do not flower and fruit every year. Regenerative potential in terms of seed output of most tree species is satisfactory. Heavy seed predation by Malabar giant squirrels in *Xylia xylocarpa*, paucity of viable seeds in *Lagerstroemia microcarpa*, and lastly forest fire, in most tree species hinder successful seed-based regeneration.

To get quantitative estimates of seed output for unit area of stands, 75 1 m^2 litter traps were installed in a permanent plot. Litter is being collected from these traps at fortnight intervals, and flowers and fruits/ seeds of individual species are being counted, in addition to leaf litter quantification.

Seedlings in fifty 100 m^2 quadrats from two permanent plots were tagged with numbered aluminium labels and monitored so as to understand the population dynamics. When the plots were under protection, conversion to higher size classes were significant. After an unexpected forest fire, the plots were burned and the effect of fire on regeneration was studied by reidentifying and remeasuring the seedlings. The study shows that the rate of conversion to lower size classes after fire was considerably greater than the rate of conversion to higher classes. From the studies

it is apparent that fire is the single largest factor causing paucity of seedlings in moist deciduous forests.

ECONOMICS

COMPLETED PROJECTS

HUMAN IMPACT STUDIES IN THE POOYAMKUTTY HYDROELECTRIC PROJECT AREA (Component of Project KFRI Genl 03/85. Report submitted to Department of Environment and Forests, Govt. of India)

Reeds from the forests of Pooyamkutty is an important material both for the modern sector paper industry as well as traditional mat and basket weaving sector.

The annual extraction of reeds from the forests is around 23,500 tonns which provides about 2.6 lakhs man days of employment annually for reed extraction and 20.6 lakhs man days for processing which makes a total of 23.3 lakhs man days per year.

About 43 percent of the annual reed supplies of the Kerala State Bamboo Corporation and about 26 percent of the requirement of the Hindustan Newsprint Limited is met from the Pooyamkutty forests.

Apart from the mats produced from the reeds collected by the KSBC, local production of mats in Pooyamkutty is around 52 lakhs square feet annually.

The availability of reeds both for the modern as well as traditional sector is much below their current requirements. The traditional sector provides relatively more employment both per unit volume of reed extracted and per unit volume of reed processed. Even the wage income per tonne of reed processed is about four times greater in the traditional sector.

The traditional sector has better claim to the reeds from Pooyamkutty both as a welfare measure and as a forest conservation measure. Therefore the reed area of Pooyamkutty should be reserved for the traditional sector.

There are three human settlements in the submergible areas of proposed dam. They are Anakulam, Mettanappara, and Kurathy kudi. Together they comprise 233 households with 931 members. The power house site is located at Pinavur kudi where 34 families with 152 members face eviction. The resettlement proposal of the Kerala State Electricity Board covers the affected population only partially.

It has to be clarified whether evictions can be restricted to the people below the FRL line or whether the settlers on the edge of the reservoir are also to be evicted. If so the resettlement effort has to be substantially higher.

Human settlements in the catchment consists of both tribal and nontribal people. Most of the tribal households have been displaced from their original homes when non-tribal colonised their land following development of accessibility for earlier power projects and during the Grow More Food Leases to nontribals.

The nontribal settlers have come in for lemon grass cultivation, following the opening of the old Alwaye-Munnar Road, land grants, Grow More Food leases added to the encroachments.

A historical review of the forest use in Pooyamkutty shows that development of accessibility intensified extraction of forest produce and promoted forest land use changes.

The impact of the proposed dam on the forests will be much more than the clearance of the few thousand hectares. By developing accessibility it would induce far reaching land use changes and forest destruction in a much larger area than required for the project.

A TECHNO-ECONOMIC STUDY OF SAW MILLING INDUSTRY IN KERALA (KFRI Research Report No. 60).

Sawmilling is a primary wood processing industry before wood is put into use in different solid wood products. An attempt is made in this study to examine the economic and technological aspects of the sawmilling industry in Kerala, in the context of declining raw material supply. The study is based on primary data collected from a sample of 165 sawmills, randomly selected from eight districts in the State.

A typical sawmill in Kerala has a vertical or horizontal band headrig, circular or band resaw, occasionally a trimmer/crosscut saw and a grinder. The number of these machines may be more than one in medium size sawmills while small units may function even with single resaw. Most of the units have Indian made machineries with technical specifications of Belgium machines. The major limiting factors identified in lumber recovery are: log degradation (due to biological organisms and physical agents), availability of relatively small diameter logs, inproper selection of tools and equipment and sawing patterns.

Productive capital consists of fixed capital and working capital and the latter constitutes about 72% of the productive capital. Stock of raw material is the major lcomponent of the working capital accounting for 66%. There exists a positive relationship between size and different types of capital and the same relationship is observed between size income and profit.

House compounds and import are two major sources of supply of timber. Because of the shortage of raw material, the capacity utilisation is of the order of 53%. As size increases the capacity utilisation also increases, since large size mills have better stock of raw material. The average outturn in a sawmill accounts for only 50%. In the context of continuous shortage of raw material, higher rate of outturn is imperative for augmenting the supply of sawn wood. This could be achieved in two ways: 1. modernisation of the sawmill and 2. protecting the logs from cracking, end splitting and biological degradation. The existing system of custom sawing is one of the constraints for the improvement of log storage technology as sawmill owner passes the loss arising out of improper storage to the lcustomer. The necessary finance for modernisation may be mobilised either by ploughing back a part of the profit to the industry or by changing the ownership pattern. With a view to increasing the capacity utilisation and minimising the waste, integration of sawmill with other allied activities such as furniture making joinery, etc. must be strengthened. However, formulation and effective implementation of long term forestry strategy for augmenting the supply of timber are essential to ease the raw material situation in the industry.

A SOCIO-ECONOMIC STUDY OF FARM FORESTRY WITH REFERENCE TO KERALA (Project Econ 02/82)

The study aims to identify the social and economic factors that influence the cultivation of non-conventional tree crops in the farm lands of Kerala. Final tables are being prepared for the data collected during the household survey of 4 villages in Trichur and Palghat Districts prior to the preparation of the final report. preparation.

HISTORY OF FOREST MANAGEMENT IN KERALA (Project Econ 05/84)

The major objectives were to analyse the development of different silvicultural systems in various periods in Kerala and to identify the factors/forces that have influenced forest land use in the State. The objectives also included recording the changes with regard to intensity of management and identify the general trends in forestry taking into account the changes in allied sectors especially agriculture and industry.

The study has been completed and the report is under preparation.

ONGOING PROJECTS

TECHNICAL AND SOCIO-ECONOMIC ANALYSIS OF CANE HARVESTING AND PROCESSING INDUSTRY (Component of Project KFRI 109/87)

Data collection is over and analysis is in progress.

HUMAN ECOLOGY AND SOCIOECONOMIC INTERACTIONS IN TRIBAL COMMUNITIES OF ATTAPPADY (Project KFRI 116/87)

The objectives included evaluating the different types of human interactions with forest and identifying the process of degradation revealing the interlinkages between the various components (land & human) and also conducting a landuse evaluation of the area.

A household survey covering 142 households in 3 selected hamlets was carried out (For other details see under "Soil Science").

ENTOMOLOGY

COMPLETED PROJECTS

SEARCH FOR NATURAL RESISTANCE TO THE INSECT PEST, *HYBLAEA PUERA* IN TEAK (Research Report No. 62)

A search was made in Kerala for teak (*Tectona grandis*) clones resistant to attack from the teak defoliator, *Hyblaea puera*. Extensive areas of plantations, natural forests, and three seed orchards representing 31 plus trees were examined during periods of defoliator outbreak. It was found that many isolated trees were left distinctly unattacked amid totally defoliated trees. Detailed investigations revealed that this is not due to genetic resistance but due to what may be called, 'phenological resistance'. Tender foliage is essential for the initial establishment and survival of the teak defoliator. Phenological resistance is resistance to attack due to asynchrony between the flushing time of the tree and insect population cycles. Early flushers had a greater chance of escape from defoliation but the escape is circumstantial and not consistent over years so that it is of little practical utility. No instance of genetic resistance to the defoliator was discovered in teak clones of Kerala. The search must continue in teak clones of other origin. Evidence was obtained to indicate genetic resistance in the related species, *Tectona hamiltoniana*. The study has also lead to standardisation of methods for screening trees for defoliator resistance and development of an artificial diet for rearing the insect in the laboratory.

STUDIES ON THE LEPIDOPTERAN FAUNA OF SILENT VALLEY (Project KFRI 105/87. Report submitted to Department of Environment and Forests, Govt. of India)

Of about 500 species of Lepidoptera collected from the Silent Valley National Park, 95 species of butterflies and 245 of moths have been identified.

The butterflies collected, belonged to 9 families. The maximum number of species belonged to the families Nymphalide and Papilionidae. Habitat preferences of the

various groups of butterflies were studied and five distinct biocoenoses with characteristic fauna were recognised, viz., interior forests, forest clearings and edges, forest canopies, grass lands and river banks. Of the various species collected, 13 were endemic to South India which are now very much restricted in their distribution. This included 5 species having protected status.

The moths recorded in this study belonged to 15 families. Pyralidae, Noctuidae, Geometridae and Arctiidae being dominant. Some groups like Sphingidae, Lasiocampidae, Drepanidae, Epiplemidae, Saturnidae and Cossidae were only poorly represented.

Preliminary data suggested insect species diversity in well forest as compared to those subjected to disturbances like incidence of fire. In general, the fauna bears a close resemblance to that of Sri Lanka although it is characterised by the presence of several endemic species showing affinities with the Malayan elements.

Conservation of the whole forest ecosystem in this region, including the core area, the Silent Valley, will be very essential for protecting the rich lepidopteran fauna represented here.

BIOLOGY AND ECOLOGY OF TEAK TRUNK BORER *CASSUS, CADAMBAE* MOORE. AND ITS CONTROL (Project Entom 13/84)

The report is under preparation.

MICROBIAL PATHOGENS OF PESTS OF TEAK AND *AILANTHUS* (Component of Project Pathol NF06/86)

The study is completed and the report is under preparation.

ONGOING PROJECTS

DEVELOPMENT OF A MANAGEMENT STRATEGY FOR THE TEAK DEFOLIATOR, *HYBLAEA PUERA* (Project KFRI 101/87)

During the reporting period sampling of larvae/pupae of *H. puera* is being continued in the 3 permanent sampling plots at Karieum-Murieum in Nilambur. Data on the incidents and nature of natural enemies associated with the larvae/pupae of the pest were also gathered. Part of the data collected during the previous year were processed.

Data gathered on the reproductive behaviour and the sex pheromone of *H. puera* were processed.

SPATIAL AND TEMPORAL DISTRIBUTION OF *AILANTHUS* PESTS, *ELIGMA NARCISSUS* AND *ATTEVA FABRICIELLA* (Project KFRI 103/87)

Fortnightly sampling of the pests is being continued in the intensive study area at Thattekkad. Information on the natural enemies associated with the 2 pests are being collected. Pest incidence in pure/mixed stands of *Ailanthus* and also on selected trees located in roadside, in private compound is being monitored.

Regular insecticidal treatment to check *Atteva* damage and 6 monthly high and gbh measurements of 500 trees in 1983 *Ailanthus* plantation at Erumeli are being continued as part of the studies on the impact of *Atteva* feeding on growth of *A. triphysa*.

GENETICS

ONGOING PROJECTS

GENETIC IMPROVEMENT OF *EUCALYPTUS* THROUGH SELECTION (Component of project KFRI 104/87)

Seeds were collected from *Eucalyptus tercticornis* plantations at Paruthipalli Range and KFDC plantations at Kattoor, Edinjar,

Venkola, Arippa, Anakkulam, Punnala and Karavoor. Seeds were also collected for progeny trial from 38 *E. grandis* plus trees at Munthanga Wildlife Sanctuary and Chethalath Range.

GENETIC IMPROVEMENT OF *AILANTHUS TRIPHYSA* (Project KFRI 115/87)

Phenological data with respect to *A. triphysa* and *A. integrifolia* were collected from Kulathupuzha, Cannanore, Kottiyur, Peruvannamuzhi, Kodanad and Pulamanthole. The sex of plus trees were noted to estimate the sex ratio. Seeds were collected from the above area. Data for floral biological studies were taken. Seeds collected from individual plus and average trees were sown in nursery beds. Data germination and survival were taken at intervals. Nursery grown plants were bagged for planting in the field.

