Annual Report
2008-'09

Kerala Forest Research Institute

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An Institution of Kerala State Council for Science, Technology and Environment

Peechi – 680 653, Thrissur Dt., Kerala

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DIRECTOR'S REPORT

The beginning of the 21st century has witnessed certain critical moments in the global economic scenario. A few other issues also have surfaced in social and environmental fronts. While the challenge of food security of nearly seven billion of the world population remains unresolved, additional concerns such as deteriorating environmental quality and global climate change have emerged as more crucial problems in recent years. Vegetation cover of the earth, mainly forests, is suggested as one of the main means for the mitigation of these adversities. Forests act as a buffer against such adverse situations by absorbing carbon dioxide, one of the greenhouse gases contributing to global warming. Presently forests worldwide absorb about a quarter of the total carbon emissions.

Although the global average of forest cover is about 30% of the total land area, there is wide disparity in this proportion from country to country and region to region. Of the total area, primary forests account for just over a third of global forests. The amount of primary forests provides a basic indication of biodiversity since these are the most diverse ecosystems on land and they hold the vast majority of the world's terrestrial species. It is estimated that each year about 60,000 km^2 of these primary forests are lost or modified by logging or other human interventions. This means that the global biodiversity is disappearing at an alarming rate. It is impossible at the moment to estimate the value of biodiversity to mankind since only a small fraction of known species have been examined for potential medicinal, agricultural or industrial value.

Hence, our immediate concerns should be twofold: expansion of global forest cover to the optimum level in order to maintain a habitable environment, and conservation of forests and biodiversity for human good.

As a forestry research organization, KFRI has been moving forward to fulfill its mission by taking up research and extension programmes related to forest and biodiversity conservation, plantation forestry, ecosystem dynamics and rehabilitation, pest and disease control, forest products and socio-economics. The research programmes covered diverse areas such as RET species, mangrove vegetation, medicinal plants, palms, bamboos, wildlife management, livelihood enhancement of forest-dependent communities, coastal green belt establishment, plantation productivity, control of forest pests, diseases and weeds, etc. The extension and training activities included nursery pest/disease management, timber testing, plant identification, seedling distribution, women empowerment and several training and educational programmes on diverse aspects of forestry. As in previous years the Institute continued to contribute its expertise on matters related to the State's ecology and environment.

During the year the Institute received Rs. 881 lakhs as grant-in-aid from the Council (Govt.of Kerala) of which Rs. 464 lakhs was under Plan Grant and the rest under Non-Plan. The funding received from external agencies towards specific projects was to the tune of Rs. 351 lakhs. Funds from Plan Grants were utilized for research and extension projects and for infrastructure development.

Dr. K.V. Sankaran

Director

THE INSTITUTE

The Kerala Forest Research Institute (KFRI) was established in 1975 by the Government of Kerala as an autonomous Institute under the Travancore-Cochin Literary, Scientific and Charitable Societies Act (1955). KFRI is a premier forestry research institute that has been instrumental in generating enhanced resolution to many different aspects of the resources of the country and the state and the associated issues. Brought under the umbrella of the Kerala State Council for Science Technology and Environment (KSCSTE) in 2003, the institute receives support leadership and guidance of the Executive Vice President of KSCSTE, and the Chief Minister of Kerala, who is also the president of KSCSTE.

Location

The main campus of KFRI is located at Peechi, about 20 km east of Thrissur City in a 28 ha. reserve forest area adjacent to Peechi-Vazhani Wildlife Sanctuary in Central Kerala. The Institute has a Subcentre at Nilambur in Malappuram District (43.36 ha.) and a Field Research Centre at Velupadam in Thrissur District (47.43ha.).

Vision, Mission and Organization

The vision of KFRI is to become a centre of excellence in tropical forestry to provide scientific backbone for effective conservation of forest ecosystem and sustainable utilization of natural resources for ensuring benefits to the society.

The mission of the Institute is to provide technical support to facilitate scientific management and utilization of forests for social benefits. Accordingly, the Institute envisages to:

(i) Conduct inter/multidisciplinary research on priority areas of tropical forestry including wildlife management, socio-economics, indigenous knowledge, value addition of forest products, participatory forest management and livelihood improvement of forest dwellers by scientific management of forest resources,

(ii) Provide technical advice and solutions to practical problems related to forest conservation and sustainable utilization of forest resources, and

(iii) Disseminate knowledge and information on forest-related matters to end-users, farmers, general public and transfer of technology to stakeholders for social benefits.

Organization

The total staff strength of the Institute is 133 which includes 57 scientists, 68 administrative staff and 8 technical staff. In addition, 75 project personnel attached to various research projects provide the necessary research support.

The administration and management of KFRI are taken care of by the Management Committee (MC) chaired by the Institute's Director. The Committee approves and manages both administrative and financial matters. Another vital body responsible for overseeing and guiding the formulation and implementation of various research programmes is the Research Council (RC) comprising eminent scientists of the Country in forestry research. The Research Council also monitors the quality and content of research undertaken by the Institute and provides guidance for improvement.

Supported by the Management Committee, the Director administers the Institute. An Administrative Section and an Accounts Section co-ordinated by the Registrar assist the Director in managing the day-to-day functioning of the Institute. The financial and expenditure matters of the Institute are scrutinized by an Internal Auditor.

The scientific manpower of KFRI is organized into nine Programme Divisions each comprising different Departments under them for the effective implementation of multidisciplinary research programmes in forestry and to disseminate the research findings to the stakeholders. Each Programme Division is headed by a Programme Coordinator and each Department, by a Head. The nine Programme Divisions are: 1. Sustainable Forest Management, 2. Forest Genetics and Biotechnology, 3. Forest Management Information System, 4. Forest Ecology and Biodiversity Conservation, 5. Wood Science and Technology, 6. Forestry and Human Dimensions, 7. Forest Health, 8. Extension and Training, and 9. Library and Information. Besides, there is a Central Instrumentation Unit as a common facility. A Research Monitoring and Evaluation (RME) Unit is also functioning to facilitate and monitor research in various Divisions.

Research Divisions

Sustainable Forest Management

The Division comprises Silviculture, Tree Physiology and Soil Science Disciplines.

The thrust areas of research of the Division are: improved nursery and silvicultural practices, production of better clones and quality planting stock of plantation species, and sustainable forest management. Besides, studies have also been undertaken on eco-restoration and afforestation of degraded sites, evaluation of factors affecting plantation productivity, soil nutrient management for different forestry species, use of coir geotextiles for improving the soil, and environmental physiology, especially water use, photosynthesis and microclimate. Monitoring weather parameters has also been undertaken by the Division.

Forest Genetics and Biotechnology

Departments of Genetics and Tree Breeding, and Biotechnology are the components of the Division.

Genetic improvement of teak, DNA fingerprinting, marker assisted selection, gene mapping and population genetics, assessment of genetic diversity of forest species, selection of plus clones and genetic improvement, studies on breeding system and gene flow have been some aspects of research in the Division. Tissue culture of important forestry species and medicinal plants and low cost micropropagation technology are other activities undertaken in the Division.

Forest Management Information System

The Division aims to meet the information needs of the stakeholders of forestry sector using modern tools of statistics, GIS and remote sensing. Creation of a database on biophysical and socio-economic aspects pertaining to forests, forest sector analysis and projections, mapping forest cover and biodiversity and modeling the growth dynamics of plantations and natural forests for effective forest management are some of the major works carried out in the Division. The Division has also developed a growth simulator for teak plantations in Kerala. Ecological studies on the Shola forests of Kerala based on remote sensing data and simultaneous calibration of allometric relations in teak stands were achieved using multilevel models. Stand modeling, biodiversity mapping, ecosystem analysis, GIS, forest resource mapping, population analysis and organization of a data bank of forestry in Kerala are programmes in various stages of implementation.

Forest Ecology and Biodiversity Conservation

The Division includes Forest Botany, Forest Ecology, Non-wood Forest Products and Wildlife Biology Departments.

The thrust areas of research of the Division are ecosystem and landscape analysis, rehabilitation and restoration, population ecology and dynamics, biodiversity evaluation and conservation of fragile ecosystems, traditional knowledge system analysis and biodiversity-informatics. Inventorisation of biodiversity of different forest types and protected areas, evaluation of below-ground biodiversity, taxonomic studies and conservation of RET species of flora have been some areas of research in the Division. Besides, the Wildlife Biology Discipline deals with inventorisation of fauna, endangered animals, man-wildlife interaction and wildlife census. Nursery and plantation technology of selected indigenous timber species, ethno-biological studies and cultivation of medicinal plants and other NWFPs such as bamboos and rattans, are other activities of the Division.

Wood Science and Technology

Research and extension activities related to wood structure, properties and utilization and sustainable extraction are the major activities of the Division. The Division has facilities

like wood preservation plant, drying kiln and instruments like Universal Testing Machine (UTM), image analyzer, NIR spectroscope, etc. The Division has undertaken extensive studies on wood structure, properties and preservative treatments for various timber species like teak, eucalypt and rubber wood. Also, anatomical and utilization studies of bamboos, reeds and canes have been undertaken. The Division has developed implements helpful for bamboo extraction.

Forestry and Human Dimensions

The Division consisting of Forest Economics and Sociology and Urban Forestry Disciplines undertakes research on human dimensions of forestry, including livelihood and recreation, environmental conservation and linkages between social and natural sciences. The major areas of research are natural/forest resource management, economic valuation, sustainable utilization of non-timber forest products, policy issues and strategic planning, sustainable forest management, participatory role of local communities in the conservation and sustainable management of forest ecosystem, resource use conflict and livelihood issues and agro-forestry systems. Assessment of supply-demand position of wood for the state, estimation of availability of bamboo in home gardens, evaluation of the livelihood conditions of bamboo workers in Kerala and establishment of a model watershed with people's participation are some of the recent achievements of the Division.

Forest Health

The Division with its Forest Entomology and Forest Pathology Departments undertakes research on various aspects of microbes, insects and weeds in the forest ecosystem.

The Division maintains authentic collections of microbes and insects of Kerala forests and also of microbial pathogens of forest insects. Eco-friendly technologies are being developed to manage the pests, diseases and weeds in forest plantations, mainly through biological means. Management of nursery and plantation diseases, diversity of plant pathogenic fungi in different forest ecosystems, VA and ectomycorrhizal fungal diversity and biological control of weeds are the main areas of research in Pathology Department.

In Entomology Department, the thrust areas include monitoring of forest insect diversity, control of termites in plantations, wood damaging insects and teak defoliator, traditional methods of post-harvest protection of bamboo from insect borers, etc. The mass production technology of the bio-pesticide Hyblaea puera Nucleo Polyhedrosis Virus (HpNPV) has been standardized, and the application technology has been transferred to stakeholders. The concept of butterfly garden has been popularized and technical advice provided to various agencies for the establishment of butterfly parks.

Extension and Training

The Division liaises with the users /stakeholders, facilitates transfer of technology

to various stakeholders and conducts training programmes in different aspects of tropical forestry like forest management, forest seed management, medicinal plant cultivation, environmental impact assessment, biodiversity monitoring and evaluation, remote sensing and GIS, root-trainer technology, clonal propagation, tree improvement and statistical application in forestry. The Division has excellent facilities for conducting training programmes including lecture halls, trainees' hostel and vehicles for field trips.

The Division also provides technical support to the Kerala Forest Department, other governmental and non-governmental agencies and farmers on site-species matching, site selection and nutrient status, fertilizer dosage, pest and disease control and conservation, utilization and marketing of timber of forest species. Advice on resource survey and estimation as well as wildlife management and census are also provided. The Division coordinates identification of plants, insects, animals and timber.

Library and Information

A library with a core collection of 16,000 books and 9,000 back volumes of journals on forestry caters to the information requirements of scientists and research scholars of the Institute and elsewhere. The collection includes many valuable reference books, doctoral theses and back volumes of periodicals and databases in CD-ROMs. As the Institute is a member of international bodies like APAFRI, IRGWP, IUCN and IUFRO, the library has in its collection the publications from these organizations. More than 90 journals including 30 from overseas are subscribed by the library. Online Public Access Catalogue of books and back volumes is available. In addition, the library provides for online access for over 1900 journals related to environment and forestry, which has provision for accessing full text/abstracts and search facility. Bibliographical databases developed on specialized topics are made available in CD-ROM. The CD Server installed in the library provides access to not only these CD-ROMs but also the TREECD 1939-1990 which covers Forestry Abstracts, Forest Products Abstracts and Agro forestry Abstracts in addition to other Abstracts. Annotated bibliographies on teak, bamboo and rattan, both in print and CDs are also available. As a step towards establishing a forestry portal, e-books, e-prints, research reports and scientific papers are presently available for searching. A comprehensive collection of scientific papers and other scientific documents by the scientists of the Institute constitutes another valuable section of the digital library.

Other Facilities

Main Campus: Peechi

Attached to the different Programme Divisions in the main campus are the laboratories with modern equipment facilities.

In addition, the following facilities are established in the main campus:

- Herbarium comprising 15,000 specimens representing 3,500 species of flowering plants
- Arboretum with 3569 accessions of 170 species belonging to 122 genera and 46 families
- Insect Collection with about 3,500 specimens of insects and lower vertebrates
- Xylarium with wood samples of 567 timber species
- Palmetum having about 80 species of palms
- Canetum with about 30 species of rattans
- Medicinal Plant Garden with many indigenous medicinal plants
- Orchidarium with indigenous fern and orchid species
- Central nursery for raising seedlings of forestry species
- Butterfly Garden

For holding conferences, workshops and meetings, good conference facilities are available. In order to accommodate the visitors and trainees attending various training programmes a guest house and a Trainees' Hostel are established.

Sub-centre: Nilambur

The Sub-centre campus at Nilambur with facilities for laboratory work and field trials in a 43.36 ha area is about 140 km away from the main campus.

- A Bambusetum with 21 species of bamboos and trial plots of several tree species are maintained at the Sub-centre.
- The Teak Museum is located within the Sub-centre campus.
- A Bioresource Nature Trail established adjacent to the Museum depicts various biological themes. A model butterfly garden is another attraction of the trail.

Field Research Centre: Velupadam

The Field Research Centre (FRC) at Velupadam in Thrissur District is spread over an area of 47.43 ha. It is 36 km away from the main campus at Peechi.