PATHOLOGY

COMPLETED PROJECTS

EPIDEMIOLOGY AND CONTROL OF DISEASES OF EUCALYPTUS CAUSED BY *CYLINDROCLADIUM* SPP. IN KERALA (Project Pathol F02/87)

Final report is under preparation.

SAPSTAIN FUNGI OF SOME COMMERCIALLY IMPORTANT TIMBERS AND THEIR CHEMICAL CONTROL (Project Pathol F04/86)

Stained wood samples were collected from Trivandrum, Quilon and Alleppey districts for isolation of organisms and 26 isolations made. Efficacy of some commonly available fungicides viz., Captafol, Carbendazim, Carboxin, Copper oxychloride, Mangozeb, Thiram, Ziram and Sodium azide was evaluated against staining as well as mould fungi employing wood block techniques. Only Sodium azide (1%) was found to inhibit all the test fungi. The efficacy of sodium azide was further tested using 10, 50, 100, 250, and 500 ppm solutions. The result showed that the chemical was effective at 250 and 500 ppm.

Effect of moisture content temperature and relative humidity on the growth of *Botryodiplodia theobromae* on rubber wood blocks was studied. A field experiment was initiated to find out the effect of *Bacillus subtiles* on the control of stain and mould fungi and observations recorded.

EVALUATION OF MICROBIAL PATHOGEN FOR BIOCONTROL AGAINST INSECT PESTS OF *AILANTHUS* AND TEAK (Component of project NF 06/86)

Experiments were completed and data are being analysed. The report is under preparation.

EX-SITU DECOMPOSITION OF LEAF LITTERS OF TEAK, EUCALYPT AND *ALBIZIA* (Component of Project Soils 14/84)

Literature survey and compilation of data completed. Initiated statistical analysis of data prior to the preparation of final report.

ONGOING PROJECTS

DECAY IN STANDING TREES IN NATURAL FORESTS (Project KFRI106/87)

Fungal sporocarps of decay fungi were collected from Silent Valley, Nilambur, Arippa and KFRI Peechi Campus. Morphological characters of sporocarps were studied and preserved them for further studies. Processed specimens and sorted them out genera-wise, and their specific identification attempted. Analysis of data on decay in standing trees (selected species) collected from the felling sites at Aramba, Achenkoil initiated.

DISEASES OF BAMBOOS, REEDS AND CANES IN KERALA (Project KFRI 110/87)

Observations on disease incidence and severity were recorded from different selected plots of bamboos, reeds and canes. Disease specimens were collected and isolations of casual organisms were made. Quantitative data on diseases of emerging culm of *B. arundinacea* from Nilambur, Noolpuzha, Muthanga and Thirunelli and various other bamboo species trial plots at KFRI Sub Centre, Nilambur were collected and processed. Subculturing of about 160 isolates was done. Pathogenicity tests of *Bipolaris* spp. (6) and *Curvularia* spp. (2) on *B. arundinacea* seedlings (1-month old) were conducted and positive results obtained for 2 species of *Bipolaris* and 1 species of *Curvularia*. Light microscopic studies involving various staining technique to detect the presence of MLO in little leaf diseased bamboo (*B. stricta*) were conducted and seed-borne fungi causing seedling diseases ditected. The seed borne fungi isolated and referred to IMI for specific identification.

SCREENING OF EUCALYPTS FOR RESISTANCE TO PINK DISEASE AND *CYLINDROCLADIUM* LEAF BLIGHT (Component of project KFRI 104/87)

About 400 *Cylindrocladium* infected leaf specimens were collected from representative plantations and trial plots of *E. tereticornis, E. grandis, E. robusta, E. camaldulensis, E. urophylla, E. pellita, E. citriodora* etc. About 200 isolates of *Cylindrocladium* spp. from these specimens are maintained in culture tubes. Morphological and cultural characters of 100 isolates studied. Most of the isolates belonged to *Cylindrocladium quinqueseptatum*. Other species obtained are *C. ilicicola* and *C. scoparium*.

Numerous Pink disease specimens were collected from eucalypt plantations at Chemputhangy, Arippa, Kulathupuzha, Punalur, Karavoor and twenty isolates of the causal organism made. All the stock cultures of *C. salmonicolor* were subcultured.

Seeds of seventy five eucalypt provenances belonging to *Eucalyptus tereticornis* (20), *E. camaldulensis* (20), *E. grandis* (19), *E. pellita* (10) and *E. urophylla* (6), were obtained from CSIRO Australia and 100 seedlings each raised in polythene containers.

For establishing provenance trial during June 1990 in high ranges and at low elevations, areas were surveyed in Vallakadavu, Kothamangalam and Kottappara. An area of about 10 ha was selected at Vallakkadavu and another 15 ha at Kottappara. Actions were initiated to clear the area of grasses/weeds/tree growth.

PROTECTIVE MEASURES AGAINST PATHOGENIC FUNGI IN POST-HARVEST RATTANS (Component of project KFRI 109/87)

Visited rattan growing areas at Peerumedu, Achenkoil, Arippa and Chauzhiacode and collected poles of *C. thwaitesii* and *C. huole* for lab experiments. Experiments on effect of moisture content (MC) of extracted rattans (*C. thwaitesii* and *C. hoolecrianus*) on incidence and spread of fungal staining was completed. Estimation of MC and rating of fungal staining continued from initial MC of 126 and 243% for *C. thwaitesii* and *C. wooleriannus* respectively upto 15-20% chemicals/fungicides were screened for their efficacy against *Botryodiplodia theobromae* by employing poisoned food technique and ED 100 value for each fungicide determined. The most promising fungicides/ chemicals were further tested by using rattan discs, blocks and poles.

DISEASES OF INDIGENOUS TREE SPECIES (Component of project KFRI 114/87)

Studies on seed-borne microorganisms and efficacy of seed dressers were evaluated. Incidence of various leaf, shoot and root diseases was recorded and chemical control studies initiated in the laboratory for serious diseases. Field survey in Palghat and Nilambur Divisions was completed with respect to diseases in natural stands. Disease samples collected, pathogens identified and pathogenicity studies completed.

LITTER DYNAMICS AND MICROBIAL ASSOCIATIONS IN *ACACIA AURICULIFORMIS* PLANTATIONS (Component of project KFRI 126/89)

A detailed survey was carried out throughout the state to identify *Acacia* plantations for conducting studies on litter dynamics, microbial associations and to determine characteristics of soils. Of the 60 plantations surveyed, 26 were selected and observation plots marked. Permanent plots were selected and observation plots marked. Permanent plots were identified in Chettikulam, Kannakuzhy and Kothamangalam plantations. Besides, temporary plots were also selected for the study. To quantify litter fall fifty litter traps were kept in *Acacia* plots at Chettikulam and Kothermanakad. Litter was collected from these baskets at monthly intervals, dried at 70°C for 24 h and weight determined. Samples were collected at monthly intervals during the reporting period, sampling is being continued.

Mesh bag technique was employed to determine the rate of decomposition. Litter bags (180 in number), each containing 20 g of air dried leaf litter, were spread over the soil surface in plantations at Chettikulam and Kannamkuzhi. Twelve bags were sampled from each plot at monthly intervals; sampling is being continued.

To assess the percentage colonization of roots by VA mycorrhizal fungi, samples were collected from 12 trees from several plantations stained and examined for percentage colonization. Sampling is being continued.

Assessed the root nodulations of *Acacia auriculiformis* plants in three plantations in Wynad, two in Trichur, two in Palghat and one in Malappuram district by counting the number of nodules in soil core samples. It was found that *Acacia* nodulates well, especially in barren and degraded soils.

Data on atmospheric temperature, relative humidity, soil pH, soil moisture content and soil temperature were collected from the study plots.

PHYSIOLOGY

ONGOING PROJECTS

CLONAL PROPAGATION OF EUCALYPTS BY ROOTING CUTTINGS (Component of Project KFRI 104/87)

Observations on coppicing behaviour of stems and growth of coppice shoots of *E. tereticornis* and *E. grandis* were completed at Elanad and Noolpuzha. Clonal propagation trials in the mist chamber were initiated in August 1989. Coppice cuttings of different sizes were treated with various growth regulators by quick-dip method. Subsequently, they were inserted into vermiculate media and kept in the mist chamber. Good rooting was observed in both the species. Standardisation of the method was experimented using cuttings with varying number of leaves using different concentration of hormones, different types of rooting containers and adjusting the time of misting.

PROPAGATION OF BAMBOO (Component of project KFRI 108/87)

The work on viability of bamboo seeds was continued during the reporting year. Seeds stored in deep-freeze and desiccator showed more than 50% viability. Preliminary trials were initiated in rooting of branch cuttings from *B. balcooa, B. arundinaecea* and *D. strictus*. Branch cuttings were treated with various growth regulating hormones and planted in vermiculite. The polythene bags in which they were planted were kept in the mist chamber.

Observations on the percentage of rooting and other growth parameters in culm cuttings of *B. arundinacea, B. vulgaris* and *D. stricutus* were continued.

PROPAGATION OF RATTAN (Component of Project KFRI 109/87)

Observations on the survival and growth of both suckers and seedlings of *Calamus* sp. in the experimental plots at Nelliampathy and Nilambur continued. The percentage of success of the suckers was rather low. Suckers of certain *Calamus* spp. were treated with NAA solution and polypotted.

PHYSIOLOGICAL ASPECTS OF WATER BLISTER IN TEAK (Component of Project KFRI 125/89)

Daily collection of the fluid from the blister affected trees was continued throughout the year to note the blister activity during changing seasons. Soil moisture content was determined in the Peechi campus once in a month throughout the year. The maximum waterholding capacity was also determined. Blister fluid was analysed for total carbon, alcohols, aldehydes and nitrogen. The water potential changes in the teak trees were measured during the last 3 months of the reporting period. The structure of the blister was examined after felling a tree at Peechi campus.

STUDIES ON WATER USE, ASSIMILATION AND GROWTH OF EUCALYPTS (Project KFRI 127/89)

A survey of eucalypt plantations in Trichur Forest Division was conducted. A coppicet eucalypt plantation was provisionally chosen for studies.

WATER USE OF SELECTED INDIGENOUS AND EXOTIC TREES (Project KFRI 128/90)

The project aims at understanding the water use of mainly *Acacia auriculiformis* in comparison to some other exotic and indigenous species.

A plantation of *A. auriculiformis* at Kotharamanacad, Palghat Division has been chosen for future studies. Using the pressure chamber daily water potential changes in *Acacia, Sweitenia, Xylia* and *Ailanthus* have been measured during March.

COMPLETED PROJECTS

STUDIES ON THE EFFECT OF SLASH BURNING ON PLANTING SITE FOR TEAK (KFRI Research Report No. 61)

An extensive field trial was conducted at Mundakadavu of Karulai range in Nilambur Forest Division during 1981-85 to study the effect of slash burning on soil properties, weed growth, taungya yield and growth of teak (*Tectona grandis* L.f.) in a second rotation plantation. The study lead to the following conclusions. Burning caused significant enhancement of base content and change in soil reaction from acidic to alkaline. These effects were short lived and within six months the soil had the same reaction and base content as at the start of the experiment. Though burning reduced weed growth during the first three months after planting, the difference was not significant subsequently. The yield of paddy (*Oryza sativa* L.) the first taungya crop was not influenced by the treatments. None of the treatments had significant influence on survival of teak. The treatment effect on height of teak, though noticed during the first three years was not significant afterwards. Savaging firewood between 10-30 cm girth over bark (which would have otherwise been burned) yielded a net revenue of Rs. 756 per hectare in 1982 after meeting the labour charges of Rs. 1244. As slash burning did not have lasting influence either on the growth of teak or on soil properties, a modification in the current practice is suggested. All wood down to 10 cm girth over bark - the lower limit up to lwhich firewood collection may be commercially viable - could be marked and the rest either burned (resulting in a light slash burning) or left at site (to deteriorate over time) depending on local conditions.

STUDIES ON STUMP AS PLANTING MATERIAL FOR *EUCALYPTUS TERETICORNIS* PLANTATIONS (KFRI Research Report No. 63).

A field study was conducted at Nilambur, Kerala, during 1981-84 to standardise the practices for raising *Eucalyptus tereticornis* plantation with stump as planting material. The effect of planting season and method, length and diameter of stump, different methods of stump storage and sealing growth of the stumplings were investigated. Effect of some growth regulators as well as insecticidal and fungicidal treatments was also evaluated. The study led to the following conclusions.

The survival of stump planted during the period between the pre-monsoon and the intense monsoon (later half of May) was found better than those planted during the first premonsoon showers in early May and intense monsoon in June. Variations in stump dimensions, tap root length, 10 to 15 cm, root diameter at 15 cm below collar, 0.5 to 1.1 cm; shoot length 2.5 to 5 cm and shoot diameter at 2.5 cm above collar, 0.8 to 1.6 cm had little influence on sprouting and survival of stumps. Treatment of stumps with boric acid 90 ppm prior to planting enhanced rooting percentage and

abundance. Storage of stumps either in pits or under shade enhanced callusing at root end. Stumps wrapped in moist gunny bags and stored under shade for 4 days or stored in pits in bundles for 11 days before field planting registered better survival. Drenching the planting hole (2 cm dia and 15 cm deep) with 100 ml of 0.1% Aldrin 30 EC solution before planting ensured protection of stumps from termite attack. Drenching the planting hole with carbendazim (Bavistin) 0.1 a.i. (2 g of Bavistin 50 WP per litre or water) and application of fertilizer (NPK 8:8:16. 100 g per stump) in two holes dug close to the planting hole ensured protection against fungal infection better survival and height increment. Sealing of shoot-end of the stump prior to planting either with wax or coaltar did not increase survival or growth. The study showed lower percentage of survival in stump planting as compared to planting of polypotted seedlings in pits. However, this method is suitable for raising plantations making use of older seedlings from previous year's nursery beds.

SILVICULTURE AND MANAGEMENT OF FAST GROWING INDIGENOUS HARDWOOD SPECIES WITH MULTIPLE END USES (Project Silvi 01/81)

The report is being prepared.

ESTIMATION OF QUANTITY OF EUCALYPTUS SEEDS FOR SOWING IN NURSERIES (Project Silvi 06/81)

Project report is under preparation.

ESTABLISHMENT OF A BAMBOOTEAUX IN THE INSTITUTE (Project Silvi 07/81)

Writing-up of the project report is in progress.

POLYURETHANE FOAM SHEETS FOR RAISING FOREST TREE SEEDLINGS (Project Silvi 08/84)

The project has been completed and the report is under preparation.

ONGOING PROJECTS

ESTABLISHMENT OF BAMBOO PLANTATIONS (Component of project KFRI 168/87)

The trial plots established in 1988 at Nilambur were maintained and regular observations on growth recorded. Additional trial plots were laid out during June-July

1989 to study the comparative performance of 12 and 25 months old polypotted seedlings underplanted in teak plantation and sparsely wooded moist deciduous forests over an area of 2.8 ha. Observations are being recorded from 1989 trial plots.

RESOURCE INVENTORY METHOD FOR CANES IN KERALA (Component of Project KFRI 109/87)

Carried out complete enumeration in 4 ha area each in 2 locations in deep forest - One at Nilambur and other at Achenkoil; the former a low density highly distributed area and the latter a high density undisturbed area - to determine the density, distribution pattern, species composition etc., for deciding the sampling method and intensity within the pocket.

Carried out reconnaisance survey to identify cane pockets in Thenmala Forest Division.

SILVICULTURAL STUDIES AND PLANTATION TRIALS OF INDIGENOUS TREE SPECIES (Component of Project KFRI 114/87)

Pure and mixed plantations of *Albizia odoratissima, Grewia tiliifolia, Haldina cordifolia, Lagerstroemia microcarpa, Pterocarpus marsupium* and *Xylia xylocarpa* were laid out at Nilambur with the object of studying their performance in the field. In all there were 14 treatment plots (6 pure + 8 mixtures) replicated three times over an area of abaout 2 ha. Observations on survival and height growth were recorded at regular intervals.

AFFORESTATION TRIALS IN ATTAPPADY (Project KFRI 120/87)

Periodic observations in the 1988 species performance trial plots at Mulli were continued. A new species performance trial was laid out during October-November 1989 with 33 species. The species selected were either drought hardy or locally important. Survival and height of all the plants were recorded every month.

Two other field experiments were laid out to study the various planting and mulching methods with *Acacia nilotaca, Ceiba pentandra* and *Agave sissalana*. Mulching trial was laid out with *Emblica officianalis* and *Tamarindus indica*.

In order to monitor the natural restoration process under protected conditions 7 square plots of 25 x 25 m of varying degradation stages/vegetational status were demarkated and fenced.

Two nursery experiments were initiated to study the moisture retention capacity of different potting media viz., field soil, red soil, red soil + jalaskathy, red soil + vermiculite and red soil + polyurethane foam.

DEMONSTRATION CUM RESEARCH ON MULTI-TIER FORESTRY THROUGH OPERATIONS RESEARCH (Project KFRI 130/90)

The objectives include establishment of a demonstration plot on forestry by optimal use of available knowhow using appropriate operations research (OR) technique. The study was started during the reporting year and data are being gathered.

SOIL SCIENCE

COMPLETED PROJECTS

SOIL PROPERTIES, EROSION RATES AND SUSPENDED LOAD IN THE POOYAMKUTTY HYDROELECTRIC PROJECT AREA (Component of project Genl. 03/85. Report submitted to Department of Environment and Forests, Govt. of India).

The soils in the Pooyamkutty river basin are light in texture, strongly acidic in reaction, and contain medium level of organic carbon in surface horizons which is resulting in locking up of bases.

An analysis of the denudation rates and the characteristics of the watersheds reveal the following.

1. Soil erosion is low or negligible in forested watersheds irrepective of slope features. Reed areas are the least erosion prone.

2. Rates of erosion increase consequent to depletion of forests.

3. Conversion of forests to agriculture increase the denudation rate. It is low under perennial crops (tree crops) and high under annual crops.

Nineteen watersheds were monitored to assess the soil erosion status of the Pooyamkutty river basin as a whole. It was estimated that 37% of the basin is subject to low rates of soil erosion; 37% to moderate and 26% to high. These trends were validated by the sediment flow data gathered.

The observations on suspended sediment load clearly indicate that the disturbed watershed of Melasari and Thudupi yield higher rates of sediment during the monsoon period.

SOIL AND PLANT COMMUNITY RELATIONSHIPS IN WET EVERGREEN FORESTS OF SILENT VALLEY (Component of Project KFRI 107/87. Report submitted to Department of Environment and Forests, Govt. of India)

This investigation was undertaken to study the physical and chemical properties of soils in seven plant communities in Silent Valley. Study sites were selected in the following plant communities - *Palaquium ellipticum; Cullenia exarillata; Palaquium - Mesua ferrea; Palquium-Poeciloneuron indicum; Mesua-Calophyllum elatum; Mesua-Cullenia; Ochlandra* (Reed) Calophyllum; Ochlandra (Reed)- Poeciloneruon Sample plots of 50 x 50 m were laid out randomly in each community. Three soil pits were taken from each plot and pooled samples from 0-20, 20-40 and 40-60 cm layers were used for the analysis.

Air dried samples were analysed for particle size separates, ph, organic carbon, exchange acidity, exchangeable bases, total , extractable P, K, Ca and Mg. particles >2,, (gravel) were determined. Soil organic matter fractionation of surface samples (0-20 cm) was also done.

Soils in general are loam and strongly acidic in all the three layers. Analysis of variance of soil properties reveals that gravel, clay, exchange acidity, extractable P, K. Ca and Mg in the 0-60 cm layer and humic and vulcic acids in the 0-20 cm differ significantly. Correlation studies show that organic carbon is correlated with total N and extractable Ca is highly correlated with Mg. In all other cases, the properties follow different pattern.

The soils in the seven plant communities exhbiit great variation in many physical and chemical properties; *Mesua-Calophyllum* and *Mesua Cullenia* form a group, *Palaquium-Poeciloneuron* stands aloof while the remaining four vary markedly from each other and also with the former three. There is sound environment for enzymatic activity. The humus substances decompose to fulvic type in *Palaquium-Mesua, Mesua-Calophyllum, Mesua-Cullenia* and Reed - *Calophyllum* while in the remaining, they decompose to humic type.

NUTRIENT PARTITIONING IN AN EVERGREEN ECOSYSTEM (Proj. Soil 12/84)

The study aims at establishing nutrient partitioning in evergreen ecosystem. The report is under preparation.

EX-SITU DECOMPOSITION OF LEAF LITTERS OF TEAK, EUCALYPT AND *ALBIZIA* (Component of Project Soils 14/84).

Project Report is under preparation

ON-GOING PROJECTS

SOIL TECHNOLOGY PACKAGES FOR ENHANCING PRODUCTIVITY IN TEAK PLANTATIONS OF KERALA (Project Soils 102/87).

Determination of soil suitability in teak plantations and formulation of soil technology packages for enhancing productivity in teak plantations of different regions is the objective of this project. Completed sampling in 25 transects of the Wynad, Thenmala and Ranni Forest Divisions and soil collected for analysis.

GROWTH RESPONSE OF SEEDLINGS OF SELECTED INDIGENOUS SPECIES TO NPK INPUTS (Project KFRI/122/89)

Periodical measurements of growth parameters of *Albizia* seedlings were taken. Completed the preliminary trial. Harvested and determined the shoot and dry matter yield. Seedlings are being raised for further trials.

FERTILIZER TRIAL IN BAMBOO PLANTATIONS (Component of project KFRI 108/87)

In the fertilizer trial plot measurement of growth parameters like circumference of culm, number, height and girth of culms were measured at 45 days interval. Casualty due to wild boar attack were replaced and the plants were watered.

SOIL STUDIES IN REED BRAKES (Component of Project KFRI 108/87)

Soil samples were collected from permanent reed sample plots for detailed analysis.

SOIL STUDIES IN CANE GROWING AREA (Component of Project KFRI 109/87)

Selected 2 sites one at Achenkoil and the other at Peermedu for detailed soil studies. Initiated the fertilizer trial in the plots.

LANDUSE STUDIES IN THE TRIBAL COMMUNITY AREA IN ATTAPPADY (Component of Project KFRI 116/87)

Landuse evaluation in selected hamlets is in progress.

SOIL STUDIES IN ACACIA PLANTATIONS (Component of Project KFRI 126/89)

Plots were selected in different regions of Kerala for soil studies and samples were collected from some of them.

STATISTICS

COMPLETED PROJECTS

A DATABANK FOR THE FORESTRY SECTOR IN KERALA (Project Stat 02/87)

The report is under preparation.

DEMAND AND SUPPLY OF WOOD IN KERALA AND THEIR FUTURE TRENDS (Project KFRI 119/87)

The report is under preparation.

ON-GOING PROJECTS

MARKET STUDIES OF BAMBOOS AND REEDS (Component of Project KFRI 108/87)

The objective is to carry out a market study of bamboo and reeds to identify the nature of demand, sources of supply and prices. Assessment of growing stock of bamboo in homesteads, estimation of the quantity of bamboo used for house construction and other purposes by the household sector in Kerala, analysing the socioeconomic aspects of household producers of bamboo mats, baskets, etc., collection of data on source of supply, nature of demand and price of bamboo available at depots etc. are the different components of the study. The household survey for estimating the growing stock of bamboo and quantity used by the household sector was completed. Survey on household-producers of bamboo-mats, baskets, etc., and collection of data on source of supply, nature of demand and price of bamboo available at depots have been started during the reporting year.

INVENTORY TECHNIQUES FOR ESTIMATION OF GROWING STOCK OF CANES (Component of Project KFRI 109/87)

A pilot survey was undertaken in Thenmala Forest Division to work out the following sampling intensity at different stages, nature and size of the sampling units, sampling method within first stage units and the estimation procedure. Out of the ten first stage

units (cane pockets) located in the stratum taken for the study, six were covered at 4 percent sampling intensity within each first stage unit. In one of the first stage units, 4 m wide strips were compared against 20 m x 20 m plots with respect to their relative efficiency and ease of execution. The various statistical analyses are in progress. A few more first stage units are to be covered after which the results can be finalized.