- Mainly nursery and field trials are conducted at the FRC campus. A bambusetum, one of India's largest live collections of bamboos with 63 species, is the special attraction of Velupadam campus.

Additional facilities

Kerala Forest Seed Centre

The Kerala Forest Seed Centre has been established at the main campus of KFRI in

collaboration with the Kerala Forest Department. The seed centre has facilities for processing and storage of forest seeds.

Seeds collected from different forest areas are dried, cleaned and graded before storage. The Centre has facility for low temperature storage of seeds. The seeds are tested, certified and supplied to Forest Departments and other stakeholders. At present seeds of only important forest trees such as teak and medicinal plants are supplied by the seed centre. It has plans to expand its stakeholder circle by meeting their demand for seeds of different forestry species.

Tree Health Helpline

KFRI has launched a Tree Health Helpline recently to attend to all queries related to tree planting and management like site selection, species site matching, planting, thinning, soil testing, fertilization, pest, disease and weed management, multi-species interactions, tree/ wood sample identification, preservative treatment of wood and economic valuation of natural resources. The clientele of the service comprise the Kerala Forest Department, wood-based industries, other stakeholders, general public, students, private and public firms. A large number of queries are being attended to, problems diagnosed and remedies prescribed. Various Departments of KFRI like Soil Science, Forest Entomology, Forest Pathology, Forest Physiology, Forest Botany, Silviculture, Wood Science, Statistics and Wildlife Biology are involved in the activity.

Asia-Pacific Forest Invasive Species Network (APFISN)

The office of the Asia-Pacific Forest Invasive Species Network (APFISN) is functioning at KFRI, Peechi under the coordinatorship of Dr. K.V. Sankaran, Director. The APFISN is a cooperative alliance of 33 member countries of the Asia-Pacific Forestry Commission - a statutory body of the FAO. The Network focuses on inter-country cooperation that helps to detect, prevent, monitor, eradicate and/or control forest invasive species in the Asia-Pacific region. The main activities of the Network include: 1. Creating awareness of forest invasive species (FIS) throughout Asia-Pacific region, 2. Exchanging and sharing of information among member countries, 3. Facilitating access to technical expertise, research results, training and education, 4. Strengthening capacities of member countries to manage FIS and prevent new incursions, and 5. Developing strategies for regional cooperation and collaboration in combating FIS threats. The Network is supported by FAO and USDA Forest Service. The Network publishes a bi-monthly newsletter 'Invasives' and fact sheets on major invasive weeds and pests, which are intended to share information among the member countries on FIS and the threats they pose.

TEAKNET Secretariat

The Secretariat of TEAKNET- an international network of institutions and

individuals interested in teak- is also located in the Main Campus of KFRI at Peechi and is coordinated by Dr. K. Jayaraman, Programme Co-ordinator, FMIS Division. TEAKNET addresses the interests of all categories of stakeholders related to teak, and formulates Action Plans focusing on short-term and long-term needs of the global teak sector. The website of TEAKNET provides information on several aspects of teak in addition to a directory of members including researchers, growers and traders. TEAKNET also maintains an information centre where available literature on teak is stored for dissemination. Conducting periodic meetings of the members, national, regional or international, is another activity where members can present and discuss common issues of their interest, suggest action plans leading to solutions. As a part of the long-term strategy, TEAKNET plans to provide research support, training or consultancy services with regard to teak.

Journal of Bamboo and Rattan

The Journal of Bamboo and Rattan - an international peer reviewed journal for bamboos and rattans, is published from KFRI under the leadership of Dr. C. Mohanan of KFRI who is the chief of the editorial team. The journal publishes scientific articles and reviews on biology and genetic resources, environment, propagation, management of stands, utilization, marketing, socio-economics and policy issues.

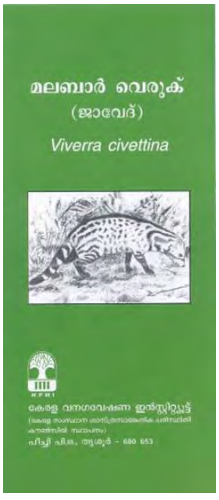
RESEARCH ACTIVITIES

COMPLETED RESEARCH PROJECTS

Status of the critically endangered species, Malabar civet *Viverra megaspila civettina* Blyth, 1862 in the southern Western Ghats. KFRI Research Report No. 305 (Jayson, E.A., 2008)

A study was carried out to locate the critically endangered Malabar civet *Viverra megaspila civettina* in Kerala. Field surveys, questionnaire survey, distribution of brochures and live trapping were adopted for the study. In addition to these, known captive breeding centers of small Indian civet were visited to locate the species. Sixty-nine potential respondents were interviewed to complete questionnaire survey. One thousand copies of specially designed Brochures were distributed to interested people in Nilambur area where the Malabar civet was last spotted. Brochures were also distributed to the potential informers.

Though several responses were obtained from the enthusiastic public when details of the Malabar civet were published in the Brochure and newspapers, detailed studies indicated that all the respondents were referring either to the common palm civet (toddy cat) or small Indian civet. An innovative live trap was specially designed for trapping which proved to be very effective.



Brochure on Malabar civet

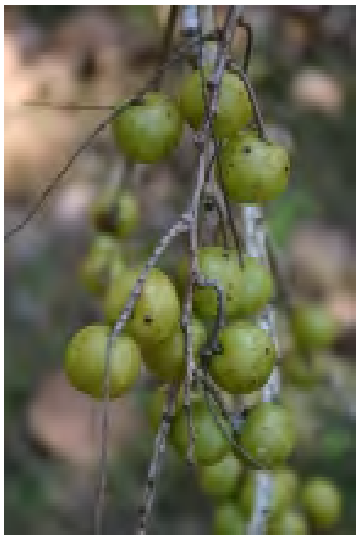
A cage designed for trapping the civet

Respondents from only Elayur, Nilambur were aware of the Malabar civet. The habitat of the civet at Elayur was getting lost at a fast pace. Cashew plantations gave way to rubber plantations and the field surveys revealed that the Malabar civet was not recently sighted there. The present study could not locate any Malabar civet in captivity also, among the captive small Indian civets. As the captive breeding of the small Indian civet was being done with great secrecy, the information on captive civets is scarce. As most of the potential habitats are with private individuals, there is tremendous pressure to change the landuse pattern, which might have adversely affected the survival of the species. The animal being nocturnal in habit, there is still hope of at least a few surviving individuals in some isolated patches at certain remote corners. Creating awareness on the rarity of the species may help in the conservation of the species in future.

Quantitative inventory of non-wood forest products in Northern Kerala. KFRI Research Report No. 306 (Sasidharan, N., Sivaram, M. and Muraleedharan, P.K., 2008)

A list of 137 NWFPs collected for commercial purpose from the forest was prepared and a quantitative inventory of the NWFPs was carried out in 15 Forest Divisions (11 Territorial and four Wildlife Divisions) of the seven northern districts of Kerala covering an area of 4,220 km^2. The NWFPs inventoried consisted of different life forms like herbs, shrubs, climbers and trees yielding useful products such as bark, flowers, fruits, seeds, leaves and roots. Most of the NWFP plants had clumped distribution, seasonal availability, rarity and they occurred in varied terrain conditions. A pilot study was conducted to determine the sample size and the number of plots to be

Medicinal roots stored for supply



Fruits of *Phyllanthus emblica*

established for the estimation of NWFPs in different forest types by species area curve method.

For the quantification of useful products of NWFPs, a software called Invent NTFP was developed. The software had two major parts. The first part dealt with input data. Using the data, the software could quickly analyse density, abundance, relative density, relative frequency, importance value index, Shannon's index and evenness index. The second part dealt with yield studies such as available quantity of useful products like root, flower, bark and leaves from different species.

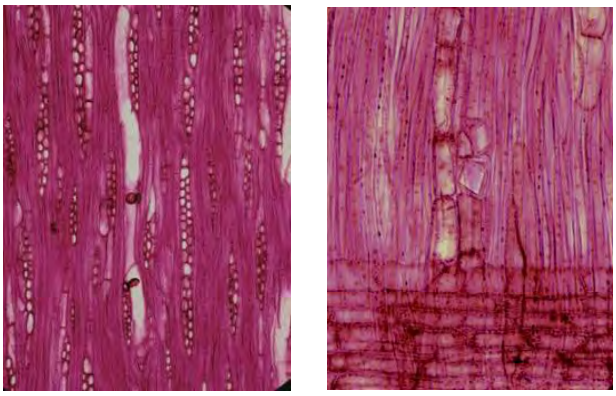
For quantification of NWFPs, a total of 11,548 sample plots were laid out in the natural forests and plantations of 15 Forest Divisions. Among the 137 NWFP plants listed for quantification, 123 were enumerated from the sample plots. Others did not appear mostly because of their habitat specificity and restricted distribution. Among the 123 NWFPs recorded, the species with enough sampling intensity alone were quantified. However, structural data such as density, frequency and abundance of the species were worked out. The highest and lowest density and availability of useful parts (kg/ha) were worked out for each forest division, range and vegetation types.

Among the 123 NWFPs studied 25 species belonged to the red listed categories such as vulnerable (12 spp.); low risk near threatened (4 spp.); endangered (6 spp.) and critically endangered (one species -*Coscinium fenestratum*). Among these, *Kingiodendron pinnatum*, *Strobilanthes ciliatus* and *Hydnocarpus pentandra* are Peninsular Indian endemics.

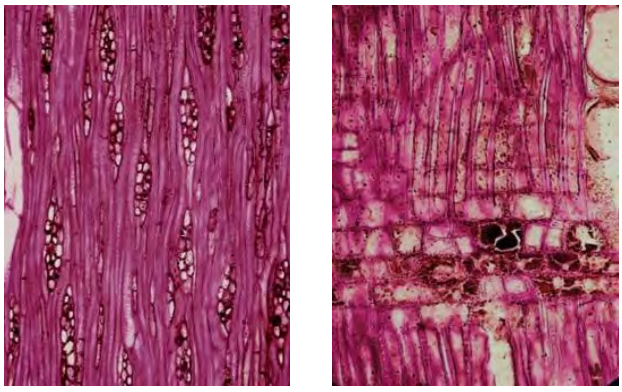
There were two stages in the marketing of NWFPs in Kerala, sale of collected products by the tribals to Federation through society and marketing of the collected products by the Federation. There existed different market situations in both the stages. In the first stage, the market structure was more or less similar to that of monopoly. In the second stage, the market structure of NWFPs in the product market was oligopolistic in Kerala with few firms or sellers in the market. With no increase in the real income and standard of living, the gatherers were compelled to collect larger quantities of those items having high demand, which was an unsustainable practice of collection. For conservation and better management of NWFPs, economic upliftment of the collectors and value addition of NWFPs through post-harvest processing are suggested.

Identification of *Santalum album* and *Osyris lanceolata* through morphological and biochemical characteristics and molecular markers to check adulteration. KFRI Research Report No. 307 (Bhat, K.V., Balasundaran, M. and Balagopalan M., 2008)

The study undertaken to elucidate the means and criteria to differentiate the woods of *Santalum album* and *Osyris lanceolata* showed the possibility of distinguishing the woods reliably on the basis of anatomical structure, colour of the hot water extract, chemical constituents and their proportion in the oil, and DNA fingerprinting.



Santalum album



Osyris lanceolata

Wood anatomical characteristics useful for distinguishing *S. album* from *O. lanceolata* were seriation of rays, type of crystalliferous cells and abundance of extractives. Wood of *S. album* had 1- to 2-seriate rays, crystals in axial parenchyma cells and scanty extractives; whereas, *O. lanceolata* had 1- to 3-seriate rays, crystals in ray cells and relatively abundant extractives. The hot water extract of *S. album* was pale yellowish without traces of red colour while that of *O. lanceolata* was reddish. Similarly, the oil extracted from *O. lanceolata* had a faint reddish hue as compared to *S. album* which was yellowish. The wood of *S. album* yielded thrice as much oil as that of *O. lanceolata*. Oil from *S. album* contained 46 to 57% and 0.42 to 1.56% α-Santalol and cis Lanceol respectively, while that from *O. lanceolata* contained 24 to 25% α-Santalol and 28% cis Lanceol. Chemical constituents such as α-Bergamotene, (Z)-β-Farnesene, β-Bisabolene, α-Bisabolol, Z-α-trans-Bergamotol were present only in *O. lanceolata*, while 2-Carene, α-Curcumene, Teresantalol and trans-β-santalol were found only in *S. album*. As DNA was unavailable from the dry specimens of *O. lanceolata*, DNA extracted from samples of locally found *O. wightiana*, reported as synonym of *O. lanceolata*, was used for the study. The genomic DNA extracted from the wood and leaf samples of *S. album* and *O. wightiana* was PCR-amplified using specific primers designed to amplify the 18S and 26S rDNA units. The variations in restriction patterns (RFLP) of these amplified products when digested with restriction endonuclease Bam HI served as tools to distinguish the two species. The 18S rDNA of *S. album* and *O. wightiana* contained 1695 and 1668 nucleotides and 26S rDNA contained 3204 and 3264 nucleotides respectively. Nucleotide sequence dissimilarities between the rRNA genes of the two species were also sufficient to distinguish *S. album* from *Osyris* species.