ADVISORY SERVICE

In addition to carrying out research projects mentioned above, advise on statistical analysis was given for the following KFRI research projects: Silvi 08/84; Soils 14/84; Pathol NF 06/86; 101/87; 105/87; 107/87 and 109/87.

WILDLIFE BIOLOGY

COMPLETED PROJECTS

WILDLIFE STUDIES IN THE POOYAMKUTTY HYDROELECTRIC PROJECT AREA

(Component of Project KFRI Genl 03/85 Report submitted to Department of Environment and Forests, Govt. of India).

The upper reaches of Pooyamkutty are important from the point of view forest continuity. It connects a stretch of forests extending from the Parambikulam Wildife Sanctuary to the Eravikulam National Park. The area contains some of the representative animals of the region, while a few have disappeared due to disturbance. A few herds of elephants totalling not more than 50 individuals are present. Calves, juveniles, adult females and adult males have been observed in the herd reflecting a healthy status. Sambar deer and wild boar are present in low density almost throughout the area as is the case with most of the forests in Kerala. Gaur is seen occasionally in the undisturbed areas. There are rare reports of wild dog, panther and sloth bear. There has not been any recent report of tiger or liontailed macaque. Bonnet macaques are present on steep inaccessible ledges of rocks. About 65 species of birds have been sighted, mostly from Pindimedu and Anakulam areas. This probably is an under estimate due to the limited area studied.

The site of the main dam and its submersion area is not particularly rich in larger mammals. Nor does the area contain any viable population of endangerd animals except the elephant. The forest continuity between the nearby wildlife sanctuaries is important, but the area where the main dam is proposed is not an important corridor. Therefore construction of the main dam at Pindimedu on the Pooyamkutty river is not likely to affect the wild animals very adversely. As against this, the case with the feeder dams are entirely different. They would submerge rich evergreen forests of upper Pooyamkutty region which is an important corridor that links the Parambikulam Wildlife Sanctuary with Eravikulam National Park and Chinnar Wildlife Sanctuary.

In addition, construction of these dams would lead to establishment of a network of roads linking Pinavur, Idamalayar, Pooyamkutty, Upper Idamalayar, Anamala and Mankulam and thus opening up almost all the presently inaccessible forests in the Pooyamkutty region to encroachment and destruction. Thus, the construction of the feeder dams would very adversely affect the forests and animals of the region.

COMMUNITY ECOLOGY OF BIRDS IN SILENT VALLEY (Project KFRI 118/87. Report submitted to Department of Environment and Forests, Govt. of India)

The objectives of the study were to find out the composition and abundance of avifauna, to study the vertical distribution of bird community and to work out the foraging ecology of birds. The study was based on observational methods, using variable-width line transects. Out of the two study areas selected one was near Sairandri and another one at Mukkali. Fiftythree species were recorded from the first study plot and 46 species from the second one. an increase in total number of birds, density and species was observed during dry months. Eleven migrant species were recorded from the area. One group of birds showed stable density through out the months while the other group showed reduction during monsoon months. Species diversity of first site was 3.06 and at the second site it was 2.95. Similarity Index between first and second study site was 0.65. Most of the species preferred height upto 20 m. out of the five foraging methods identified the most commonly used one was probing and the main food site was foliage. The reasons for the reduction of birds during monsoon months and the presence of more generalistic feeders were discussed.

FEEDING AND RANGING PATTERNS OF LION-TAILED MACAQUE (Project KFRI 112/87. Report submitted to Department of Environment and Forests, Govt. of India)

This is the first long-term study on lion-tailed macaque (Macaca silenus) in Silent Valley National Park. In the intensive study area consisting of about 2000 ha of evergreen forests, 13 troops were observed with a total of about 171 individuals. Three distinct lion-tailed macaque populations were observed. The first consisting of five troops with a total of 49 individuals was restricted to the areas west of Kunthipuzha like Nilikkal (980 m to 1050 m). The second population consists of at least four troops with 80 individuals was restricted to eastern side of Kunthipuzha encompassing areas like Valiyaparathodu (1000 m to 1300 m), Kummattanthodu (900 m to 1100 m), Kattuvara mudi (1100 m to 1300 m), and lower slopes of Kattimudi (1200 m to 1400 m). This area is contiguous to the Attappady RF. The third population was restricted to Panthanthodu (850 m to 1000 m), Aruvampara (1100 m), and south of the road from Mukkali to Silent Valley and consisted of four lion-tailed macaque troops with 42 individuals.

In all the locations, most sightings were in the *Cullenia-Palaquium* tree association. The macaques fed heavily on the seeds and flowers of *Cullenia exarillata* from May to

December when the flowers or seeds were available in different parts of the study area.

It is suggested that the Panthanthode forest beat of Attappady Block I RF may be added to Silent Valley National Park, as this area fall within the home range of at least 7 of the 13 lion-tailed macaque troops encountered in this study.

ON-GOING PROJECTS

ECOLOGY AND BEHAVIOUR OF SAMBAR DEER, *CERVUS UNICOLOR* IN PARAMBIKULAM WILDLIFE SANCTUARY (Project KFRI 111/87)

The project is completed and the report is under preparation.

STATUS AND DISTRIBUTION OF MAMMALS AND BIRDS IN CHINNAR WILD-LIFE SANCTUARY AND ERAVIKULAM NATIONAL PARK (Project KFRI/131/90)

The work carried out includes reconnaissance of the area and collection of fodder plants.

WOOD SCIENCE

COMPLETED PROJECTS

ESTABLISHMENT OF A XYLARIUM (Project Wood 07/82)

A total of 122 wood specimens representing 74 genera and 92 species of Kerala Forests and a total of 455 specimens of foreign species representing 10 countries have been collected. The project report is under preparation.

ON-GOING PROJECTS

WOOD PROPERTIES OF SOME LESSER-KNOWN TREE SPECIES OF KERALA (Project KFRI/113/87)

Physical appearance, basic density, heartwood proportion, radial and tangential shrinkage of the wood of the following 11 species were determined during the reporting period: *Aporousa lindleyana Drypetes wightii, Knema attenuata, Polyalthia coffeoides, Dymocarpus longan, Drypetes oblongifolia, Dymorphocalyx lawianus, Lipsea floribunda, Isonandra stocksii, Connomomum veerumand Heretiera papilio.*

UPGRADATION OF RUBBER WOOD (Project KFRI 123/89)

Diffusion treatment with 10% Boric acid solution was carried out on samples of different thicknesses (2.5, 5, 7.5 and 10 cm). The dry salt retention of chemical was determined. The samples have been kept for different storage periods to arrive at optimum period. Different pressure treatment schedules with Boric acid solution containing sodium pendachlorophenoxide and synthetic pyrethroid have been tried on rubber wood of different moisture content levels. The study has shown that adequate loading of chemicals can be obtained even at a moisture content of 50-60%.

WOOD QUALITY IMPROVEMENT OF EUCALYPTS (Component of Project KFRI 104/87)

Control trees of *Eucalyptus grandis* have been identified in Wynad and Munnar Forest Divisions for wood quality comparison between plus trees and other trees of the population. Also, plantations of *E. tereticornis* have been located for the study.

PRESERVATIVE TREATMENTS AND PROPERTIES OF BAMBOOS (Component of Project KFRI 108/87)

Periodic observations were taken on the treated bamboo poles in round and half split foam in ground contact and reepers in quarter-split foam in out-of-ground contact. At the end of 24 months, treatments with copper sulphate and zinc chloride have given better results compared to control and other treatments.

Reed bundles were stored under water to see the effect of storage on the quality of reed for mat-weaving and the reed products. Reeds stored for 1, 2 and 3 months were converted into products. The study shows that quality products can be made from reed stored upto 2 months. Reeds stored for 3 months have the problems of high wastage due to breakability, fungal stain and dull colour.

DETERMINATION OF PROPERTIES OF RATTAN AND PROCESSING TECHNIQUES (Component of Project 109/87)

The behaviour of rattans has been explained from the anatomical point of view. For example, the easy breakability of *Calamus metzianus*, a non-commercial cane, is found to be due to thin-walled fibres, low fibre content and wider metaxylem vessels. Strength properties are being determined to establish structure property relationships. A joint effort is being made with the Karnataka Forest Dept. to improve the rattan processing techniques to get better colour and appearance.

UTILIZATION ASPECTS OF INDIGENOUS TREE SPECIES (Component of Project KFRI 114/87)

Sampling of the 6 species included in the study (*Albizia, Grewia, Haldina, Pterocarpus, Lagerstroemia* and *Xylia*) was completed for Wynad (Northern), Pothundy and Parambikulam (Central). Wood samples (increment cores) collected were examined for density and heartwood content variation to make a comparison between different regions of the State.

DAMAGE DUE TO WATER BLISTER IN TEAK (Component of Project KFRI 125/88)

The objectives to study the nature and type of damage caused by water blister to the timber. The vertical and horizontal extent of damage in a water blister affected tree was examined by felling a tree. Anatomical observations were also made of the wood tissue surrounding the blister opening. The presence of external indicator of damage was confirmed through a field survey at Nilambur.

LIBRARY

During the year under report the Library acquired 160 books and continued subscription to 185 current journals. Other additions to the Library collections include about 575 reprints. The practice of issuing fortnightly compilation of contents pages of journals entitled "Current Titles" was continued as a Current Awareness Service for the benefit of scientists in the Institute. During the year 1989-90 about 400 persons other than scientists in the Institute, made use of the KFRI Library.

A notable event during the year was the establishment of a Bamboo Information Centre in the Library-a project sponsored by the International Development Research Centre, (IDRC), Canada. Under the project the infrastructural facilities of the Library was enhanced by acquiring the following equipment.

1. IBM PC AT Computer with 80 MB Hard disk.
2. Modi Xerox 3045 heavy duty copying machine
3. Uninterruptible Power Supply (UPS) 2 KVA
4. HP Laser Printer 11 P series
5. Xerox Ventura DTP software

A computerised database of bamboo literature, research programmes and scientists involved in bamboo research was developed. About 500 records were input to the database during the year.

6. OTHER ACTIVITIES

International Workshop

A training workshop on Tropical Forest Ecosystem Conservation and Development in South and South East Asia was conducted at Trichur wfrom 1-13 May 1989 for the benefit of selected trainee participants from India and other South and South East Asian Countries. Participants included nominees from Bangladesh, Bhutan, Nepal, Sri Lanka, Indonesia, Philippines, Papua Guinea, Thailand and Vietnam in addition to 12 persons from India. Funds were provided by the UNESCO Regional Office in India through the World Heritage Fund of UNESCO-MAB, IDRC, Canada and Ministry of Environment & Forests, Govt. of India. In addition to Resource Persons from the Institute and institutions from India the UNESCO sponsored 3 Resource Persons one each from UNESCO, Paris, U.K. and Australia. The specific objectives of the Workshop were

- to provide an overview of the rationale, scientific principles and methods of effecting conservation and redevelopment

- to provide opportunities for sharing experience by arranging case-study presentations and group discussions on conservation and redevelopment problems in the countries of the region.

The 2-week workshop which have included field visits and exercises to Vazhachal, Sholayar, Attappady and Silent Valley was considered successful and beneficial.

The major recommendations adopted in the preliminary session of the workshop included recommendation to the Govt. of India to nominate Silent Valley National Park as a world natural heritage site, to study the state of restoration in logged over forests as a priority research area and pay greater attention to sociological aspects for successful management and protection of the tropical forest ecosystem and the biodiversity represented therein.

Exhibition

As part of the All India Science and Technology Demonstration Campaign, the Institute organised a 2-weeks exhibition at Ottappalam from 1-14 September 1989 in which the activities of the Institute were explained to public. Our stall attracted a large number of visitors - displays of bamboo propagation techniques and furniture made out of rubberwood being the main attractions.

Training Workshop for Carpenters

A training Workshop for carpenters on use of preservative treated rubberwood for furniture making was conducted in collaboration with the Small Industries Service

Institute (Govt. of India), Trichur. In the one-week workshop held during 12-18 March 1990, ten carpenters selected from thrissur district were trained. The Workshop was inaugurated by Prof. NM Joseph, Minister for Forests.

Newsletter

Two issues of the KFRI Newsletter Evergreen were published during the year.

Extension Activities

Entomology

The following instances of insect damage reported in plantations/nurseries by the State Forest Department were investigated and control measures suggested where necessary.

Sl.No	Tree species	Problem caused by	Location
1.	*Acacia auriculiformis*	Sapling borer	Mannarmala, Nilambur Range
2.	*Ailanthus triphysa*	Leaf feeding insects	Peringal, Vazhani Range
3.	*Albizia falcataria*	Cutworm damage in the nursery	Ambalappara Range
4.	Cashew	Tea mosquito (*Helopeltis antonii*)	Kurisumudi, Kaladi Range
5.	*Eucalyptus tereticornis*	Termite damage	Kozhikunnu, Wadakkancherry Range
6.	*E. tereticornis*	Sapling borer	Nellikkara, Kalikavu Range
7.	Teak	Whitegrub damage in the nursery	Charpa, Vellikulangara & Vazhachal Ranges
8.	Teak	Sapling borer	Vadasserikkara Range
9.	Teak	Coffee locust	Rajakadu, Aryankavu Range

The following disease problems referred to the Institute were investigated and findings along with remedical measures, if any, communicated to the Forest Department in Extension Reports:

	Tree species	Disease/cause diagnosed	Locality
1.	*Eucalyptus tereticornis*	Pink disease and *Cylindrocladium* lef blight	Millapalam Kolathupuzha
2.	Teak seedlings	Sclerotial die back	Karulai
3.	*Causuarina equisetifolia*	Bacterial wilt	Trichur
4.	*Tectona grandis*	Bacterial wilt	Karulai
5.	*Albizia falcataria*	Root rot	Kollathirumedu
6.	*Tectona grandis*	Bacterial wilt	Perumthode (Kalady Range)
7.	*A. falcataria*	Fire followed by *Botryodiplodia* attack	Maravanchira, Anchal Range
9.	*A. falcataria*	Web blight disease	Paencoil (Thenmala Range)
10.	*E. tereticornis*	*Cylindrocladium* leaf blight	Shalikara (Thenmala Range)
11.	*C. equisetifolia*	Blister blight Disease	Olavakode (Palghat Range)
12.	*Grevillea robusta*	Pink disease	Karimban, Nagarampara
13.	*E. grandis*	*Cylindrocladium* seed blight and stem infection	Vallakkadavu, Kozhikkanam and Thankamany
14.	*Acacia mearnsi*	Root, stem and branch infection caused by *Cylindrocladium* sp.	Pettimudy (Munnar) Vattavada
15.	*A. falcataria*	Web blight	Vazhachal
16.	*E. tereticornis*	Leaf blight	Karavoor
17.	*A. falcataria*	Die-back	Anakkulam
18.	*A. falcataria*	Web blight	Vachumaran

Physiology

1. A weather station is being maintained in the Peechi Campus and Daily recording of various weather parameters are going on. Collected data are given to researchers within and outside of the Institute.

2. Several species of *Ochlandra* were collected from forests and nursery and given to Dr. PKK Nair, President, Kaul Science Foundation, Lucknow. A team from the above Institute visited the Institute for advice on research needs.

3. Seedlings of *Calamus* were supplied to Rubber Research Institute of India for their programme of cane planting within rubber plantation. Necessary advice on raising plantation was also given.

4. Advice on propagation of bamboo was given to Hindustan Newsprint Ltd. Velloor for raising plantations of bamboo.

5. Advice on vegetative propagation of bamboo and reeds nursery and planting techniques for canes and storage methods for bamboo seeds were given to Conservator of Forests, Social Forestry, Kozhikode.

Silviculture

1. As desired by the Cochin Devaswom Board, Trichur the teak plantation raised by the Board at Thiruvillwamala was inspected and a plan for proper maintenance of their 44.34 ha of 1969 plantation was prepared and sent.

2. Technical input was provided to the DFO, Chalakudy for raising a teak- *Casuarina* plantation at Palappilly.

3. Technical details for raising a teak plantation on a 15-year rotation was given to the Asst. Engineer, KSEB, Investigation Division.

4. Details regarding cultivation of *Vateria indica and Dipterocarpus indicus* provided to Shri SR Borawake, Kopargaon, Maharashtra.

5. Technical help given to KSSP in their proposed programme of Bamboo planting in catchment areas.

6. Shri K.C. Chacko served as a Member of a 3-men expert committee constituted by Govt. of Kerala to look into and report to the Government on the environmental and ecological impact if any, on cutting the bamboo and reed forest in eastern Attappady on the bank of Siruvani river. The site was insepected and report submitted to the Govt.

Soil Science

1. The Division attended to the following querries and rendered necessary assistance.

   Fertilizer for *Eucalyptus grandis* seedlings in Pachakanam Range of the Grassland Afforestation Division

   Stunted growth of teak stems in Velloor, Thodupuzha Range of the Kothamangalam Division.

   Fertilizer doses for seedlings raised under Nilambur Social Forestry Range.

   Soil data for 25 sites representing natural forests and plantations in the Trichur Division, provided to the Working Plan Officer, Trichur Division.

2. Soil properties studied in the Kenaf experimental plots.

3. Dr. S Sankar served as a member of Task Force II: Watershed Development. Western Ghat Development Programme, Govt. of India.

Statistics

1. Developed prediction equations for predicting tree volume from girth measured at 10 cm above ground for 18 tree species for the Kerala Forest Department.

2. Advice on sampling method was given to the Forest Dept. for estimation of the quantity of the firewood in the Chimini submergible area. Estimation of total quantity of firewood available in the area, the corresponding standard error and the confidence interval were worked out based on the data supplied by the Forest Department.

3. Advice on experimental designs for clonal trials on short and long rotation species was given to the Institute of Forest Genetics and Tree Breeding, Coimbatore.

Wildlife

The scientists of the Division attended to the following extension work.

1. Nilgiri Tahr Census in Eravikulam National Park

2. Investigation of the causes of elephant deaths at Kulathupuzha

3. Advice given to Forest Department on techniques to be applied in wild animal census.

4. Participation in the capture of crop raiding elephants in Wynad Wildlife Sanctuary.

5. Dr. PS Easa gave lectures on "Importance of Wildlife Conservation" in the Nature camps held by Forest Department at Periyar Tiger Reserve, Thekkady in August 1989 and March 1990

Wood Science

1. Timber identification has been done and reports sent to the following organisation/ private parties.

Organisation	Timber identified	Technical
a. Kerala State Wood Industries Ltd., Nilambur	Imporoted timbers: *Shorea* sp., *Iutsia* sp., *Nauclea* sp., *Hymenaea courbar*	advice given on the suitability of these timbers for joinary and construction.
b. Divisional Forest Officer, Nenmmara.	*Diospyros* sp.	"
c. Larson & Tubro Ltd., Bombay.	*Acacia arabica*	"
d. Forest Range Officer, Vazhachal.	*Bischofia javanica*	"
e. Sri A.D. Joy, Akkarakaram House, Potta, Chalakudy.	*Artocarpus hirsutus*	"

2. Technical consultancy on rubber wood was provided to M/s. Aspinwood Ltd. Preservative treatment carried out at four different packing case units as per the Institute's pres-cription was examined. Besides technical advice/information on rubber wood processing was given to 20 enterpreneurs.

4. Participation in the capture of crop raiding elephants in Wynad Wildlife Sanctuary.

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7. PARTICIPATION IN TRAININGS/SEMINARS/WORKSHOPS

International:

1. Dr. KM Bhat (Wood Science) attended a research-cum-training programme in the Institute of Wood Biology, Hamburg, Germany during 17 April - 6 July 1989.

2. Shri M Balagopalan, (Soil Science) participated in the Regional Symposium on "Recent development in tree plantations of humid/subhumid regions of Asia" at the Universiti Pertanian, Malaysia, Serdong, Selangor and presented a paper 'Properties of Soils in *Albizia falcataria* plantations in Kerala' during 5 - 9 June 1989.

3. Shri Mammen Chundamannil, (Economics) attended the 13th Commonwealth Forestry Conference in Rotorua, New Zealand during 17 Sept. - 4 October 1989 and presented a paper 'Investment policy and multiple use sustained yield forestry in Kerala, Inida'.

4. Dr. KV Sankaran (Pathology) attended a 6-week training programme on Identification of Fungi of Agricultural Importance during 25 September - 3 November 1989 and a 2-week training programme on Identification of Plant Pathogenic Bacteria during 6 November - 17 November 1989 at CAB Mycological Institute, Kew, UK.

5. C Mohan (Pathology) participated in the "3rd International Conference on Plant Protection in the Tropics" at Genting Highlands Resort, Malaysia and presented a paper on 'Field diseases and storage deterioration of rattans in India' during 22 - 23 March 1990.

6. Dr. PS Easa (Wildlife) attended the workshop on "Biology and Conservation of Large Asian Mammals" at Chitwan National Park in Nepal during 24 January - 11 February 1990.

7. Dr. K Swarupanandan (Ecology) attended the 4th Round Table Conference on Dipterocarps at Bogor, Jawa, during 12 - 15 December 1989 and presented a paper "Seedling morphology and some contemporary thoughts on the phylogeny and circumscription of the family Dipterocarpaceae.

8. Smt. N Sarojam (Library) attended a training course on "Information Repackaging and Consolidation" at Asian Institute of Technology, Bangkok during 15 January - 16 February 1990.

9. Shri K Ravindran (Library) attended a training course on "Indexing and Abstracting" at the Agricultural Information Bank for Asia, University of Philippines, Laos Banos during 29 January - 10 February 1990.

National:

1. Sri C. Mohanan (Pathology) attended a conference of the Indian Association of Mycoplasmology and workshop on Isolation, Identification of Mycoplasma from animals, plants and men held at Mathura and All India Institute of Medical Sciences, New Delhi during 6-9 April 1989.

2. Dr. C Renuka (Botany) attended National Symposium on "Environmental Assessment and its Management through Social Forestry in Tribal regions" held at Ranchi during 10 - 12 April 1989 and presented a paper "Rattan plantation - its potential and prospects in Social Forestry".

3. Dr. VV Sudheendrakumar (Entomology) and Dr. NG Nair (Botany) attended The 3rd Forestry Congress held at FRI, Dehra Dun during May 29 - 1 June 1989 and presented the following papers.

   Reproductive behaviour of the teak defoliator *Hyblaea puera* and its application in the pest management (VV Sudheendrakumar)

   Mixed plantations and their role in conservation of indigenous trees in Kerala (NG Nair)

4. Dr. K Swarupanandan (Ecology) and Sri N. Sasidharan (Botany)attended the Summar Institute on Climatological Instrumentation conducted by Central Institute of Fisheries Technology, Cochin during 6 - 14 June 1989.

5. Shri K. Sankara Pillai, (Library) attended a training course on "Computer Application to Library and Information Activities" organised by Indian National Scientific Documentation Centre during 26 June to 21 July 1989 at New Delhi.

6. Dr. RV Varma (Entomology) attended the National Seminar on Forest Protection at Dehra Dun during 29 - 30 June 1989 and presented the following papers.

   Predatory potential of the reduviid bug *Panthos bimaculatus* against major pests of *Ailanthus* (RV Varma)

   Implantation and injection of some systemic insecticide for the control of teak carpenterworm *Cassus cadambae* (George Mathew).

7. Dr. K.V. Sankaran (Pathology) attended one-week training programme on recent techniques in mycorrhiza research at the University of Agricultural Sciences, Bangalore, 16-23 July 1989.

8. Dr. PS Easa (Wildlife) participated in the Vertebrate Ecology Workshop at Mudumalai Wildlife Sanctuary during 23 - 25 July 1989 and 4 November - 4 December 1989 as a Faculty Member.

9. Dr. KK Seethalakshmi, T Surendran and CK Soman (Physiology) attended the National Seminar on Vegetative Propagation of species of forestry importance organised by IFGTB at Coimbatore during 27 - 28 July 1989 and presented the following papers.