Post- harvest protection of bamboo from insect borers by a technique enhancing starch hydrolysis. KFRI Research Report No. 308 (Bhat, K.V. and Jose Kallarackal, 2008)

The reduction of storage starch in harvested bamboo culms during post-harvest period was investigated in two common species of bamboos, namely, *Bambusa bambos* and *Dendrocalamus strictus*. The extent of starch storage in culm tissues varied between the different height levels of the culms and between seasons. Also, there was no definite pattern of seasonal variation in starch content and the extent of starch stored. On an average, approximately 60% reduction in starch content occurred in a fortnight following harvesting. Starch depletion trend was identical in samples stored at room temperature (30° C) and at lower temperatures (20° C) but was more pronounced in the former. Maximum starch depletion occurred during May-August. The starch depletion was attributable to the activity of β-amylase enzyme which showed high activity during the first week after harvesting. The enzyme activity rose from a low value recorded on day-2 and attained a peak, usually on day-6, and then declined gradually. However, in samples where the enzyme activity was high right from the day-2 (or probably, right from the time of harvesting), the activity reduced gradually without a subsequent rise. The declining trend in enzyme activity evident during the second week was more gradual as compared to

Starch stained with iodine reagent in freshly harvested culms (L) and after two weeks of storage(R)

its initial increase which was more rapid. It was also found that lower temperature was not as favourable as room temperature for depletion of storage starch. In general, the enzyme activity was high from July to December as compared to the rest of the period. The sugars released due to the amylolytic hydrolysis of starch were probably utilised for the respiratory activity in the culm tissues since there was an obvious increase in respiratory activity in harvested culms during the first week of post-harvest storage. Application of end coats of cashewnut shell oil or a wall paint called black japan on cut ends and other exposed parts of the culm segments decreased the rate of moisture loss from the culms. However, the treatment had a negative effect on starch depletion. Thus it is concluded that end coating

may serve only as a barrier to the entry of borer beetles into the culms during the post-harvest period. Steeping the culms with amylase solution during harvesting did not result in appreciable increase in subsequent starch depletion as probably the solution taken up by the transpiration stream was not distributed laterally. The stomatal conductance and transpiration rates were high during summer months in both the species. The Fv/Fm values obtained from chlorophyll fluorescence measurements which are indicative of photosynthetic efficiency showed a reduction as the dry period progressed.

Water and light use characteristics of the vegetation in the different strata of a moist deciduous forest. KFRI Research Report No. 310 (Jose Kallarackal and Chandrashekara, U.M., 2008.)

The study was conducted in a moist deciduous forest located at Pattakarimbu, Nilambur North Forest Division, Kerala, India. The tree community structure, composition, distribution pattern and diversity were studied in the forest site by laying 100 quadrats, each of 10m x 10m size. In the study plots, of the 33 tree species encountered, *Xylia xylocarpa*, *Terminalia paniculata* and *Grewia tiliifolia* were the most dominant ones. The total tree density in the plot was 415 individuals ha-1 with a total tree basal area of 23.2 m^2 ha^{-1}. The crown to land ratio (CLR) was 112.1 ± 6.5 and leaf area index (LAI) was 3.60 ± 0.22. Estimated species diversity index

Water and light use measurements in the field

value was 3.49, which suggests that over-dominance of any single or a set of species was absent in this forest.

The duration of the mature leaf phase in the species studied varied from 187 days to 256 days, while yellowing before the abscission took 12 to 32 days. It was also recorded that the duration between complete leaf-yellowing and leaf abscission ranged from 6 to 16 days. Several deciduous species studied produced new foliage during early part of the summer season (January-February). The leaf colour

variations and the changes in specific leaf area (SLA) were followed in several species.

The variations in LAI during different months (2004-2005) showed that it started from a higher value (3.60) in June and gradually decreased thereafter up to March (1.57), except a rise (2.89) during December and another rise during April. Wide variations in leaf litter production were found between plots. Transpiration measurements were done in 12 MDF species *Wrightia tinctoria, Gmelina arborea, Stereospermum colais, Xylia xylocarpa, Dalbergia latifolia, Tectona grandis, Cleistanthus collinus, Sterculia guttata, Terminalia paniculata, Dillenia pentagyna, Terminalia crenulata*, and *Bauhinia malabarica* during the dry period (pre-monsoon period, the monsoon period and the post-monsoon period). Leaf area was the most important determinant regulating the water loss due to transpiration. All the species had a marked reduction in sap flux during midday when the VPD reached values greater than 1.0 kPa. This is a very important water conserving mechanism. Values of pre-dawn water potentials in seven tree species showed values in the range of -0.45 to -0.60 MPa (Megapascals). In almost all the species, there was partial closure of the stomata from midday. The maximum stomatal conductance values were shown before noon. This is an adaptation for most of the native species to prevent water loss from the plant during the warm sunny days in the tropics.

It was found that during the dry season the light availability at the ground level was two-third of the light available above. However, during the post-monsoon period, when the canopy was relatively denser, it was only one third of that available above the canopy. The Fv/Fm values and the PI values recorded showed that some of the seedlings were under severe water stress during the dry season. This could be the reason for the absence of several tree species in the adult stage, but present in seedling stage. It was the interactive controls such as resources, modulators, disturbance regime, human activities and biotic communities that directly regulate ecosystem processes. Species that altered these controls generally had strong effects on ecosystems.

Bamboo shoots harvested for processing

Establishment of a pilot scale bamboo stand for edible bamboo shoot production in Kerala. KFRI Research Report No. 311 (Muktesh Kumar, M.S., 2009)

A preliminary study was conducted on six species of edible bamboos namely, *Bambusa bambos, B. tulda, Dendrocalamus brandisii, D. hamiltonii, D. longispathus* and *D. strictus*. The shoot production season in Kerala was from June to September

and 3-6 shoots were produced from a clump during this period. Shoots were also produced during November-December when Kerala received northeast monsoon rains. However, if regularly watered, new shoots developed at specific intervals. The shoots could be harvested 7-14 days after their emergence when the shoot height was about 15-30 cm depending upon the species. It was estimated that a freshly harvested young shoot of *Bambusa bambos* weighing 5 kg could yield 1.5-2.5 kg edible bamboo. Growth of bamboo was very fast and the culms attained harvestable maturity in less than five years. The average number of shoots produced in *Bambusa bambos* was 23 per annum with an approximate weight of 32-50 kg. In *Dendrocalamus hamiltonii* the average number of culm production was recorded to be 53 weighing approximately 20-40 kg. It is evident that bamboo has emerged as a cash crop to generate income for the rural communities in the bamboo shoot industry and their potential as a dietary.

Pseudoxytenanthera bourdillonii culms

Establishment of a bamboo stand for conservation and sustainable utilization of *Pseudoxytenanthera bourdillonii* (Gamble) Naithani (Arayambu). KFRI Research Report No. 312 (Muktesh Kumar M.S. and Seethalakshmi, K.K., 2009)

Pseudoxytenanthera bourdillonii popularly known as Arayambu or ponmungil is a rare endemic bamboo of Kerala part of the Western Ghats. Over-exploitation, flowering at very long intervals and death of clump after flowering have led to dwindling population of this species in its natural habitat. Rooting response was very poor in culm cuttings in all the treatments. No rooting was found in branch cuttings. Of the 11 treatments including GRS and control over three seasons using cuttings from three different parts, rooting was observed only in four treatments. Although there was an indication that with IBA treatments during February-May rooting was possible, the current success rate of 10-15 percent was not promising. Observations showed that offset planting alone was successful. Success rate, although very low in current experiments, there was an indication that rooting of culm cuttings was possible in this species. The population identified was restricted to a few clumps in isolated localities. The natural habitat where the species is distributed needs to be protected as far as possible, from biotic factors. For *ex situ* conservation, plots need to be established in other agro-climatic regions similar to its natural distribution.

Information Compendium on Kerala Forestry Sector. KFRI Research Report No.

313 (Jayaraman, K., Krishnankutty, C.N., Menon, A.R.R., Anitha, V., Vijayakumaran Nair, P., Sivaram, M., Jayson, E.A. and Rugmini, P., 2008).

Information bulletins on 23 topics relevant to forests of Kerala were prepared viz., forest area, type of forests, biodiversity, wildlife, sacred groves, Myristica swamps, mangroves, forest plantations, home gardens, social forestry, non-wood forest products, bamboo,

Moist deciduous forest

A bamboo stand

cane, ecotourism, marketing of forest produce, demand and supply of wood, consumption of fuelwood, wood-based industries, forest inhabitants, threats to the forests of Kerala, Forest Policy and regulations, sustainable forest management and forest research. The bulletins were later combined as an Information Compendium on Forest Sector of Kerala. Some of the main themes discussed in the Compendium are as follows:

Forests in Kerala, mostly confined to upland, occupy about 29 per cent of the land area of Kerala. Because of the large population, the per capita forest land in the State is 0.04 ha which is much low compared to the national (0.08 ha) or global (0.62 ha) figures. According to the remote sensing based stratification, moist deciduous forests cover the maximum area of forests (43.8%) followed by evergreen and semi-evergreen (35%). Dry deciduous forests (1%) occupy the least area.

During the last three and a half decades, the percentage area under evergreen forests has come down to 35 per cent from 49 per cent. Moist deciduous forests which constituted 31 per cent of the total area in 1973 now make up 43.8 percent. The State forests have a rich diversity of flora and fauna comprising as many as 11,840 plant species and 8,452 animal species. A total area of 2630.49 km^2 has been brought under Protected Category in Kerala which is 23.3 per cent of the total forest area. The State has about 2000 sacred groves, which are distinct and unique in biological diversity. Myristica swamps are a special case of swampy vegetation

largely confined to certain pockets in southern Kerala occupying not more than 0.014 per cent of the total forest area of Kerala. The enormous biodiversity of the Myristica swamp forests is noteworthy. The extent of undisturbed mangroves in Kerala is reduced to just 150 ha mostly distributed in Ernakulam, Kannur and Kozhikode Districts but the potential area comes to around 1670 ha.

Forest plantations occupy about 14 per cent of the area under forests in Kerala. Teak and eucalypts have been the principal forest plantation species. Under the World Bank-aided Social Forestry Programme implemented in 1980's in Kerala, around 20,000 ha were brought to Social Forestry plantations of *Acacia auriculiformis*, *Eucalyptus tereticornis* and *Casuarina equisetifolia*.

Non-wood Forest Products (NWFPs) play an important role in the rural economy of Kerala. There are about 550 species utilized as NWFPs but absence of suitable marketing channels for these products is a constraint. Natural forests and home gardens are also the sources of bamboo in Kerala. Palakkad is a major outlet for export of bamboo to the neighboring states but the quantity traded has been coming down over years due to depletion. Kerala State Bamboo Corporation is the only agency concerned with collection of reeds from forests, distribution to registered mat weavers and sale to other traditional workers. Around 14 species of cane are found growing in Kerala. The resource depletion of cane in natural forests has led to large scale import of the same from Assam and Arunachal Pradesh.

Kerala Forest Department has a well developed marketing system including a network of sales depots. bamboos, reeds and eucalyptus are being allotted yearly to the industries like HNL. NWFP collected from forests through tribals are marketed by the Federation of SC/ST Societies. Over the years, timber prices have been on the increase, import has been going up and export coming down. Over the years, there has been a decline in demand for wood, primarily due to the use of substitutes for timber in construction and increased use of LPG.

Eco-tourism has taken off in a big way in Kerala resulting in phenomenal increase in both the tourist arrivals and earnings from tourism. With increasing urbanization and focus on wildlife and natural ecosystems, Sanctuaries and National Parks are favorite destinations for tourists. However, unrestricted tourism in the protected areas may pose a serious threat to the wildlife and their habitats.

In spite of many governmental programmes, tribal populations in forests are under deprived conditions. Some of the major problems associated with tribals are acute poverty, malnutrition, consumption of intoxicants and exploitation by way of land grabbing by non-tribals which have led to unrest in various tribal pockets.

Forests in the State are managed in consonance with the National Forest Policy which lays stress on environmental stability and joint forest management. Over the years, the State has introduced several rules and regulations aimed at the protection of forest resources.


Views of Bioresources Nature Park

Certain restrictions made on felling of trees from areas outside forests have also been effective in preserving the growing stock of trees outside forests.

Establishment of a Bioresources Nature Trail in the Kerala part of the Western Ghats. KFRI Research Report No. 314 (Chandrashekara, U.M., Sasidharan, N. and Sajeev, T.V., 2008)

The Project was taken up to develop about 10 ha land in the Kerala Forest Research Institute (KFRI) Subcentre, Nilambur into a Bioresources Nature Trail. In a span of three years, the area adjacent to the Teak Museum in the KFRI Sub Centre has been transformed into a landscaped thematic Bioresources Nature Trail which harbors 578 species of the plant kingdom, covering some rare or endangered or threatened species. All the species have been identified, labeled and presented in such a way that visitors can observe the characters of each one of them.

The Nature Trail starts with a orchid house which harbors over 76 species of orchids-both terrestrial and epiphytic. The fern house contains about 71 species of ferns arranged in two tiers along the wall of a four armed green house. Outside the fern house is the hydrophytes garden laid out in the open space. This garden holds 80 species of water plants arranged in sunken tanks and pots. The thallophytes and bryophytes house comes next which is a green house with sunken floor. There are eight species of algae and eighteen species of bryophytes presented here.

The rock garden and the green house contain 115 species of xerophytes and succulents. The local varieties grow in the rock garden and those which were brought from far away places are kept in the green house. The medicinal plant garden adjoining the green house has192 species of plants used in various traditional medical systems of India. The Bioresources Nature Trail also has a gymnosperm garden with 18 species planted out in a large open area.

The Trail is being run as part of the Teak Museum. The visitor flow has been encouraging ever since the opening of the Bioresources Nature Trail.

Biodiversity conservation and Participatory Forest Management. KFRI Research Report No. 315 (Muralidharan, P.K. and Sasidharan, N., 2008)

Commercialisation and associated over-extraction of NTFPs and establishment of plantations have led to serious erosion of forest resources in many parts of the State. This has led to a shift of focus from commercial forestry to environmental forestry in the Forest Policy of 1988. Thus, participatory forest management came into being with the idea of sharing both responsibilities and accountabilities between the Forest Departments and local communities. The Forest Department has established Vana Samrakshana Samitis (VSSs) of local communities living in the fringe areas of forests (Fringe Area VSS) and and that of tribals ((Tribal VSS). The latter have been entitled to collect NTFPs. In order to prevent further depletion of NTFP resources and promote their sustainable extraction, it is necessary to enhance the knowledge base of the collectors and PFM participants. To meet this end, preparation of a primer for training the VSS was taken up in collaboration with the Forest Department. The primer so prepared in Malayalam lists the scientific names of NTFPs and provides guidelines for protection and sustainable utilization of biodiversity.

Conservation and sustainable management of below-ground biodiversity in the Kerala part of Nilgiri Biosphere Reserve-Phase I. KFRI Research Report No. 316 (Chandrashekara, U.M., Balasundaram, M., Sankaran, K.V., Sujatha, M.P., Varma, R.V., Senapati, B.K. and Manvika Sehgal, 2008).

The benchmark site of the Project on Conservation and Management of Below-ground Biodiveristy (BGBD Project) established in the Kerala part of Nilgiri Biosphere Reserve (latitude 10°50' and 12°16'N and longitudes 76° and 77°15'E), is located in the micro-watershed of Chaliyar River. The study site covers different landuse systems such as primary forests, secondary forests, managed plantations,

Effect of vermi-compost application on growth

Participants of the Training Workshop

agroforestry systems and annual crop-based systems. Among different landuse systems, the semi-evergreen forests with 67 tree species are rich in tree species diversity. On the other hand, moist deciduous forest patches are being repeatedly disturbed. Forest patches closer to the agricultural lands are highly degraded. In teak plantation, density and basal area of teak are significantly less in water-logged area than in uplands.

The moist deciduous forests located near human habitation possess sparse vegetation and nutrient poor compact soil. These forests showed relatively higher ant diversity and density. Thus ants, particularly *Lobopelta* sp. and *Leptogenys* sp., could be considered as indicator species of forest disturbance. Among the endogeic earthworms *Parryodrilus lavelee* and *Pontoscolex corethrurus* showed maximum availability in a variety of landuse patterns. Since these two species have a wide tolerance to landuse changes, they may be suitable for land restoration purpose.

Comparatively high diversity of AM fungi in soils of cashew plantations, degraded forests and teak plantations indicate that conditions in these soils are highly suitable for the proliferation of a host of mycorrhizal fungi. The available data show that plant dependency on mycorrhiza is apparently more in highly degraded sites. It was recorded that in the unmanaged systems the root colonization of VAM fungi were more than in some of the well managed monocropping systems. Thus it was clear that in unmanaged systems, plants are more dependent on mycorrhiza for growth. Further analysis of data indicated that majority of the landuse systems were not significantly different from the unmanaged plantations in terms of per cent root colonization by mycorrhiza indicating that these plots are also poorly managed. Results showed that the rhizobial population in polyculture systems was significantly more than in annual crop based systems. Among the thirteen species of naturally growing legumes in the study area, *Desmodium triflorum* produced most profuse nodulation. Thus the wild legumes such as *Desmodium triflorum* could be a potential source of green cover crops.

In Chaliyar River watershed, a faster rate in landuse and land cover changes was recorded. The farming community also expressed the view that the conversion of one cropping system to another was more frequent resulting in the increased soil erosion and runoff rates. Considering these aspects, four strategies viz., a) application of green leaf manure, b) application of plant growth promoting microorganisms and earthworm rich compost, c) reduction of nutrient loss from the croplands, and d) growth of leguminous and/ or biomass transfer species in the crop lands for maintaining soil fertility, sustainable yield and to enhance density and diversity of soil biota in different cropping systems, have been identified.

Forestry sector analysis for the State of Kerala- Phase II. KFRI Research Report No. 317 (Jayaraman, K.; Anitha, V. and Sivaram, M. 2008)

View of the teak plantation

Forest sector analysis was initiated under the ADB framework. Attempts were made to conduct analysis for three subsectors viz., natural forests, plantations and industries, the major findings of which were as follows.

The cause and effect analysis performed for the key problem of forest degradation indicated that the deficient sector outputs include fire, grazing, illicit felling, illicit collection of minor forest produce (MFP) and encroachment. These deficiencies arise from ineffective enforcement of regulations, inadequate infrastructure and lack of cooperation from people. Deficient institutional capabilities and inadequate policies resulting from inadequate financial and technical resources have been identified as reasons for the situation. Forest degradation causes reduced regeneration, reduction in wildlife numbers, shortage of raw materials and reduced environmental benefits. All these impacts get reflected in respective manners at the national level as well.

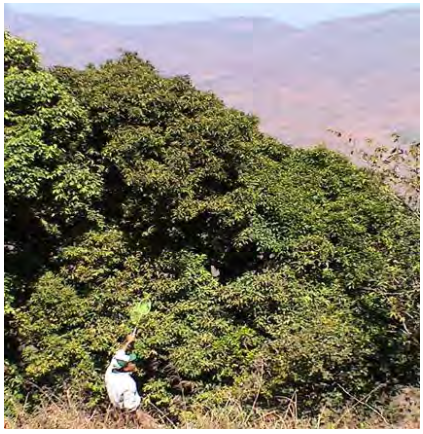
When adequate financial and technical resources are provided, institutional capabilities are strengthened and good policies emerge resulting in effective enforcement of regulations, adequate infrastructure and people's participation in forest management. When institutions function well, the sector outputs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

Controlling fire, grazing, illicit felling and collection of minor forest produce (MFP)

and encroachment form the different alternatives for improving the forest conditions. Alternative analysis indicated that controlling fire seems to be best option for improvement of forest conditions taking into account its immediate effect, easiness to implement, financial and economic viability, social and political acceptance and the widespread impact.

Cause and effect analysis for decrease in productivity levels of forest plantations showed that it resulted from poor genetic stock, low management inputs, soil erosion, illicit felling and to some extent, fire. These deficiencies arise from poor technology, inadequate infrastructure and ineffective enforcement of regulations. Inadequate research programmes and deficient institutional capabilities could be contributing to the above situation in the wake of inadequate financial and technical resources. Low productivity of plantations puts higher pressure on homesteads as a timber source, results in increased imports due to shortage of raw materials. At the national level, this leads to loss of tree cover, loss of foreign exchange, lower profits and lower quality of life due to lower employment and natural disasters. In the presence of adequate financial and technical resources, institutional capabilities are strengthened resulting in better technology, adequate infrastructure and effective enforcement of regulations. Good plantation technology with high management inputs and effective soil conservation brings in higher productivity. Control on illicit felling and fire help protect the resource. Improved productivity puts less pressure on homesteads for production of wood. Higher domestic production implies fewer imports, more availability of raw materials and enhanced environmental benefits on account of the larger growing stock. These impacts are then carried over to the national level. Alternative analysis conducted showed that providing high management inputs and controlling fire are preferable on account of the quickness of results. Plant improvement programme, although effective, has long gestation period.

Cause and effect analysis for decreasing outturn from industries identified shortage of raw material, inferior processing technology employed, poor processing capacity, high input costs such as that of electricity/diesel, administrative snags and several other operational difficulties as causes. Low domestic production, inadequate funds of the entrepreneurs and ineffective regulations act as causes for the deteriorating situation. Deficient institutional capabilities and ineffective policies lead to the poor operational environment. Low industrial outturn gives lower returns for the entrepreneurs, results in increased imports, promotes unemployment and increased product costs. At the national level, this leads to economic recession, loss of foreign exchange, poverty and inflation. In the presence of adequate financial and technical resources, institutional capabilities are strengthened. Coupled with good policies, this leads to higher domestic production of raw materials, and effective regulations. The resulting sector outputs are adequate raw materials, better processing technology, higher processing capacity, low input costs and absence of unwanted administrative controls. Increased outturn leads to higher returns, less imports, higher employment



Tree of *Syzygium palghatense*

Flowers of *Syzygium palghatense*

rates and decreasing product costs with consequent impacts at the national level.

Alternative analysis conducted showed that import of wood because of the quickness of the effect seems to be an effective strategy to tide over the shortage of raw materials and thus to increase the outturn from industries. Removing administrative snags will promote enthusiasm and confidence of the entrepreneurs. Increasing plantation productivity is a long-term strategy for enhancing domestic production. Reducing input costs like that of electricity and diesel charges, wages, etc. may not be effective due to their many interlinkages with matters.

Conservation of the critically endangered tree *Syzygium palghatense* Gamble (Myrtaceae) in the Western Ghats of Kerala. KFRI Research Report No. 318 (Yesodharan, K., Mohandas, K. and Chandrasekhara Pillai, K., 2009).

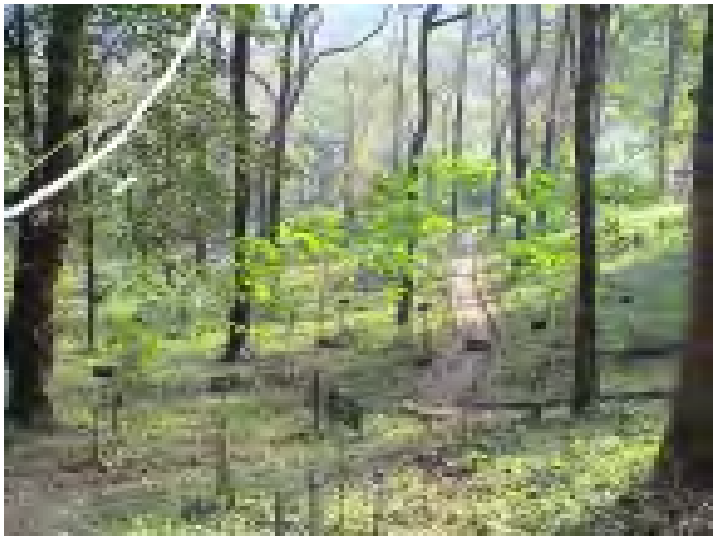
Syzygium palghatense Gamble (Myrtaceae) is a critically endangered evergreen tree found in the southern Western Ghats of Kerala, reported only from Parambikulam Wildlife Sanctuary in Palakkad District. The species is known only by the 17 plants (six trees, eight saplings and three seedlings) found in the Pandaravarai of Parambikulam WLS of which only two trees were found in flower during the study. The trees were found on a slope at about 1200 m.asl. Population status, pollination and reproductive biology and constraints in the natural regeneration were studied.

The scientific data gathered on population studies along with climatic factors enabled to determine the causal factors responsible for reduction of the population in its natural habitat which subsequently led to the rarity of species. Understanding climatic and edaphic requirements *in situ* will be of use while implementing the restoration of the species.

Since *S. palghatense* is a critically endangered species, vegetative propagation technique such as rooting of stem cuttings and seed propagation technique can be

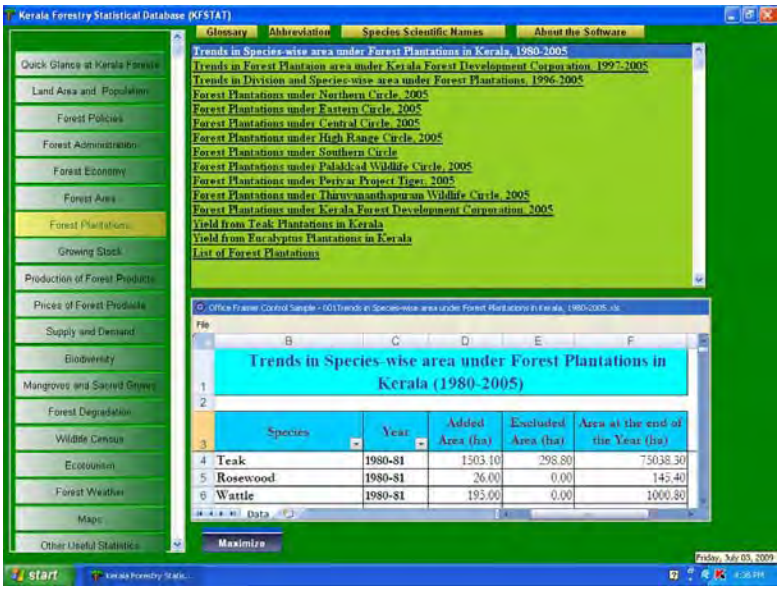
adopted for its multiplication. Planting seedlings of the species in its natural habitat, in botanical gardens and including the species in the rehabilitation programmes are suggested for the recovery of the species.

Establishment of an Arboretum of rare and characteristic species of the moist deciduous forests of Kerala. KFRI Research Report No. 319 (Nair, K.K.N., Yesodharan, K. and Unni, K.K., 2009)



A view of the Arboretum

The Arboretum was established in the main campus of Kerala Forest Research Institute at Peechi. The area is covered by moist deciduous forests represented by 34 species and 726 individual trees. By supplementing the existing stand by filling tree gaps present, the live collection was maintained. Seeds of different arborescent species were collected from the moist deciduous forests of the state along with those of a few endemic species from the adjoining semi evergreen, evergreen and dry deciduous forests. The collected seeds were germinated in the nursery at the Field Research Station of the Institute at Veluppadam in Thrissur District, with the details generated on germination percentage of most of them. When the seedlings attained suitable size, they were planted in the Arboretum plot in the tree gaps already identified with appropriate spacing. The Arboretum was maintained with necessary casualty replacements, weeding and watering, whenever required. The present holding of the Arboretum is 3089 accessions belonging to 170 species under 50 families and 122 genera, with about 50 taxa endemic to southern Peninsular India. Arboretum is maintained with the details on location and grid map. The Arboretum has obtained the Index Seminum ID No.1518 and is also enlisted in the National Network of Botanical Gardens in India.



Main menu of the database and retrieval system

Computerized database on Kerala forest resources and data retrieval system. KFRI Research Report No. 320 (Sivaram, M., 2009).

A computerized database and data retrieval system on forest resources of Kerala State, India was developed. The database contains the spatio-temporal data covering themes such as forest area, forest plantations, production, supply, and demand and prices of forest products. The data in the database are stored in popular file formats such as Excel (xls), Word (doc) or Acrobat (pdf). The database has an interface developed using 'Microsoft Visual Basic'. It helps to retrieve the required data in a few clicks. The graphical representation of the data, data source and glossary are also integrated in the system.

The highlights of the important statistical data and the following two major applications of the database are as follows:

i. Projection of availability of teak wood from forest plantations was undertaken under different scenarios, taking into account the factors such as species-mix, age structure, rotation age, productivity and planting rates. The projections indicated that the promotion of teak outside the forests such as home gardens and farmlands would help to bridge the gap between future demand and supply.

ii. The long-term trends in the real prices (deflated current prices) of teak wood in different girth classes for the period 1956 to 2005 were analysed by fitting different spline models. The analysis indicated that there was a declining trend in real

prices since 1995 probably due to increased availability of substitute materials in the market. However, of late, the prices of teak wood have been increasing. The short-term price forecasts of teak wood were made using artificial neural network and auto-regressive integrated moving average models. The forecasts indicated that the quality teak wood would fetch high returns. Therefore, efforts should be made to produce quality teak wood.

Development of protocols for processing and testing of forest seeds. KFRI Research Report No. 321(Chacko, K.C., 2009)

Various aspects of seed handling such as processing, storage physiology, pre-sowing treatments, viability and purity testing were studied for twelve indigenous forest tree species of Kerala State. They are *Albizia lebbeck, Aegle marmelos, Artocarpus hirsutus, Cassia fistula, Dysoxylum malabaricum, Gluta travancorica, Gmelina arborea, Neolamarckia cadamba, Oroxylum indicum, Syzygium cumini, Tectona grandis* and *Terminalia bellirica*.