   Vegetative propagation of Bamboo using growth regulating substances (T Surendran, KK Seethalakshmi and CK Soman)

   Vegetative propagation of some important tree species by rooting cuttings (KK Seethalakshmi, T Surendran and CK Soman)

10. Shri Mamman Chundamannil (Economics) participated in the seminar on the 21st Centuary focussing on technologies for rural development organised by the Institute of Management in Government, Trivandrum during 22 - 24 August 1989.

11. Dr. ARR Menon (Ecology) and Shri AR Rajan (Statistics) participated in the Regional Workshop on Indian Remote Sensing Satellite (IRS-1A) Mission and its application potential held at the CESS, Trivandrum on 25 September 1989.

12. Dr. S Sankar (Soil Science) participated in the National Seminar on "Socio-economic and environmental impacts of water resources projects" at CWRDM, Kozhikode during 30 September - 1 October 1989 and presented a paper "Impact of hydroelectric projects on soils and landuse - a case study of the proposed Pooyamkutty HEP".

13. Dr. KM Bhat, (Wood Science) participated in the Workshop on the Development of standard white cane for the rural blind" held at Bombay on 27 October 1989 and presented a paper entitled "Property Evaluation of selected timber and cane species for developing standard white cane for the rural blind.

14. Dr. KM Bhat (Wood Science), Sri M. Balasundaran ,Sri. C Mohanan and Mrs. E.J.M. Florence (Pathology) participated in a Seminar on New Dimensions to Wood Science and Technology Research and Development, held at Bangalore during 3-5 November, 1989 and presented the following papers

   Laboratory evaluation of natural durability of lesser-and under-utilised timber species of Kerala (M. Balasundaran and R. Gnanaharan)

   Fungal biodeterioration of some commercially important timbers of Kerala and efficacy of fungicides for its control (EJM Florence)

Tunning the wood quality and anatomical research to user's needs in the context of changing patterns of wood supply (KM Bhat).

The present sawmilling technology in Kerala and the factors influencing timber recovery (KM Bhat and PK Muraleedharan)

Decay of standing trees in natural trees of Kerala (C Mohan)

15. Shri EA Jayson (Wildlife) participated in the All India symposium on animal behaviour at University of Rajasthan during 27 - 29 November 1989 and presented a paper entitled "Seasonal abundance of birds at Silent Valley National park".

16. Dr. RV Varma, (Entomology), Shri KC Chacko, Dr. RC Pandalai (Silviculture), Shri C Mohan, Shri MI Mohamed Ali (Pathology) and Dr. KK Seethalakshmi (Physiology) attended the National Seminar on Seed Technology held at the Institute of Forest Genetics and Tree Breeding, Coimbatore during 29 - 30 November 1989 and presented the following papers.

Imapct of *Atteva fabriciella* feeding on seed production in *Ailanthus triphysa* (RV Varma)

Effect of seed dressing chemicals on spermoplane microflora of some important indigenous tree species of Kerala (MI Mohamed Ali and JK Sharma)

17. Dr. George Mathew (Entomology) Sri M. Balasundaran and Mrs. E.J.M. Florence (Pathology), Dr. R. Gnanaharan and TK Dhamodaran (Wood Science) and CN Krishnankutty (Statistics) attended the National Seminar on Rubberwood on 12 December 1989 at Kottayam. The following papers were presented.

Laboratory evaluation of preservative treated rubberwood against fungi (M. Balasundaran and R. Gnanaharan)

Effect of moisture content of rubberwood and microclimatic factors on the growth of *Botrydiplodia theobromae* causing sapstain (EJM Florence)

Research needs in the utilisation of rubberwood (R Gnanaharan)

Upgradation of rubberwood through Boron diffusion treatment (TK Dhamodaran and R Gnanaharan)

18. Sri C. Mohanan and Sri M.I. Mohamed Ali (Pathology) Participated in the National Seminar on Casuarinas in India held at Neyveli during 18-19 December 1989 and presented the following papers

    Fungal diseases of Casuarinas in India - an overview (C. Mohanan and J.K. Sharma)

    Bacterial wilt disease of *Casuarina equisetifolia* - a new record from Kerala (M.I.M. Ali and J.K. Sharma)

19. Dr. ARR Menon (Ecology) attended a workshop on "Digital Image Analysis" at the Regional Remote Sensing Service Centre, Bangalore during 29 January - 10 February 1990.

20. Dr. C Renuka (Botany) attended the National Workshop on Nursery Techniques at Madurai during 1 - 2 February 1990 and presented a paper entitled "Package of practices and nursery techniques for rattan.

21. Dr. P Vijayakumaran Nair and Dr. PS Easa (Wildlife) participated in the National Seminar on Ecology, Behaviour and Management of Elephants in Kerala at Trivandrum during 22 - 25 February 1990 and presented the following papers.

    Elephants in Parambikulam Wildlife Sanctuary and management options. (PS Easa)

    Conservation unit for elephants (PS Easa)

    Interaction between elephants and teak plantations in Parambikulam Wildlife Sanctuary (PV Nair and EA Jayson)

    Bibliometric studies on elephant literature (PV Nair, N Sarojam)

22. Shri EA Jayson (Wildlife) and Shri Thomas P Thomas (Soil Science) participated in the 2nd Kerala Science Congress held in Trivandrum during 23 - 25 February 1990. Shri Thomas presented a paper "Soils in Wynad Forest Division - a comparison between natural and plantation ecosystems".

23. Dr. KSS Nair and Dr. RV Varma (Entomology) attended the Seminar on "Future Trends in Entomology in India" held at Madras on 5 March 1990.

8. PUBLICATIONS

Papers published in Journals/ Proceedings/Books

1. Balasundaran, M. and Gnanaharan, R. 1990. Laboratory evaluation of natural durability of rubberwood with reference to fungal decay. Journal of the Indian Academy of Wood Science 21: 69-70.

2. Bhat KM, Bhat KV and Dhamodaran TK 1989. Fibre length variation in stem and branches of 11 tropical hardwoods. IAWA Bull (n.s.) 10: 63-70.

3. Bhat KM, Bhat KV and Dhamodaran TK 1990. Wood Density andfibre length of *Eucalyptus grandis* grown in Kerala, India. Wood and Fibre Science 22: 55-61.

4. Bhat KM, Renuka C, Seethalakshmi KK, Muraleedharan PK and Mohan C 1989. Management and utilization of rattan resources in India. In: Recent research on Rattans. AN Rao and Isaro Vongkuluang (Eds.) Kasetsart University, Bangkok and IDRC, Canada: 33-45.

5. Bhat KM, Thulasidas PK and Easa PS 1989. Bark fibre length of some Indian Tropical Trees. Indian Forester 115: 839-841.

6. Chundamannil M 1989. Utilization of forests in Kerala. In: Nair NB (Ed.). Proceedings of the First Kerala Science Congress. State Committee on Science, Technology and Environment, Trivandrum: 395-397.

7. Dhamodaran TK and Gnanaharan R 1989. Upgradation of rubberwood through Boron diffusion treatment. Rubber Board Bulletin 25 (1): 12-17.

8. Gnanaharan R 1989. Utilization of rubberwood in India. In: Proc. IUFRO Project Group P5.01 meeting, Manaus, Brazil, November 1984: 434-439.

9. Gnanaharan R 1989. Research needs in the utilization of rubberwood. Rubber Board Bulletin 25(1): 21-24.

10. Gnanaharan R and Dhamodaran TK 1989. Effect of wilt disease and age on the strength properties of coconut palm stem wood. Wood Science and Technology 23: 205-209.

11. Gnanaharan R and Dhamodaran TK 1989. Preservative treatment of stem wood of wilt diseased coconut palms. Journal of Tropical Forest Science 1: 341-345.

12. Krishnankutty, CN 1989. Longterm price trend of timber in Kerala. Indian Journal of Forestry 12(1): 7-12.

13. Mathew G and Mohanadas K 1989. Insects associated with some forest trees in some types of natural forests in the Western Ghats, Kerala. Entomon 14(3): 325-333.

14. Mathew G and Nair KSS 1990. Storage pests of bamboos in Kerala. Proc. of Internat. Bamboo Workshop, Cochin, 1988: 212-214.

15. Mathew, G and Varma RV 1990. Occurrence and pest status of some insects attacking bamboo in newly established plantations in Kerala. Proc. of the Internat. Bamboo Workshop, Cochin, 1988: 195-198.

16. Menon ARR 1990. Utilization of remote sensing data in identifying bamboo breaks. Proc. Internat. Bamboo Workshop, Cochin 1988: 14-18.

17. Mohan C 1990. Diseases of bamboos in Kerala. Proc. of Internat. Bamboo Workshop, Cochin, 1988: 173-183.

18. Mohan C and Liese W 1990. Diseases of bamboos. International Book Series. Int. J. Trop. Plant Disease 8: 1-20.

19. Mohan C and Muraleedharan PK 1989. Rattan resources in the sacred groves of Kerala, India. RIC Bulletin 7(3/4): 4-5.

20. Mohan C and Sharma JK 1989. Fungal diseases of Casuarina in India - an overview. Proc. Nat. Sem. on Casuarina, December 18 - 19 1989, Neyveli, 1989: 10.

21. Mohan C and Sharma JK 1989. Seed pathology of forest tree species in India - Present status, practical problems and future prospects. Proc. Sem. on Forest Seed Technology, Coimbatore: 20 pp.

22. Mohamed Ali MI and Mathew G 1989. Occurrence of *Beauveria bassiana* on sapling borer *Sahyadrassus malabaricus* in Kerala, India. Curr. Sci. 58(12): 931-933.

23. Mohamed Ali MI and Nair NG 1989. *Pythium intermedium* causing root rot of *Oroxylum indicum* in Kerala - a new Indian Record. Curr. Sci. 58(13): 147-148.

24. Mohamed Ali MI and Sharma JK 1989. Effect of seed dressing chemicals on spermoplane micoflora of some important indigenous tree species of Kerala. Proc. Sem. on Forest Seeds Technology. Nov. 29-30, Coimbatore.

25. Nair CTS and Chundamannil M 1989. Forest management systems in the tropical mixed forests of India. In: Review of Forest Management Systems of Tropical Area, FAO Forestry Paper No. 89. FAO, Rome: 19-89.

26. Ramachandran KK 1989. Endangered Grizzled Giant Squirrel Habitat. J. Bombay Nat. Hist. Soc. 86: 94-95.

27. Renuka C 1989. Rattan industry in Kerala - an overview. In: AN Rao and Isara Vongkaluang (Eds). Recent research on rattans. Proc. Internat. Rattan Seminar, Chiangmai, Thailand, 1987.

28. Soman CK and Seethalakshmi KK 1989. Effect of different storage conditions on the viability of seeds of *Bambusa arundinacea*. Seed Science and Technology 17: 355-360.

29. Swarupanandan K, Sasidharan N and Mangaly JK 1989. A reconsideration of the generic circumscription of *Heterostemma* Wt. and Arn. (Asclepidiaceae) and a new species from India. Bot. J. Linn. Soc. 101: 249-259.

30. Varma RV 1989. New record of *Panthos binaculatus* (Hemiptera: Reduviidae) as a predator of pests of *Ailanthus triphysa*. Entomon 14 (3 & 4): 357-358.

31. Varma RV 1990. Termite problem in forest plantations and its control in India. Sociobiology 17(1): 155-166.

32. Varma RV 1990. Effect of juvenile hormone analogues on *Odontotermis guptai* (Isoptera: Termitidae) under laboratory conditions. In: GK Veeresh, Malik B. and Viraktamath, CA, Social Insects and the Environment (Eds), Oxford and IBH, New Delhi: 612-613.

33. Varma RV and Gnanaharan R 1989. Field evaluation of preservative treated rubberwood (*Hevea brasiliensis*) against subterranean termites. Mat. und Org. 24(4): 254-263.

APPENDIX I

STAFF AS ON 31.3.1989.

DR. K S S Nair, Director (I/C)

Administration

1.	Shri.	Joseph K John	Registrar
2.	"	P Arvindakshan	Dy. Registrar (Admn)
3.	"	P Achuthankutty	P A to Director
4.	Smt.	V K Leela	Office Assistant
5.	Shri.	M K Aravindakshan	"
7.	Shri.	V K Mohanan	"
8.	Smt.	K M Suseela	"
9.	"	K N Rajamma	"
10.	"	M Kamalamma	"
11.	Shri.	P A Sulaiman	"
12.	"	K A Gopalan	"
13.	"	T J Alfred Headisjis	"
14.	Smt.	K Annapoorni	Stenographer
15.	"	Mary Kuruvilla	"
16.	Shri.	P M Venugopalan	Receptionist
17.	"	V D Johny	Typist
18.	"	P Mohandas	Driver
19.	"	K Chandran	"
20.	"	A V Velayudhan	Attender
21.	"	V N Balakrishnan	"
22.	"	K S Karunakaran	"
23.	"	P A Sankarankutty	"
24.	"	Dhoraji Raj	"
25.	"	C K Vincent	Bus Driver
			Bus Cleaner

Engineering

26.	Shri	K K Thomas	Office Assistant
27.	"	P R Jose	Sergent
28.	"	K S Gopalan	Overseer
29.	"	P P Sunny	Skilled Maintainence Asst.
30.	"	V S Neelakandan	Attender
31.	"	K Said Mohammed	Watcher
32.	"	K C Subramanian	"
33.	"	A C Antony	"
34.	"	K Nanu	"
35.	"	K C Subramanian	Pump Operator
36.	"	D Skariah	"
37.	"	K M Velayudhan	"
38.	"	M R Anilkumar	"

39.	"	T M Abdul Vahab	"
40.	"	P B Sajeev Rao	"
41.	Smt.	V M Amminy	Full Time Sweeper
42.	"	K D Chinnamma	"
43.	"	P K Thakamani	Part Time Sweeper
44.	"	A K Amminy	"
45.	"	K C Mary	"
46.	"	E V Thanka	"
47.	"	K V Bharathi	"
Library			
48.	Shri.	K Ravindran	Librarian
49.	"	K Sankara Pillai	Asst. Librarian
50.	"	Subash Kuriakose	Artist Photographer
51.	Smt.	N Sarojam	Library Asst.
52.	Shri.	K H Hussain	"
53.	"	E V Eshac	Office Assistant
54.	"	V Asokan	Typist
55.	"	James Tidode	"
56.	"	C A Jose	Binder
57.	"	M Cherukunjan Nair	Attender
58.	"	P S Raman	"
59.	"	K V Sidharthan	"
Botony (Physiology)			
60.	Dr.	Jose Kallarackal	Scientist C
61.	Dr.	K K Seethalakshmi	Scientist D
62.	Shri.	T Surendran	"
63.	"	C K Soman	Field Asst.
64.	Smt.	D Sumangala Amma	Stenographer
65.	Shri.	A S Sreenivasan	Attender
66.	"	M K Sivaraman	Garden Worker
Botony (Taxonomy)			
67.	Shri.	N Gopalakrishnan Nair	Scientist D
68.	Dr.	K K Narayanan Nair	"
69.	Shri.	N Sasidharan	"
70.	Dr.	C Renuka	"
71.	Shri.	M S Muktesh Kumar	"
72.	Shri.	K K Unni	Field Asst.
73.	Shri.	T Prabhakaran	Gardner
74.	Shri.	K R George	Attender
75.	Smt.	A M Lalitha	Gardn Worker
76.	Smt.	T G Chandrika	"

Ecology			
77.	Dr.	K Balasubramanyan	Scientist C
78.	Dr.	K Swarupanandan	Scientist D
79.	Dr.	A R Ramachandra Menon	"
80.	Shri.	P K Chandrasekhara Pillai	Field Asst.
81.	Shri.	M B Dasan	Attender
Economics			
82.	Dr.	P K Muraleedharan	Scientist D
83.	Shri.	Mammen Chundamannil	"
Entomology			
84.	Dr.	K S S Nair	Scientist B
85.	Dr.	R Venugopala Varma	Scientist C
86.	Dr.	George Mathew	Scientist D
87.	Dr.	V V Sudheendrakumar	"
88.	Shri.	K Mohanadas	Scientist E
89.	"	P Padmanabhan	Field Asst.
90.	"	B P Sridharan	Attender
91.	"	P I Madhavan	Driver
Genetics			
92.	Smt.	E P Indira	Scientist D
93.	Shri.	K K Ramesh	Field Asst.
94.	"	E T Kuttikrishnan	Attender
Pathology			
95.	Dr.	J K Sharma	Scientist B
96.	Shri.	C Mohanan	Scientist D
97.	Smt.	E J Maria Florence	"
98.	Shri.	M Balasundaran	"
99.	"	M I Mohamed Ali	"
100.	Dr.	K V Sankaran	"
101.	Shri.	K Yesodharan	Field Asst.
102.	Smt.	Grace Andrews	Stenographer
103.	Shri.	M C Reghunandan	Attender
104.	Smt.	T S Chandrika	Garden Work
Silviculture			
105.	Shri.	K C Chacko	Silviculturist
106.	Dr.	R Chandrasekhara Pandalai	Scientist E
107.	Shri.	Nandakumar U Narath	"
108.	"	T V Madhusudhanan	"
109.	"	K Rajendran	Office Assistant
110.	"	P M Vasu	Attender
111.	"	M C Mohandas	"

112.	"	K Girijavallabhan	Driver
113.	"	P Avunni	Watcher
114.	"	K Mohanan	"
115.	"	A K Sulaiman	Cook-cum- Attendant
116.	"	V Mohamed Ali	Garden Worker
117.	Smt.	A V Thankam	"
118.	"	K T Pathumma	"
119.	Shri.	P Mohammed	"
120.	"	C J John	"
121.	"	C P Showkathali	"

Soil Science

122.	Dr.	T G Alexander	Scientist B
123.	Dr.	S Sankar	Scientist D
124.	Shri.	M Balagopalan	"
125.	"	Thomas P Thomas	"
126.	Smt.	M P Sujatha	Scientist E
127.	Shri.	P V Subramanian	Attender
128.	"	T Chandran	Driver

Statistics

129.	Dr.	K Jayaraman	Scientist C
130.	Smt.	P Rugmini	Scientist D
131.	Shri.	C N Krishnankutty	"
132.	"	A R Rajan	Programmer
133.	"	E P Somasekharan Nair	W P Assistant
134.	"	K R Sevaraman	Attender
135.	Smt.	V Chandrika	Typist
136.	Shri.	K Vijayan	Driver

Wildlife Biology

137.	Dr.	P Vijayakumaran Nair	Scientist D
138.	Shri.	K K Ramachandran	"
130.	"	P S Easa	"
140.	"	E A Jayson	"
141.	Shri.	M A Sankarankutty	Attender

Wood Science

142.	Dr.	R Gnanaharan	Scientist B
143.	Dr.	K Mahabala Bhat	Scientist C
144.	Dr.	K Vishnu Bhat	Scientist D
145.	Shri.	T K Dhamodaran	"
146.	"	P K Thulasidas	Laboratory Asst.
147.	"	A Ramakrishnan	Stenographer
148.	Shri.	K K Ahammed	Attender
149.	"	S Shahul Hameed	Driver
150.	"	Kurian Mathew	"

Varma & Varma

Marath Lane,
M.G. Road,
Trichur - 1

Chartered Accountants

Date :

AUDITORS' REPORT

The Governing Body Members,
Kerala Forest Research Institute Society,
PEECHI.

We have audited the annexed Balance Sheet of the KERALA FOREST RESEARCH INSTITUTE SOCIETY, PEECHI, as at 31st March, 1990 and the annexed Income and Expenditure Account of the Institute for the year ended on the date and report that :-

(a) We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit.

(b) Proper books of account have been kept by the Institute as far as appears from our examination of the books.

(c) The Balance Sheet and the Income and Expenditure Account dealt with by this report are in agreement with the books of account.

(d) The following items are shown under capital work-in-progress:-

(1) Peechi Building - IV Phase and new type II quarters, Directors quarters, etc.		7,08,539.91
(2) Nilambur Sub-Centre construction		4,25,540.20
(3) Advance for construction -		
Kerala State Construction Corporation Ltd.	10,881.00	
Kerala Public Health Engineering department, Water suply system	19,81,500.00	19,92,381.00
		31,26,461.11

We understand that the construction of the above buildings were completed and occupied by the Institute. If full depreciation is charged at the rates applicable to similar assets, the following will be the effect of the accounts.

General Fund will be less by	Rs.	78,161.53
Fixed Assets will be more by	Rs.	30,48,299.58
(Provided the above amount is capitalised)		

/contd ... 2/

(e) We have noted some delay in depositing the Provident Fund dues.

(f) The physical verification of fixed assets have not been conducted by the institute, during the financial year.

Subject to the above, in our opinion and to the best of our information and according to the explanations given to us, the accounts together with the notes thereon, give a true and fair view :-

(a) in the case of the Balance Sheet, of the state of affairs of the Institute as at 31st March 1990, and
(b) in the case of the Income and Expenditure Account, of the excess of expenditure over income for the year ended on that date.

For VARMA & VARMA
Sd/-
K.R. PURUSHOTHAMA PAI
PARTNER
CHARTERED ACCOUNTANTS

24 JAN. 1991

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KERALA FOREST RESEARCH INSTITUTE SOCIETY, PEECHI

BALANCE SHEET AS AT 31ST MARCH 1990

	As per schedule	Figures as at 31. 3. 1990	Figures as at 31. 3. 1989
LIABILITIES			
GENERAL FUND :	A	2,08,85,413.74	2,21,76,171.37
CURRENT LIABILITIES AND PROVISIONS :	B	23,02,363.20	9,04,785.81
TOTAL		2,31,87,776.94	2,30,80,957.18
ASSETS			
FIXED ASSETS :	C	1,56,12,387.12	1,61,68,699.88
CAPITAL WORK-IN-PROGRESS :	D	48,70,671.09	48,32,514.94
CURRENT ASSETS, LOANS AND ADVANCES :	E	27,04,718.73	20,79,742.36
NOTES AND ADDITIONAL INFORMATIONS :			
TOTAL		2,31,87,776.94	2,30,80,957.18

Sd/-
DIRECTOR

CHAIRMAN
EXECUTIVE COMMITTEE

As per our separate report of even date attached

For VARMA & VARMA
Sd/-
K.R. PURUSHOTHAMA PAI
PARTNER
CHARTERED ACCOUNTANTS

24 JAN. 1991

ks/e.

KERALA FOREST RESEARCH INSTITUTE SOCIETY, PEECHI

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH 1990

	As per	Figures for the year ended 31. 3. 1990 Rs. Ps.	Figures for the year ended 31. 3. 1989 Rs. Ps.
INCOME			
Interest on Savings bank and Fixed Deposit Accounts	G	86,856.27	38,749.80
Miscellaneous income		2,01,458.20	2,00,695.80
Excess of Expenditure over Income transferred to General Fund		66,53,764.03	65,07,202.99
		69,42,078.50	67,46,648.59
EXPENDITURE :			
Salary and Allowance		41,69,844.50	38,15,165.00
Contribution to Provident Fund		3,03,943.00	2,49,629.00
Contribution to workers Provident Fund		7,252.00	8,868.00
Leave Travel Concession		10,358.80	43,537.40
Leave salary and pension contribution		2,923.00	49,540.00
Group Gratuity Assurance		55,000.00	60,555.90
Travelling Expense (including Rs.26475.75) paid to Governing Body members)		1,02,566.70	1,32,424.40
Medical reimbursement		43,791.62	42,849.53
Postage		23,004.05	26,433.40
Printing and stationery		63,522.43	68,829.66
Telephone charges		89,481.90	61,465.00
Bank charges		5,830.23	1,255.00
Subscription to Journals and periodicals		4,36,672.25	2,74,862.41
Repairs & maintenance of buildings and equipments		1,42,132.55	1,39,091.00
Repairs and maintenance of Vehicles		2,90,135.70	4,23,029.59
Garden maintenance		5,350.50	4,603.45
Stores and Chemicals consumed		1,66,900.80	1,67,818.30
Seminars & Symposia		30,697.25	25,266.75
Photocopying charges		36,611.20	43,038.80
Staff Welfare expenses		5,649.60	21,012.95
Electricity charges		87,957.00	95,901.10
Legal expenses		9,950.00	10,007.50
Property tax		29,092.50	29,759.00
Lease rent of land		2.00	2.00
Miscellaneous expenses		21,190.71	21,077.88
Audit fee		6,000.00	6,000.00
Depreciation on fixed assets		7,96,218.21	9,24,625.57
Notes & Additional Informations	G		
		69,42,078.50	67,46,648.59

Sd/-
DIRECTOR

CHAIRMAN
EXECUTIVE COMMITTEE

As per our separate report of even date attached

For VARMA & VARMA
Sd/-
K.R. PURUSHOTHAMA PAI
PARTNER
CHARTERED ACCOUNTANTS

24 JAN. 1991
urni/-

e.