Teak seed grading

Seeds of *N. cadamba* processed by froth method

For seed extraction from *Albizia lebbeck* and similar dehiscent fruits, a solar seed drier that can be used even on rainy days was designed and fabricated. Storage of *A. lebbeck* seeds for short periods up to 3.5 months was not affected by storage temperature, although the species is reported to store well for long periods under low temperature and humidity. For purity test 50 g sample was optimum.

For *Tectona grandis*, a seed grader for separating seeds above 9 mm size is designed, fabricated and used in Kerala Forest Seed Centre. This seed grader, which saves 50% labour, costs about Rs. 100001. Studies on seed viability and germination revealed that a strong correlation exists between cutting and germination tests. An equation is recommended for predicting germination from results of cutting test.

For efficient splitting of *Cassia fistula* pods and easy extraction of seeds, the pods may be hit along suture line with wooden mallet. As regards to seed storage, cold storage has no added advantage for short term. For purity test 100 g is the optimal sample size.

Aegle marmelos, earlier suspected to be recalcitrant, shows orthodox behavior as seeds dried up to 4.84% moisture content gives up to 94% germination. *Artocarpus hirsutus* seeds are short-lived and store well only up to two weeks even if moisture content is maintained above 35%.

Dysoxylum malabaricum seeds are short lived and store well for two weeks under ambient well-ventilated conditions. *Gluta travancorica* seeds store well for three months without significant loss of viability. Partial or complete removal of seed coat enhances germination and hence this procedure is recommended as a pre-sowing treatment. *Gmelina arborea* seeds show intermediate storage behavior.

For easy and efficient extraction of seeds from fruits of *Neolamarckia cadamba*, 'froth method' has been discovered. *N. cadamba* seeds show orthodox behavior. For purity test 1.5 g is the optimal sample size.

Oroxylum indicum seeds are orthodox. Tetrazolium staining can be used for reliable prediction of germination of seeds. The optimal sample size for the purity test is 10 g.

Syzygium cumini, a highly recalcitrant species, loses viability drastically on drying below 35% moisture content.

Terminalia bellirica seeds show orthodox -storage behavior. Germination of seeds is improved by removal of mesocarp and weathering of seeds (wetting with water and drying under sun) for about a week

ONGOING RESEARCH PROJECTS

Standardization of nursery and plantation techniques of mahogany with particular reference to soil, nutrition and shoot borer incidence (Thomas P. Thomas, Mohanadas, K., Rugmini, P. 2003 April - 2009 Sept. KFRI Plan Grants)

Demonstrating the effect of controlling the teak defoliator on volume increment in teak in the permanent plots established at Nilambur (Sajeev, T.V., Sudheendrakumar, V.V. 2003 April - 2012 March. KFRI Plan Grants)

Productivity and growth studies on sympodial bamboos and establishment of a monopodial bambusetum (Pandalai, R.C., Rugmini, P. 2003 April - 2012 March. KFRI Plan Grants)

Establishment of an arboretum of rare and characteristic species of the moist deciduous forests of Kerala (Nair, K.K.N., Yesodharan, K., Unni, K.K. 2003 April - 2012 March. KFRI Plan Grants)

Growth and yield studies in species trial plots established by KFRI (Chandrashekara, U.M., Nandakumar, U.N. 2003 April - 2012 March. KFRI Plan Grants)

Standardization of bamboo cultivation practices for homesteads of Kerala (Nandakumar, U.N., Thomas P. Thomas, Unni, K.K. 2003 April - 2009 March KFRI Plan Grants)

Maintenance of provenance trial plots of eucalypts and acacia and development of

new clones for establishment of Clonal Multiplication Area (CMA) (Maria Florence, E.J., Balasundaran, M. 2003 August - 2012 March KFRI Plan Grants)

Establishment of butterfly garden at Nilambur (George Mathew, Sajeev, T.V. 2004 January - 2009 Sept. KFRI Plan Grants)

Establishment of *ex-situ* gardens of species of *Dalbergia* and monocotyledons in Bioresources Nature Trail in the Kerala part of Western Ghats (Chandrashekara, U.M., Sasidharan, N. 2004 April - 2009 March. Planning and Economic Affairs Dept., Govt. of Kerala).

Improvement of teak through genetic evaluation (Indira, E.P. 2004 April - 2012 March. KFRI Plan Grants)

Enrichment of insect and microbial culture collections at KFRI (George Mathew, Mohanan, C. 2004 April - 2012 March. KFRI Plan Grants)

Habitat enrichment in the butterfly garden at KFRI campus, Peechi (George Mathew 2004 April - 2012 March. KFRI Plan Grants)

Strengthening and computerisation of KFRI Herbarium (Yesodharan, K., Nair, K.K.N. 2004 April - 2009 March. KFRI Plan Grants)

Strengthening and enriching the Palmetum (Renuka, C. 2004 April - 2012 March. KFRI Plan Grants)

Strengthening medicinal plants garden in the Peechi campus (Sasidharan, N. 2004 April - 2012 March. KFRI Plan Grants)

Participatory Forest Management and ecodevelopment alternatives: Initiatives and challenges in Kerala (Mammen Chundamannil, Hussain, K.H., Unnikrishnan, P.N. (KFD). 2004 April - 2010 March. KFRI Plan Grants)

Use of bioprotectant against fungal deterioration of rubber wood (Maria Florence, E.J., Balasundaran, M. 2004 December - 2007 November. Department of Science and Technology, Govt. of India)

Mapping and quantitative assessment of geographic distribution and the population status of plant resources of Western Ghats (Sharma, J.K., Menon, A.R.R., Renuka, C. 2004 December - 2008 November. Department of Biotechnology, Govt. of India)

Developing appropriate technology for community level production of charcoal and activated carbon from coconut stem wood and shell for industrial use (Dhamodaran, T.K., Gnanaharan, R. 2005 June - 2008 May. Coconut Development Board, Kerala)

Regeneration study of selected terminalias in Kerala (Pillai, P.K.C., Chandrashekara, U.M. 2005 April - 2009 March. KFRI Plan Grants)

Genetic diversity and conservation of teak (Indira, E.P., Bhat, K.M. 2005 April - 2010 March. KFRI Plan Grants)

Recording of weather data at different centers of KFRI (Jose Kallarackal, Pillai, P.K.C. 2005 April - 2012 March. KFRI Plan Grants)

Establishment of a Clonal Multiplication Area for teak (Surendran, T. 2005 April - 2012 March. KFRI Plan Grants)

Improving sandal population in Marayur Sandal Reserve through assisted natural regeneration and planting improved seedlings and clones (Balasundaran, M., Dy. Conservator of Forests (KFD). 2005 April - 2009 March KFRI Plan Grants)

Studies on the growth performance of the rattan species under plantations (Renuka, C. 2005 April - 2009 Sept. KFRI Plan Grants)

Documentation and conservation of small mammals of the sacred groves of Kerala State, Peninsular India (Padmanabhan, P. 2005 April - 2009 Sept. KFRI Plan Grants)

Identification of mammals based on hair structure, flesh, tissue and preparation of a manual (Ramachandran K.K., Jayson, E.A., Balasundaran, M. 2005 April - 2010 March KFRI Plan Grants)

Enrichment of microbial culture collections at KFRI (Mohanan, C. 2005 April - 2012 March. KFRI Plan Grants)

Bamboo for affordable shelter: Demonstration of appropriate construction practices and construction of durable model Bamboo House (Dhamodaran, T.K., Gnanaharan, R. 2005 April - 2009 March. KFRI Plan Grants)

Developing an innovative industrial technology of shockwave-assisted protection of bamboo against fungi and insect borers (Dhamodaran, T.K., Gnanaharan, R., Maria Florence, E.J., Jagdeesh, E. (IISC, Bangalore). 2005 April - 2009 March. KFRI Plan Grants)

Qualitative and quantitative analysis of biologically active principles, Baicalein, Luteolin and Psoralen from *Oroxylum indicum, Premna integrifolia* and *Aegle marmelos* respectively and its allied species (Sasidharan, N.2005 April - 2009 March. KFRI Plan Grants)

The conservation of mangroves in Kerala: Economic and ecological linkages (Muraleedharan, P.K., Anitha, V. 2005 April - 2009 Sept. KFRI Plan Grants)

Organising educational programmes at Teak Museum , KFRI Subcentre, Nilambur (Sani Lookose 2005 April - 2012 March. KFRI Plan Grants)

Studies on controlling teak defoliator outbreaks by seeding baculovirus, HpNPV in epicenter populations (Sudheendrakumar, V.V., Sajeev, T.V., Jayaraman, K. 2005 August - 2008 July. Dept. of Biotechnology, Govt. of India)

Multilocational field trials for selected bamboo species in Kerala (Raveendran, V.P., Unni, K.K., Seethalakshmi, K.K. 2005 August - 2009 July. National Mission on Bamboo Applications (NMBA)

Improving livelihood of bamboo artisans and bamboo farmers in ten clusters through technological interventions (Seethalakshmi, K.K., Sankar, S., Pandalai, R.C., Muralidharan, E.M., Dhamodaran, T.K. 2006 April - 2010 March. KFRI Plan Grants)

Improving the yield and reducing the rotation age of teak plantations through superior clonal teak (Surendran, T., Muralidharan, E.M., Chacko, K.C., Sharma, J.K. CCF (Planning KFD), CF (WP& R), DCF Research (North) DCF Research (South). 2006 April - 2011 March. KFRI Plan Grants)

Rehabilitation of 50 ha of sandal reserve in Marayur with improved planting stock resistant to spike disease and high oil content (Balasundaran, M., CCF (Planning), Dy.Conservator of Forests (Res., South), DFO (Marayoor). 2006 April - 2011 March. KFRI Plan Grants)

Strengthening and enriching Institute Central Nursery (Pandalai, R.C., Pillai, P.K.C. 2006 April - 2012 March. KFRI Plan Grants)

Strengthening the *ex-situ* conservation of evergreen trees (Unni, K.K. 2006 April - 2011 March. KFRI Plan Grants)

Strengthening and documentation of Wildlife Museum (Ramachandran, K.K., Jayson, E.A., Padmanabhan, P. 2006 April - 2012 March. KFRI Plan Grants)

Strengthening of floristic diversity in the KFRI Subcentre campus through planting and weed management (Chandrashekara, U.M. 2006 April - 2012 March. KFRI Plan Grants)

Transfer of technology of biological control of the teak defoliator pest to the Kerala Forest Department for field implementation and entrepreneurs for commercial production (Sudheendrakumar, V.V., Sajeev, T.V., Varma, R.V. 2006 April - 2010 March. KFRI Plan Grants)

Model watershed: Maintenance, monitoring and outreach (Sankar, S. 2006 April - 2010 Sept. KFRI Plan Grants)

Information Compendium on Kerala Forestry Sector (Jayaraman, K., Krishnankuttty, C.N., Menon, A.R.R., Vijayakumaran Nair, P.V., Sivaram, M., Rugmini, P. 2006 April - 2009 March. KFRI Plan Grants)

Capability development in instrumental methods of analysis (Balagopalan, M. 2006 April - 2012 March. KFRI Plan Grants)

Management and monitoring of growth of coppice crop in the experimental plantations of *Eucalyptus tereticornis* (Kayampoovam and Punnala) and *E. grandis* (Sooryanelli and Vattavada) (Sankaran, K.V., Pillai, P.K.C. 2006 April - 2011 March. KFRI Plan Grants)

Species recovery of *Dipterocarpus bourdillonii* and *Humboldtia bourdillonii*, two critically endangered endemic trees of Western Ghats (Swarupanandan, K., Muralidharan, E.M., Indira, E.P., Pandalai, R.C. 2006 March - 2011 Feb. DBT (Ministry of Science and Technology)

A handbook on the butterflies of Nilgiri Biosphere Reserve (George Mathew. 2006 April - 2009 June. Ministry of Environment and Forests, Govt. of India)

Processing storage and supply of forest tree seeds through KFSC (Pandalai, R.C. 2006 July - 2009 Sept. Kerala Forest Department)

Ecosystem structure and dynamics, biodiversity, human dimensions and their linkages of Iringol Sacred Grove in the Western Ghats of India (Nair, K.K.N., Menon, A.R.R., Ramachandran, K.K., Thomas P. Thomas, Anitha, V., Sivaram, M., Jayson, E.A., George Mathew, Vijayakumaran Nair, P., Yesodharan, K. 2006 August - 2009 July. Ministry of Environment and Forests, Govt. of India)

Linking conservation and forest management with sustainable livelihoods and resource use conflict in Agasthyamalai Biosphere Reserve (Anitha, V. 2006 August - 2009 July Ministry of Environment and Forests, Govt. of India)

Species recovery plan for *Semecarpus kathalekanensis*: a critically endangered fresh water swamp species of the Western Ghats (Vijayakumaran Nair, P., Pandalai, R.C. 2006 Sept. - 2009 Aug. Department of Biotechnology, Govt. of India)

Tolerance of indigenous forest species to degraded lateritic soils of Kerala (Sujatha, M.P., Suresh Kumar (KAU), Thomas P. Thomas. 2006 Oct. -2009 Sept. Ministry of Environment and Forests, Govt. of India)

Conservation and sustainable management of non-timber forest products through participatory approach in the Western Ghats, Kerala (Muraleedharan, P.K., Anitha, V., Sasidharan, N., Seethalakshmi, K.K., 2007 April - 2009 December. UNDP-GEF Small Grant Programme, Collaborating with URAVU, Wayanad)

Preparation of Biodiversity Register for Panchayaths of Wayanad District (Muktesh Kumar, M.S., Ramachandran, K.K., Anil Zacharia, Animal Husbandry Dept., Wayanad. 2007 June - 2009 May. Rashtriya Sam Vikas Yojana - Wayanad District)

Establishment of a soil museum at KFRI (Sujatha, M.P., Thomas P. Thomas 2007 July - 2010 Jun. KFRI Plan Grants)

Early selection and mass multiplication of *Eucalyptus* interspecific hybrid clones (Balasundaran, M., Maria Florence, E.J. 2007 July - 2010 Jun. KFRI Plan Grants)

Rust fungi of Kerala- Biodiversity and biosystematics (Mohanan, C. 2007 July-2010 Mar. KFRI Plan Grants)

Macrofungi of Kerala - Biodiversity and biosystematics (Mohanan, C. 2007 July - 2010 Jun. KFRI Plan Grants)

Establishment of a tree protection helpline for the state of Kerala (Sudheendrakumar, V.V., Sankaran, K.V., Sajeev, T.V. 2007 July - 2009 Jun. KFRI Plan Grants)

Digital library in forestry (Sankara Pillai, K., Sarojam, N., George K.F. 2007 July -2010 Jun. KFRI Plan Grants)

Flowering plants of Kerala - CD Version 2.0 (Sasidharan, N. 2007 July - 2010 Jun. KFRI Plan Grants)

Strengthening and rehabilitating the Bioresources Nature Park in the KFRI Sub Centre Campus (Chandrashekara, U.M. 2007 July - 2010 Jun. KFRI Plan Grants)

Establishment of a Taxonomic Garden in the KFRI Sub Centre Campus (Chandrashekara, U.M. 2007 July - 2010 Jun. KFRI Plan Grants)

Biodiversity of terrestrial and lignicolous macrofungi in the Kerala part of the Western Ghats (Mohanan, C. 2007 July - 2010 Jun. Ministry of Environment and Forests, Govt. of India)

Identification of satyrine butterflies of Peninsular India through DNA barcodes (George Mathew 2007 August - 2010 July Department of Biotechnology, Govt. of India)

Establishment of a Bamboo Technical Support Group for South Zone under

National Bamboo Mission at KFRI, Peechi (Seethalakshmi, K.K., Pandalai, R.C., Sankar, S., Mohanan, C., Muralidharan, E.M., Muraleedharan, P.K., Krishnankutty, C.N., Anitha, V., Vijayakumaran Nair, P., Unni, K.K., Soman, C.K., Thulasidas P.K., and Mohammed Kunhi, K.V. 2007 September - 2009 March. National Bamboo Mission, Govt. of India)

Protection of Tsunami-affected coastal areas by establishing bioshields through people's participation. (Balagopalan, M., Seethalakshmi, K.K., Raveendran, V.P., Sheikh Hyder Hussain (KFD). 2007 September - 2009 February. Tsunami Rehabilitation Programme, Govt. of Kerala)

Carbon storage in different age teak plantations in Kerala (Balagopalan, M., Rugmini, P., Mehar Singh (KFD) Rajan Seghal (KFD). 2007 Sept. - 2010 Aug. Kerala Forest Development Corporation)

DNA barcoding of *Dalbergia* species. (Nair, K.K.N., Balasundaran, M. 2007 July - 2010 Jun. Department of Biotechnology, Govt. of India)

Field trial of tree infusion technique to manage mistletoe infestation in teak plantations (Sajeev, T.V., Jose Kallarackal, Mehar Singh (KFD), Rajan Sehgal(KFD). 2007 November - 2010 Oct. Kerala Forest Department)

Conservation and sustainable management of below-ground biodiversity in the Kerala part of Nilgiri Biosphere Reserve - Phase II (Chandrasekhara, U.M., Balasundaran, M., Sujatha M.P., Varma R.V. (KSBB). 2008 January - 2009 Dec. TSBF-SARNET, J. N. University, New Delhi)

Conservation of microfungi: a voice for unprotected and vulnerable organisms (Sankaran, K.V., Hussain, K.H. 2008 Jan. - 2010 Mar. UK £ 6000; Darwin Initiative, UK)

Symbiotic nitrogen fixing bacteria supported INM for rosewood plantations in degraded acid soils of Western Ghats (Balasundaran, M., Sujatha, M.P., Maria Florence, E.J. 2008 Mar. - 2011 Feb. Department of Biotechnology, Govt. of India)

A field study to evaluate the efficacy of lemongrass in controlling runoff and soil erosion (Thomas P. Thomas, Sankar, S. 2008 March - 2011 Feb. Planning & Economic Affairs (E) Department, Govt. of Kerala)

Forestry sector analysis for the state of Kerala (Jayaraman, K., Anitha, V. 2008 May - 2009 Apr. Ministry of Statistics and Programme Implementation, GOI)

Evaluation of *Saraca asoca*, *Kaempferia rotunda*, their substitutes and medicinal preparations with respect to phytochemical and biological properties (Sasidharan, N., Jose Padikkala 2008 June - 2011 May National Medicinal Plants Board, New Delhi)

Software development for forestry applications (Jayaraman, K., Menon, A.R.R. 2008 June - 2009 May KFRI Plan Fund)

Optimizing management of bamboo stands using growth simulation models (Jayaraman, K., Pandalai, R.C., Sujatha, M.P. 2008 June- 2011 May KFRI Plan Fund)

Quality improvement of organic manures for reducing soil health hazards (Sujatha,

M.P., Balasundaran, M. 2008 June - 2011 May KFRI Plan Fund)

Development and maintenance of the Medicinal Plants Garden in the Peechi Campus (Sasidharan, N. 2008 June - 2011 May KFRI Plan Fund)

Vegetative propagation of selected medicinal plants for enrichment of resources - Phase II (Surendran, T. 2008 June - 2011 May KFRI Plan Fund)

Ecophysiological responses of tree species to elevation gradient in the shola forests of Kerala (Chandrashekara, U.M., Kallarackal, J., Soman, C.K. 2008 June - 2011 May KFRI Plan Fund)

Assessment of crop damage by wild animals in Trichur District Kerala (Jayson, E.A. 2008 July - 2011 June KFRI Plan Fund)

Phylogeny and generic classification of the woody bamboos (Muktesh Kumar, M.S., Balasundaran, M. 2008 June - 2012 May National Science Foundation, USA)

Natural enemies of the weeds *Impatiens glandulifera* and *Hedichium* spp. native to Himalayas (Sankaran, K.V. 2008 June - 2009 May DFID, UK)

Directory of wetlands (Vijayakumaran Nair, P.V. 2008 June - 2009 May Kerala State Biodiversity Board)

Land use and its change in forests of Kerala (Vijayakumaran Nair, P.V. 2008 June - 2011 May KFRI Plan Fund)

Evaluation of the effectiveness of water submersion method for protection of bamboo from borer damage (Bhat, K.V., Balasundaran, M. 2008 June - 2010 May KFRI Plan Fund)

Natural enemies of the Red Palm Mite in India (Sankaran K.V., Sudheendrakumar, V.V. 2008 Sept - 2009 Aug CABI Europe - UK)

Developing appropriate technology and establishing a plant for activated carbon production from coconut shells for community based organizations (Dhamodaran T.K. 2008 Nov - 2012 Jun ICAR (NAIP))

Planting stock production of selected commercial species of bamboos (Somen C.K., Seethalakshmi, K.K., Unni, K.K., Raveendran, V.P. 2008 Dec - 2009 Nov National Bamboo Mission)

Impact of industrial activities on soil and water qualities in Koratty Panchayath area (Balagopalan, M., Sujatha, M.P. 2009 Jan - 2011 Dec. Kerala State Council for Science Technology and Environment)

Bamboo resource development and utilisation in Karassery Panchayath (Raveendran, V.P., Sankar, S., Seethalakshmi, K.K. 2009 Jan - 2011 Dec. Karassery Panchayath)

HIGHLIGHTS OF ONGOING RESEARCH PROJECTS

Biodiversity and Systematics

Flowering Plants of Kerala - CD Ver. 2.0

Data sheets were prepared with search characters such as flower colour, inflorescence, stamens, petals and fruit type for 350 species. Descriptions were prepared for about 2,400 plants. About 1,550 images depicting the diagnostic features of 450 species were prepared for inclusion in the CD.

Strobilanthes anamallaica

Strobilanthes barbatus

Strobilanthes decurrens

Strobilanthes dupenii

Strobilanthes gracilis

Strobilanthes heyneanus

Strobilanthes kunthianus

Strobilanthes pulneyensis

Strobilanthes lawsoni

Strobilanthes micranthus

Taxonomy of Microlepidoptera

A survey of Microheterocera belonging to the families Psychidae, Pyralidae, Tortricidae, Tineidae (Tineoidae), Oecophoridae, Ethmiidae, Lecithoceridae, Gelechiidae, Blastobasidae, Cosmopterigidae (Gelechioidea), Plutellidae, Yponomeutidae, Lyonetiidae, Glyphipterigidae and Heliodinidae was conducted in the Kerala part of Western Ghats. Of the 79 species recorded, six species were new records for Kerala and two species were new records for India.

In order to identify the species, external morphology of various species with special reference to head appendages, wings and external genitalia was also investigated. These studies have shown that characteristics of the labial palpi, wing venation and parts of external genitalia such as uncus, saccus, gnathos, juxta, tegumen of the male as well as corpus bursae, ductus bursae and signum of the female have diagnostic value in species identification.

Dichomeris sp. - new species

Monopis trigonoleuca- new to India

All India Co-ordinated Project [AICOPTAX] on Taxonomy of bamboos

Field trips were conducted to different parts of Karnataka, Andhra Pradesh, Goa and Sri Lanka. The required environment parameters such as habitat and ecological details were recorded during specimen collection from region/locality for each species. About 600 specimens were collected and 500 cibachrome sheets from National & International Herbaria (CAL, DD, MH, PBL, BSI, BHC, BSD, CALI, K, P, E, BO) including 100 photos of type specimens are maintained in KFRI. In total, 82 species were taxonomically characterised. Flowers of some of the undescribed species were also described during the study. Typification and nomenclatural studies have been carried out for several species.

Bambusa nutans

Dendrocalamus giganteus

From Sri Lanka, the distribution of *Pseudoxytenanthera monadelpha* was located at Hatta, *Davidea attenuata* at Tunkinde, *Ochlandra stridula* at Avisanialla. At Horton Plains, intermixed in the grasslands, there was a heavy population of *Arundinaria densifolia* and *Arundinaria debilis*. Some species known to be exclusive to Sri Lanka were found distributed in the Indian phytogeographic zones. The endemic status of certain species of bamboos needs to be re-evaluated.

All India Co-ordinated Project on Taxonomy (AICOPTAX) of Palms

Specimens were collected from Andaman and Nicobar Islands, identified and herbarium prepared. Due to the recent tsunami the coconut and *Phoenix* populations were found severely damaged. Many species of *Calamus* and *Korthalsia laciniosa* were also destroyed in South Andamans, Car Nicobar and Great Nicobar. The palm collections at the Herbarium at BSI, Port Blair were studied and necessary photographs were taken to be included in the database.

Modification of the field key on Indian palms based on the review made by the BSI was done. New species reported recently were incorporated in the key. The CD was finalized and submitted to the Ministry of Environment and Forests.

The CD on field identification developed was designed to identify the palms by selecting a few easily observable key characters. This was developed using Visual Basic 6.0 and Access. India is represented with 100 species of palms. With this CD, the palms can be identified in three or four mouse clicks.

Typical character search

Species description and images

The key characters for identification of palms are arranged in the main menu under different icons such as habit, stem, leaf, leaflets, etc. on the right side. First, one has to choose the habit by clicking on the icon which is highlighted and selecting from the resultant figures followed by other characters for sorting the palms. A complete list of palms also is given in the main menu. By selecting the desired species one can get the information on individual taxa such as description, distribution and figures.

Macrofungi of Kerala: Biodiversity and Biosystematics

A total of 2600 macrofungal specimens were collected, processed and identification attempted. Of these, 15(1.27%) were dung inhabiting (coprophilous); 210 (17.8%), litter

Chlorophyllum molybdites

Termitomyces sp.

dwelling; 320(27%), wood inhabiting (lignicolous) and 630 (53%), terrestrial. Of the 320 lignicolous members, 95% were from the rotting wood and the rest were from roots, stems or bark of living trees.

A large number of macromycetes collected were specifically associated with certain tree species forming ectomycorrhizal association. Several species belonging to *Amanita, Inocybe, Boletus, Russula, Laccaria, Lactarius, Cantharellus, Scleroderma, Pisolithus, Lycoperdon,* were collected from natural forests and forest plantations which are mostly ectomycorrhizal. In the terrestrial habitat, the most common and dominant genera collected are *Termitomyces, Lepiota, Amanita, Agaricus, Russula, Laccaria, Inocybe,* and *Hygrocybe.* The dominant and commonly encountered lignicolous genera include: *Pleurotus, Lentinus, Gymnopilus, Hydropus, Marasmius, Marasmiellus, Crepidotus, Pluteus, Auricularia.* The frequently encountered polypore genera include: *Fomitopsis, Phellinus, Trametus, Microporus, Polyporus, Hexagonia, Ganoderma;* the major litter dwelling genera encountered are: *Collybia, Mycena, Marasmius, Marasmiellus,* and *Psathyrella.*

The coprophilous genera are rather poorly represented by *Psilocybe, Agrocybe*, and *Coprinus*.The common Gasteromycetes species collected were: *Aseroe*, *Clathrus, Dictyophora, Scleroderma, Calvatia, Lycoperdon, Lysurius* and *Mutinus*. Macromycetes belonging to Ascomycete group include: *Xylaria, Daldinia, Bulgaria,* and *Cookenia.*

Rust fungi of Kerala: Biodiversity and biosystematics

A total of 446 plant specimens infected by rust fungi were collected, processed and identification of the rust fungi/host plants attempted. More than 200 host plant species belonging to different families were found infected. Rust fungi usually infected healthy, vigorously growing plants; if infections were small and limited to certain plant parts, they were difficult to detect. Perennial, systemic infections caused deformities such as

witches brooms, cankers or galls. Plants with severe rust infections appeared stunted, chlorotic, or otherwise, discoloured; heavy uredinial sporulation turned the affected plant part yellowish orange. Rust fungi sporulated on leaves, shoots, fruits, and woody stems. A large number of host plants in different forest ecosystems belonging to the Anacardiaceae, Apocynaceae, Combretaceae, Euphorbiaceae, Fabaceae, Lauraceae, Malvaceae, Meliaceae, Oleaceae, Poaceae, Rhamnaceae, Rosaceae, Rubiaceae, Salicaceae, Urticaceae and Verbenaceae were affected by rust fungi. Important rust fungal genera encountered included *Aecidium, Cerotelium, Crossopora, Dasturella, Hemileia, Maravalia, Melampsora, Olivea, Puccinia, Ravenelia, Roestelia, Uredo, Uromyces* and *Zaghouania*.