KERALA FOREST RESEARCH INSTITUTE SOCIETY, PEECHI

SCHEDULES ATTACHED TO AND FORMING PART OF THE BALANCE SHEET AS AT 31ST MARCH 1990

	Current year ended 31. 3. 1990 Rs. Ps.	Previous year ended 31. 3. 1989 Rs. Ps.
SCHEDULE : A		
GENERAL FUNDS :-		
1. Balance as per last Balance Sheet	2,18,75,567.69	2,17,07,770.68
Add : Grant received from Government of Kerala	52,75,277.00	66,75,000.00
	2,71,50,844.69	2,83,82,770.68
Less: Excess of expenditure over income	66,53,764.03	65,07,202.99
	2,04,97,080.66	2,18,75,567.69
2. Surplus/Deficit in Grants of completed external Research Projects - As per last Balance Sheet.	3,00,603.68	3,00,603.68
Add: Surplus/Deficit in Grants of completed external Research Projects - For the current year	87,729.40	.....
GRAND TOTAL (1) + (2)	3,88,333.08	3,00,603.68
	2,08,85,413.74	2,21,76,171.37
SCHEDULE : B		
CURRENT LIABILITIES AND PROVISIONS :-		
A. Current Liabilities :		
External Research work-in-progress pending adjustment.	19,07,492.10	5,62,407.48
Security Deposit from Contractors	15,344.00	15,344.00
Other Liabilities	3,79,527.10	3,27,034.33
B. Provisions	.....	.....
	23,02,363.20	9,04,785.81

CHAIRMAN
EXECUTIVE COMMITTEE

Sd/-
DIRECTOR

As per our separate report of even date attached

24 JAN. 1991

urni/-

For VARMA & VARMA
Sd/-
K.R. PURUSHOTHAMA PAI
PARTNER
CHARTERED ACCOUNTANTS

KERALA FOREST RESEARCH INSTITUTE SOCIETY, PEECHI

SCHEDULE : C

FIXED ASSETS :-

DESCRIPTION	ORIGINAL COST			DEPRECIATION			NET BLOCK	
	As on 1. 4. 1989	Additions	As on 31. 3. 1990	As on 1. 4. 1989	For the Year	As on 31. 3. 1990	As on 31. 3. 1990	As on 31. 3. 1989
Buildings, Compound Walls & Roads	14621847.89		14621847.89	1624247.85	386165.11	2010412.96	12611434.93	12997600.04
Furniture and Fixtures	973796.56	40144.10	1013940.66	604392.58	40954.81	645347.39	368593.27	169403.98
Electrical fittings	1103908.09		1103908.09	485957.66	92156.14	578113.80	525794.29	617950.43
Office Equipments	268601.98		268601.98	164066.75	15389.62	179456.37	89145.61	104535.23
Research Equipments	3278438.84	176020.30	3454459.14	1866416.57	168871.69	2035288.26	1419170.88	1412022.27
Library books	1659060.34	23741.05	1682801.39	1145261.10	80631.04	1225892.14	456909.25	513799.24
Motor Vehicles	567965.70		567965.70	550077.66	4692.39	554770.05	13195.65	17888.04
Insectorium and Potting shed	179889.88		179889.80	55915.87	6198.70	62114.57	117775.31	123974.01
Boat	32219.81		32219.81	20753.55	1146.63	21900.18	10319.63	11466.26
Cycles	1034.63		1034.63	974.25	12.08	986.33	48.30	60.38
	22686763.72	239905.45	22926669.17	6518063.84	796218.21	7314282.05	15612387.12	16168699.88

CHAIRMAN
EXECUTIVE COMMITTEE

DIRECTOR

As per our separate report of even date attached

For VARMA & VARMA

24 JAN 1991

unni/-
e.

K. R. PURUSHOTHAMA PAI
PARTNER
CHARTERED ACCOUNTANTS

KERALA FOREST RESEARCH INSTITUTE SOCIETY, PEECHI

	Current year ended 31. 3. 1990 Rs. Ps.	Previous year ended 31. 3. 1989 Rs. Ps.
SCHEDULE : D		
CAPITAL WORK IN PROGRESS		
Peechi Building IV Phase and New Type II Quarters, Directors Quarters etc.	7,08,539.91	7,08,539.91
Nilambur construction	4,25,540.20	4,25,540.20
Teak Research Centre	15,28,110.32	15,28,110.32
Advance for construction -		
Kerala State Construction Corporation Ltd.	10,881.00	10,881.00
Kerala Public Health Engineering Department	19,81,500.00	19,81,500.00
Mist Chamber Construction	2,16,099.66	1,77,943.51
	48,70,671.09	48,32,514.94
SCHEDULE : E		
CURRENT ASSETS, LOANS AND ADVANCES :		
A. *Current Assets :*		
External Research work-in-progress	1,58,004.08	3,97,095.47
Stocks as per inventory taken, valued and certified by the Directors :		
a) Stock of Stationery	20,207.65	
b) Stores and Chemicals	1,397.90	15,225.03
c) Unused Stamps	541.35	4,435.50
Cash on hand	54,202.95	45.40
Balance with State Bank of Travancore :		29,867.40
i) In Savings Bank Account	13,42,221.12	
ii) In fixed Deposit Account (Being security for obtaining Guarantee facility)		3,58,594.45
iii) In Fixed Deposit	29,500.00	
Balance with Treasury :	21,500.00	36,500.00
i) In Savings Bank Account		
ii) In Fixed Deposit Account	2,21,605.00	
Accrued interest on Fixed Deposits	3,11,500.00	3,80,636.00
	1,10,903.77	3,11,500.00
	22,71,583.82	67,647.15
		16,01,546.40
B. *Loans and advances :*		
Advances recoverable in cash or in kind or for value to be received (unsecured considered good) :	2,38,051.53	
Prepaid expenses	1,95,083.38	2,53,731.63
Other Advances and Deposits		2,24,464.33
	4,33,134.91	4,78,195.96
SUMMARY		
A. Current Assets	22,71,583.82	16,01,546.40
B. Loans and Advances	4,33,134.91	4,78,195.96
	27,04,718.73	20,79,742.36

CHAIRMAN
EXECUTIVE COMMITTEE

Sd/-
DIRECTOR

As per our separate report of even date attached

24 JAN. 1991

unni/-

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KERALA FOREST RESEARCH INSTITUTE SOCIETY, PEECHI

SCHEDULE : F
NOTES ATTACHED TO AND FORMING PART OF THE ACCOUNTS :-

1. In the opinion of the Institute current assets, loans and advances have the value at which they are stated in the balance sheet if realised in the ordinary course of business.
2. The construction of Peechi building IVth phase and new type II quarters, Directors quarters, Nilambur sub centre building, and water supply system were completed and occupied/utilised by the Institute. The cost of construction has not been capitalised in the absence of the final bill. For the above reason, depreciation on these items were not provided in the accounts.
3. Depreciation has been calculated at the rates as in the previous year.
4. Previous years figures are regrouped/recast wherever necessary to suit current years' lay out.
5. Surplus/deficit in grants of the completed external research projects are transferred to the general fund during the year.
6. There is some delay in making payment of Provident Fund dues.
7. Advances and deposits are subject to confirmation.
8. With regard to house rent collection from staff, required registers were maintained with effect from 1 - 4 - 1990.
9. A sum of Rs.17,718/- is provided in the accounts towards interest on unspent grant of Pooyamkutty project. The interest pertains to earlier years viz: 1984 - 85 Rs.2,368/-, 1985 - 86 Rs.13,353/- and 1986 - 87 Rs.1,997/-. Interest is calculated at the rate of 5% per annum on the closing balance in the project account as disclosed in the books of accounts maintained by the Institute.
10. Stock of Institute publication and vehicle spare parts were not taken in the financial books of accounts.

Sd/-
DIRECTOR

CHAIRMAN
EXECUTIVE COMMITTEE

As per our separate report of even date attached

For VARMA & VARMA
Sd/-
K.R. PURUSHOTHAMA PAI
PARTNER
CHARTERED ACCOUNTANTS

24 JAN. 1991

unni/-

e.

KERALA FOREST RESEARCH INSTITUTE SOCIETY, PEECHI

SCHEDULE : G
MISCELLANEOUS INCOME :-

		Current year ended 31. 3. 1990 Rs. Ps.	Previous year ended 31. 3. 1989 Rs. Ps.
House rent recovered from staff		1,08,703.00	1,02,631.00
Rest House rent recovery - Nilambur sub-centre		3,871.55	4,135.55
Vehicle hire charges recovered		20,231.60	17,890.90
Photocopying charges		8,091.15	6,892.85
Sale of Books		15,531.55	13,204.90
Interest on Vehicle Loan from Staff	2,992.00		
Service charge for Wood Testing	6,993.10		
Sundry sales	520.00		
Library due	640.75		
Share of honararium from staff	250.00		
Other receipts	869.50		
		12,265.35	55,940.60
Excess refund of Gratuity from L.I.C.		32,764.00	.....
		2,01,458.20	2,00,695.80

CHAIRMAN
EXECUTIVE COMMITTEE

Sd/-
DIRECTOR

As per our separate report of even date attached

For VARMA & VARMA
Sd/-
K.R. PURUSHOTHAMA PAI
PARTNER
CHARTERED ACCOUNTANTS

24 JAN. 1991

unni/-

APPENDIX III

GOVERNING BODY

1. Prof. N M Joseph
   Minister for Forests
   Govt. of Kerala
   Secretariat
   Thiruvananthapuram - 695 001

2. Prof. N Balakrishnan Nair
   Chairman
   State Committee on Science,
   Technology & Environment
   General Hospital Road
   Thiruvananthapuram - 695 037

3. Shri. V Krishnamurthy, IAS
   Secretary to Government
   Planning and Economic Affairs Dept.
   Secretariat
   Thiruvananthapuram - 695 001

4. Shri. P K Sivanandan, IAS
   Commissioner & Secretary to Govt.
   (Forests & Wildlife)
   Secretariat
   Thiruvananthapuram - 695 001

5. Shri. K Mohandas, IAS
   Special Secretary (Finance)
   Secretariat
   Thiruvananthapuram - 695 001

6. Shri. G Mukundan, IFS
   Principal Chief Conservator of Forests
   Office of the Chief Conservator of Forests
   Vazhuthacaud
   Thiruvananthapuram - 695 014

7. Dr. E G Silas
   Vice-Chancellor
   Kerala Agricultur University
   Vellanikkara - 680 654

8. The Inspector General of Forests
Ministry of Environment & Forests
Paryavaran Bhavan
CGO Complex, Lodi Road
New Delhi - 110 003

9. Dr. P M Ganapathy
Director
Indian Plywood Industries
Research Institute
Tumkur Road
Bangalore

10. Prof. P S Ramakrishnan
School of Environmental Studies
Jawaharlal Nehru University
New Delhi 110 067

11. Shri. K K Nair
Retd. Chief Conservator of Forests
Komath House
Kozhikode 673 001

12. Shri. J C Varmah
'Shivdham'
194 - E, Rajpur Road
Rajpur
Dehra Dun 248 009

13. Shri A K Kaderkutty
Managing Director
Western India Plywood Ltd.
Baliapatom
Kannoore 670 010

14. Director
Kerala Forest Research Institute
Peechi

EXECUTIVE COMMITTEE

1. Prof. N Balakrishnan Nair
   Chairman
   State Committee on Science,
   Technology & Environment
   General Hospital Road
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   Komath House,
   Cannanore Road
   Kozhikode

5. Dr. P M Ganapathy
   Director
   Indian Plywood Industries
   Research Institute
   Tumkur Road
   Bangalore 560 022

6. Director
   Kerala Forest Research Institute
   Peechi