Definite patterns of relationships were observed among the host plant groups and the rust fungi that parasitized them. Some genera of rust fungi, especially *Puccinia* and *Uromyces*, were capable of parasitizing plants of many families. However, many rust fungal genera appeared to be rather definitely restricted to certain host plants. Most of the rust fungal infection on forestry species led to foliage necrosis and thereby premature defoliation. However, severe foliage and stem infection which led to malformation of shoots was also observed in a few plants including *Cinnamomum malabatrum, C. zeylanicum, Meliosma pinnata* and *Olea dioica*.

DNA barcoding of *Dalbergia species*

The project aimed at development of DNA barcode for *Dalbergia* species. The collaborating institutions were National Institute of Plant Genomic Research (NIPGR), New Delhi and National Chemical Laboratory (NCL), Pune. Data on the distribution of the 12 *Dalbergia* species in the Western Ghats of Kerala and Tamil Nadu from BSI-SC Herbarium and literature to facilitate sample collection were collected. Taxonomical and morphological characterization of the collected *Dalbergia* germplasm was continued. The sample preservation method was standardized and the collected samples were processed and DNA extracted.

Dalbergia sissoides twig with flowers

Dalbergia volubilis climbing stem

Leaf samples were collected from 136 accessions of 11 *Dalbergia* species from various locations of the Western Ghats. The DNA was extracted from the leaf samples and PCR amplified using three conserved chloroplast loci, rpoB, matK and trnH-psbA, and sequenced PCR products at NIPGR and NCL for development of DNA bar code.

Biodiversity/ genetic conservation

Ecology and behaviour of forest owls as applied to their conservation in the forests of Western Ghats through modeling of habitat parameters

Distribution, status and habitat use of forest owls in the southern Western Ghats of India was studied. Intensive surveys were carried out in 276 census points, using dusk watch, initial quiet listening, call playback and spotlighting. One hundred and thirty seven points were surveyed from Kerala and 139 points from Tamil Nadu State. Thirteen species of owls were recorded from the southern Western Ghats of Kerala and Tamil Nadu. Lesser owls namely the barred jungle owlet, collared scops owl, oriental scops owl and brown hawk owl were recorded from all the protected areas unlike the larger owls. Of the sixteen species of owls distributed in Kerala part of the Western Ghats, nine species were found in the forests and others in the cultivated lands and open country. Two species were migratory and 14 species were resident. Thirteen species of owls were recorded from the Kerala State and a new report of the short eared owl *(Asio otus)*, a migrant species, was obtained from the Peechi-Vazhani Wildlife Sanctuary. Oriental bay owl *(Phodilus badius)* was reported for the first time from Idukki and Neyyar Wildlife Sanctuaries. Southernmost distribution limit of the brown hawk owl was identified in the southern Western Ghats. The Ceylon bay owl, an endemic species was newly reported from two protected areas namely the Idukki and Neyyar Wildlife Sanctuaries. Southern distributional limit of seven species of owls was reported for the first time from the Western Ghats.

Distribution pattern of owls in the southern Western Ghats was characterised using vegetation types, topographic variables, disturbance level and status of protection. Highest encounter rates of owls were recorded from the Nelliampathy-Parambikulam-Vazhachal-Anamalai hill complex. Lesser owls namely barred jungle owlet, collared scops owl, oriental scops owl and brown hawk owl were recorded from all the protected areas unlike the large owls (forest eagle owl, brown fish owl, mottled wood owl, brown wood owl and Indian great horned owl). Barred jungle owlet was the predominant lesser owl and the Indian great horned owl was the dominant in the large owl category. Maximum species richness was recorded from the Indira Gandhi Wildlife Sanctuary.

Collared scops owl and barred jungle owlet occurred from the low altitude dry forest to high altitude montane forest. The brown hawk owl preferred mid stratum of the canopy, which possessed dead branches, unlike the collared scops owl which used trees with dense foliage in teak and soft wood plantations. The rainfall had

Eurasian eagle owl

Spotted owlet

an influence on the vocal behaviour and response of brown hawk owl. Distribution of brown fish owl was influenced by the water bodies. Forest eagle owl utilized the riparian forest adjacent to the dry thorn forest, which supported good population of blacknaped hare and giant squirrels. Mottled wood owl utilized the open rocky areas with scattered woody vegetation in the low altitude. Microhabitat utilization of barred jungle owlet revealed that the species was abundant in low altitudes and disturbed forest areas.

Butterfly Gardening

Butterfly gardening is a conservation cum educational programme. It involves recreation of lost habitats of butterflies through careful landscaping and host plant introduction. Butterfly gardens can be set up in any location by introducing host plants and by creating suitable habitats. Generally, locations that are close to natural forests or natural vegetation will attract more number of species compared to urban areas. Similarly, larger gardens are likely to contain more number of

View of butterfly garden at Nilambur (L) and Peechi (R)

butterflies. KFRI has set up three parks- 1) in the KFRI main campus at Peechi, 2) in the KFRI subcentre at Nilambur and 3) at Thenmala in the Ecotourism area. Attempts are also being made to establish such parks at Pathiramanal and Akkulam.

In a pilot study carried out at KFRI in a 0.5 ha area where about 150 plant species belonging to different plant families were introduced, 4509 sightings of 43 species of butterflies were recorded during the first half of the project (i.e., after 18 months) and 5993 sightings of 56 species of butterflies during the second half (i.e., after 36 months). The butterflies sighted from the garden included 8 species that are endemic to the Western Ghats and 10 species having protected status under the Indian Wildlife Protection Act. Along with the enhancement in the floral diversity and the resultant butterfly diversity, there was increase in the overall diversity of the area, particularly of insects, spiders, reptiles and birds.

Butterfly garden at Nilambur is a component of the Bioresources Nature Park. Besides maintaining the garden, attempts were also made to impart insight into the life history, behaviour and role of butterflies in sustaining natural ecosystems. Butterflies sighted in the garden included Common Mime, Common Rose, Crimson Rose, Lime Butterfly, Blue Mormon, Southern Birdwing, Glassy Blue Tiger, Blue Tiger, Dark Blue Tiger, Emigrants and Grass Yellows. The plants maintained in the garden included larval host plants such as *Citrus, Albizia, Cassia, Cinnamomum, Aristolochia* and nectar plants like *Ixora, Lantana, Mussaenda*, Marigold, *Zinnia* and *Clerodendrum*. Repair work of the cascade set up for maintaining the humidity regime of the garden was also undertaken.

Establishment of a Taxonomic Garden in the KFRI Sub Centre Campus

About 2 ha area near the Bioresources Nature Park was selected and the weeds were cleared for the establishment of a taxonomic garden. The collection of plants was initiated at the rate of one to three species for each angiosperm family. The collection of propagules was completed for 50 angiosperm families. The plant propagules were maintained in the nursery established in the Sub Centre Campus. During the planting season, the propagules were planted in the taxonomic garden.

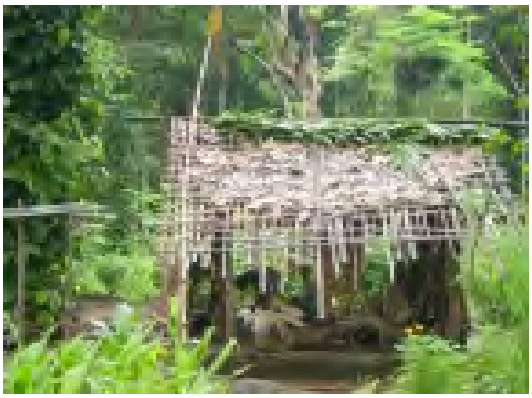
Site preparation for taxonomic garden

Propagules planted in the garden

Linking conservation and forest management with sustainable livelihoods and resource use conflict in Agasthyamalai Biosphere Reserve

Land use pattern in Agasthyamalai Biosphere Reserve (ABR) was similar to that of the State. Major portion of the geographical area is allotted to agricultural cultivation which highlights the importance of agriculture sector in ABR. Primary information collected from the study area highlighted that poverty and market incentives for expanding area of cultivation in the fringe area of forest acted as the natural incentives for the deforestation in the study area. The main tribal communities in ABR were the Kani and Malapantarams. Almost all had become agriculture-dependent, although scientific method of production was not followed technically. Non-timber forest produce collection continued to be the main source of income for most of the Kani tribals living within the Sanctuary area, whereas those residing in the peripheral areas had almost completely shifted to rubber cultivation. Kanis' perception of forests and ABR was based on the principle of sacredness. Conflicts in the region highlighted wildlife problem as a major threat to their agriculture.

An undisturbed landscape of ABR



A tribal hut

Neyyar, Thenmala and Shendurney were the fast emerging ecotourism sites in ABR which could be a viable alternative to the conservation of forest and enhancing the standard of living of the depending communities. Similarly, Agasthyarkoodam peak (abode the shrine of Agasthyamuni) in the ABR attracted tourists as well as pilgrims. The average revenue generated per day during the 2009 season is approximately Rs. 24027.

Genetic diversity and conservation of teak

The objectives of the study were a) to identify population/ individual variations b) to study the genetic diversity with respect to morphological and wood characteristics and c) to establish a germplasm bank and to compare different ecotypes under uniform conditions

Explorations were carried out in natural teak populations in different states of India and 25 populations were selected for in depth studies. Thirty-one morphological

characters related to tree height, GBH, tree form and leaves were measured or observed to study the phenotypic variations. All the characters related to tree form were recorded as per the recommendations of international teak provenance trials of DANIDA Forest Seed Center. After collecting seeds from 25 different geographic locations, a nursery was raised and germplasm bank established so as to study the genetic variations. Growth and other measurements were periodically recorded.

Wood samples in the form of discs/core samples were also collected from all the locations to study the wood characteristics. Important anatomical properties under study are ring width, vessel diameter, vessel frequency, proportion of fibres, vessels and parenchyma. Wood density, heartwood content and colour variation of wood are also under study. Extractive content is being analyzed to ascertain the effects on natural durability.

Ecological/Ecosystem studies

Species recovery plan for *Semecarpus kathalekanensis*: A critically endangered fresh-water swamp species of the Western Ghats

Semecarpus travancoricum was located in Athirappally area, at slightly higher elevation. The same was located also from Periyar area and from Parambikulam Wildlife Sanctuary. From the Athirappally population, vegetative propagation and germination trials were carried out. It was found that the species grew slightly away from swamps in contrast to *Semecarpus kathalekanensis* found in Kathalekan region, right inside the swamp. Elevation-wise, both species were at about the same altitude. Swamps in southern Kerala were found at about 200m elevation. One could observe lattice of roots extending to water in Kathalekan swamps.

Seedlings of *Semecarpus kathalekanensis*

Field planted seedlings

Seedlings of *Semecarpus kathalekanensis* obtained from Sirsi were planted in three sets. The first set consisted of 100 seedlings planted in a square block within the KFRI campus with 3m x 3m spacing. The plot contained both regions with rock

outcrops as well as deep soil. The plants were watered in dry season (January to May). One month after planting 99% of the plants survived. Health of the plants was monitored qualitatively as poor, average and good. After two months of growth, healthy and weak plants could be distinguished. After six months, 8% of the plants, mostly with poor health started drying. Most of them were in areas with shallow soil. After one year 48% of the plants were found healthy, 25% were average, 12 % poor and 15% had dried up. At one and half years and two years, some of plants recouped and about 78 plants were in good health. Seedlings of *S. travancoricum* planted inside a swamp patch in Kulathupuzha did not survive.

Mapping and quantitative assessment of geographic distribution and the population status of the plant resources of Western Ghats

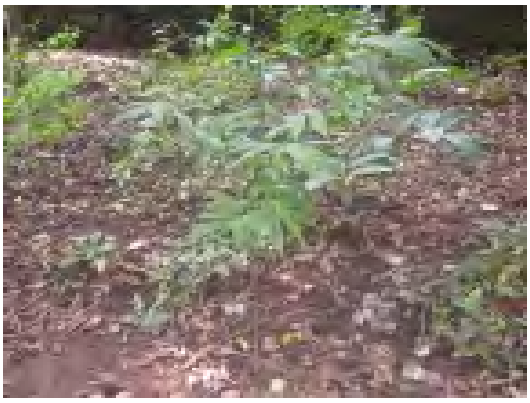
The Western Ghats region was divided into 6.25 km^2 grids and systematic sampling procedure was adopted using appropriate sampling strategy. Satellite imagery was also used for identifying vegetation types and its density status prior to sampling.

Anaphyllum wightii - threatened

Drypetes wightii - vulnerable

Vegetation data from 5m x 1000m strips of the grids were gathered for structural and species distribution analysis. In addition to the 190 grids covered in the previous years, 40 more grids were covered during 2008-2009 period in southern Kerala in Ranni, Konni, Periyar Tiger Reserve and Munnar area. The major forest vegetation types covered were tropical wet-evergreen, semi-evergreen, moist deciduous, sholas, scrubs, grasslands and forest plan tations. Herbaria of important species were prepared. A new plant species was also recorded from Parambikulam area.

Regeneration of selected Terminalias in Kerala



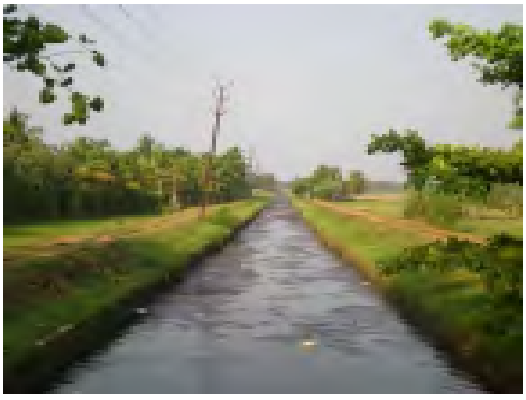
Field planted seedlings of *Terminalia* sp.

Enumeration was carried out in 193 plots (46.55 ha) from the five Forest Circles in Kerala. Tree density of the mother trees was 61/ha for *T. paniculata*, 23/ha for *T. crenulata* and 0.54/ha for *T. travancorensis*. Regeneration of *T. paniculata* was 76/ha, out of which 28% came under 10-30 cm girth class, 25% under 3-9.9 cm girth class and 47% under the category of <3 cm girth. Regeneration of *T. crenulata* was 22/ha and out of them 18% belonged to 10-30 cm girth class, 26% came under 3-9.9 cm girth class and 56% belonged to the un-established (<3 cm girth) category. Regeneration of *T. travancorensis* was 0.02/ha and it was under the category 10-30cm girth class. Seed germination was 0.75% for *T. paniculata*, 40% for *T. crenulata* and 30% for *T. travancorensis*.

Directory of wetlands of Kerala

Rivers, lakes, ponds and paddy fields constitute the wetlands. The focus of the present study was on linkages and interdependence of the constituents, especially from a biodiversity point of view. Six northern districts were enumerated by SACON and eight by KFRI as part of a combined project.

Wetland of North Kole



Wetland of South Kole

Kecheri River was one of the main rivers in central Kerala. The river originates from Machad hills, part of Peechi-Vazhani Wildlife Sanctuary and Reserve Forest. Vazhani Dam was constructed across this river in 1959. The reservoir has one

irrigation canal (left bank) and the river acts as the right bank canal. The river flows to west then turns to south and joins Kole wetlands to drain through raised bund canals (Kole-canal) and finally into Chettuwai Lake by way of both Enamakkal sluice and Idiyanchira sluice. Though the river is small, it has flash flood in low lying lands especially in Kole wetlands during monsoon.

Though Kecheri River system is one of the smallest basins in Kerala (814 km^2), it has remarkable water resources. Man-made reservoirs, irrigation canals, impoundments in the river, ponds and a huge reservoir of Kole wetlands facilitate water resources in the basin. The available water is very judiciously used in the area compared to the rest of Kerala. Paddy is cultivated as to a higher intensity; one can see only a small number of uncultivated paddy fields. Keecheri basin receives inputs from Karuvannur basin also. Puthen Thodu, Chirakkal Thodu, Herbert Canal and Ettumana Canal are connecting with Karuvannur River. Apart from these, some areas depend on Peechi irrigation canal from Peechi reservoir.

Vazhani Reservoir is constructed across the main river. Pathazhakundu Reservoir and Poomala Reservoir are the other important water bodies in the basin. Water from Keecheri river floods during rainy season is usually avoided because of Vazhani reservoir. During dry season water is available through the river, part of which usually adds to the water in the Kole canals. Total extent of the basin is about 700 km^2. Forest area is about 68.59 km^2. Kole lands come to about 96.21 km^2. Paddy fields excluding kole lands come to 67.59 km^2. Main wetlands are dams, paddy fields, ponds and kole lands. Ponds above 0.2 ha, come to about 50, are shown in topo sheets of 1:50,000 scale. Larger water bodies are 12 in number.

Ecology and biodiversity of mangroves: Fungal diversity

AM fungal root colonization and spore density in rhizosphere soil were studied at Madakkara, Thekkumbad, Dhalil and Thazhekkavu (Kannur District) employing standard techniques. All the mangrove species and associates studied were found colonized by AM fungi in their roots and percent root colonization ranged from 2 - 80%. Among the species, *Acanthus ilicifolia* recorded highest AM root colonization, while *Sonneratia* and *Kandelia candal* recorded the lowest. Among mangroves, *Aegiceros* recorded high percent root colonization (71%). AM fungal spore density in rhizosphere soil ranged from 19 - 314/10g soil. Of the mangroves, *Rhizophora mucronata* samples collected from Madakkara recorded the highest number of AM fungal spores.

Fungal diseases affecting the mangroves and associates included leaf spots, leaf blotches, die-back of shoots, stem canker and die-back of plants. Die-back of a large number of *Sonneratia* (>30-year-old trees) and shoot die-back of 3-year-old *Rhizophora mucronata* plants were observed at Madakkara. Severe leaf infection was recorded in mangrove associates like *Derris, Ficus, Clerodendrum* and *Odalam*.

The fungi isolated from these disease specimens included *Selenophoma, Phyllosticta, Pestalotiopsis, Cylindrocladium, Colletotrichum gloeosporioides, Fusarium, Exserohilum, Botryodiplodia, Curvularia, Alternaria, Cirrenalia* and *Dendryphiella*. Two hitherto unrecorded *Cytospora* spp. causing stem canker and die-back in *Sonneratia*, and a *Phellinus* sp. causing decay in *Rhizophora mucronata* were recorded. Detailed studies on morphological and microscopic characteristics of *Phellinus* sp. revealed that the fungus was a new species *Phellinus rhizophorae* Mohanan. The soft rot fungi found associated with mangroves and their associates were *Microporus, Microporellus, Hexagonia, Daedalia, Auricularia* and *Polyporus*. Old stands of *Excoecaria* and *Rhizophora* were found affected by *Auricularia, Microporus* and *Hexagonia*.

Twelve species of mangroves growing at Madakkara and Thazhekkavu were selected for the study of endophytic fungi. The species diversity (Shannon index) and species evenness of the endophyte assemblages were calculated. A total of 29 foliar fungal endophytes were encountered in different mangrove species and their colonization frequency ranged from 1 to 93.

Protection of Tsunami-affected coastal areas by establishing bioshields through people's participation

The project was taken up for establishing bioshields along coastal areas through people's participation and evaluation of performance and carbon sequestration potential of these stands. A mother nursery was established at Chendrappinni for raising the planting stock of casuarina and bamboos. The nursery beds were watered regularly and after 60 days, healthy seedlings in the mother nursery were transplanted into polythene bags of 12 cm x 18cm size, filled with red soil, sand and cowdung. The transplanted seedlings were watered regularly. For bamboos, 1000 two-noded cuttings of *Bambusa vulgaris* were treated with 100 ppm solution of IBA were laid under soil in five nursery beds. Sprouting of new shoots started after six days. The nursery beds were watered regularly and after 60 days, the average height of sprouts was 45 cm. More than 1 lakh plants of *Casuarina* and 10000 *Bambusa vulgaris* rooted cuttings were produced.

Bamboo nursery

Watering of field planted seedlings

Field planting started at Vadanappally and Ganeshamangalam Beach from 12 July 2008. Planting was inaugurated by Hon'ble Minister for Agriculture Sri. Mullakkara Retnakaran. About 6 km area at Vadanappilly and Kadappuram Panchayath areas was planted. During August to November a length of 3.8 km at Vadanappilly and 2.3 km at Kadappuram Panchayaths was planted. The survival of plants was enumerated in March- April 2009, approximately 6 months after planting.

Plantation Forestry

Planting stock production of selected commercial species of bamboos

The project envisaged production of about one lakh planting stock of selected bamboo species at the KFRI Field Research Centre, Velupadam. The planting stock was meant for supply to planting programmes under National Bamboo Mission projects as per the directions of Kerala Bamboo Mission.

Nurseries were established in an area adjacent to the Bambusetum in the Field Research Centre at Veluppadam and at KFRI main campus, Peechi. Seedlings of *Bambusa bambos*, *B. tulda, Dendrocalamus hamiltonii, D. strictus, Melocanna*

Views of the nursery beds established for raising bamboo seedlings

bambusoides and *Ochlandra travancorica* were raised in beds and potted in polythene bags. Vegetative propagation of *Bambusa vulgaris, B. vulgaris var. striata, B. polymorpha, B. wamin, Dendrocalamus brandisii, D. giganteus, D. longispathus, D. stocksii, D. sikkimensis* and *Gigantochloa atroviolacea* was done using growth regulator treatments. Observation of sprouting and rooting of different species was being carried out. Tissue culture plants of *Bambusa balcooa* and *Dendrocalamus asper* were maintained at Peechi and Veluppadam nurseries. Potted seedlings were distributed to farmers free of cost.

Recording of weather data at different centers of KFRI

Four automated weather stations have been established by KFRI viz., at Peechi,

Data retrieval from weather stations

Nilambur, Veluppadam and Marayoor. Data from the already established weather stations were retrieved via Wireless Data Transmission mechanism.Hourly data on temperature, relative humidity, wind speed, wind direction, solar radiation and rainfall for June 2007 onwards was available for Nilambur, from January 2008 was available for Peechi, from March 2008 for Veluppadam and from July 2008 for Marayur etc. Daily weather data is displayed and given for researchers.

Establishment of Clonal Multiplication Area (CMA) of teak in KFRI campus

As part of tree improvement programmes for teak in Kerala, KFRI had selected 50 plus trees during 1980's from plantations of teak located in Waynad, Nilambur, Konni and Thenmala Forest Divisions. Using the recently developed technique for clonal multiplication, 30 plus trees were successfully cloned in KFRI and clonal gardens were raised using rooted ramets of these plus trees at Emangad (Nilambur), Kalkulam (Nilambur), Decent Mukku (Quilon), and at Chettikulam (Thrissur). Some of the clones have exhibited exceptionally good growth in height and girth during the initial months of field trial. In order to facilitate a detailed multi-locational field study, production and field planting of sufficient number of rooted ramets of all the promising plus trees was found necessary. Thus a Clonal Multiplication Area (CMA) was established during 2005-2009.

Clonal garden established at KFRI

For establishment of a CMA, about 750 rooted cuttings were produced by cloning 10 selected superior teak plus trees. These cloned teak plants were planted in the nursery area of the Institute campus during the month of August, 2008. The spacing provided was 1mx1m between plants. All the clones were planted in a linear design in 4 different blocks. Each block was separated by sufficient space provided between them. When these plants grew and attained a height of about 1m they were cut back and allowed to branch profusely, so that they developed into hedge plants.

These hedge plants would serve as a source for fresh shoot material for future clonal propagation programme on a large scale.

Improving the yield and reducing the rotation age of teak plantations through superior clonal teak

Clonal propagation in the mist chamber

Clonal propagation of promising plus trees of teak, T1,T10,T11,T7,T24, T34,T46 and T47 were carried out inside the mist propagation chamber. Sufficient number of juvenile shoots were prepared inside the mist chamber and these were used for providing fresh buds for carrying out tissue culture trials. Promising results were obtained in micro-propagation of clones - T1, T10, T7, and T24. Sufficient numbers of stock plants of promising clones were prepared and kept ready for large- scale multiplication work.

Field performance of micro and macropropagated planting stock of selected five commercially important bamboo species

Planting of *Dendrocalamus asper* and *Bambusa balcooa* was completed in experimental plots at Attappady. The planting stock of *Bambusa bambos* and *Dendrocalamus strictus* was proliferated and an area near Kalpathy river bank was identified for planting.

Planting stock of bamboos ready for planting

Observations on performance of the different type of planting stock were recorded. The activities of the project were coordinated with Institute of Forest Genetics and Tree Breeding, Coimbatore and Institute of Wood Science and Technology, Bangalore.

Studies on growth performance of the rattan species under plantations

The objectives of the study were to monitor the growth of different species of rattans in the plantations and to study the flowering and fruiting pattern of different species. Plantations raised by the Forest Department during 1998 were selected. Plots were established at Pattikkad, Kottiyoor, Kannavam and Thodupuzha Ranges. Only *C. thwaitesii* had been planted in all these plots. Observations on growth characteristics like height, diameter, number of suckers, sucker height, number of new leaves, survival, etc. were recorded at six-month interval.

At each site, the plots were divided into different groups based on the dendrograms drawn with various growth parameters. Thus at Thodupuzha there were 19 groups, at Kottiyur 26 groups, at Kannavam 13 groups and at Kuthiran 23 groups. Soil samples were collected (0-10 and 10-20 cm depths) from each group and these samples were analyzed for pH, organic carbon and extractable phosphorus.

Growth enhancement of *Dalbergia latifolia* through soil management techniques

Growth enhancement in response to fertiliser input

This study was conducted with a view of increasing the growth of *Dalbergia latifolia* Roxb. through various soil management practices using different types of planting materials. The study also aimed at finding out the association and variability of isolate of rhizobium along with the clonal propagation of the species. Growth response to various treatments such as lime, vermi-compost, cowdung, chemical fertilizer, rhizobium and combinations of organic manures with chemical fertilizer was studied by conducting pot trial at Field Research Centre of KFRI at Velupadam and field trial at Subcentre of KFRI in Nilambur. Changes in soil properties due to the application of various treatments were also studied. Results indicated that organic manures such as cowdung (1kg/plant) or compost (1kg/plant) either alone or in combination with chemical fertilizer (½ kg cowdung or ½ kg compost + 15g potash + 50g amophos) were effective in realizing a substantial increase in the growth of *D. latifolia* besides improvement in soil quality. All the three types

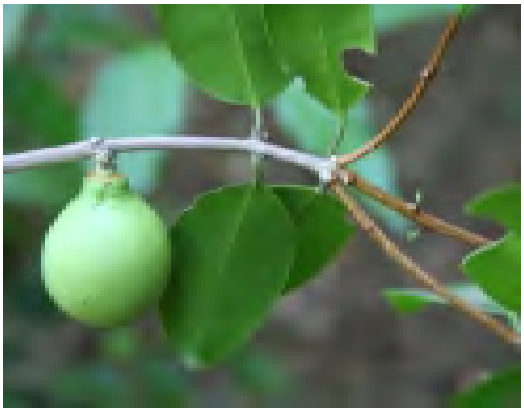
of planting materials (root suckers, seedlings and rooted cuttings) used in the study responded very well to the above treatments and the maximum growth responses were observed in root suckers followed by seedlings and cuttings. The best strain of rhizobium was isolated from those collected from Nilambur and all the cultures were capable of forming nodulation on *D. latifolia* seedlings. But the application of these rhizobia had no significant impact on the growth. In order to produce rooted cuttings from suckers the best concentration of IBA was 5000 ppm.

Forest Utilization

Production of quality planting material of rare medicinal plants of commercial importance

Extensive surveys were conducted for the collection of the five selected medicinal plants in forests as well non-forest areas. Eighteen accessions of *Saraca asoca* (both stem cuttings and seeds) were collected of which four accessions were from forest areas of Nelliyampathy, Kuttiyadi and Kallar. The rest of the collections of *Saraca* were made

Ipomoea mauritiana tuber



Salacia oblonga fruit

from homesteads, parks and gardens in Thrissur District. Six accessions of *Trichosanthes cucumerina* were collected from Kottakkal Arya Vaidya Sala, Kerala Agricultural University, Kunnamkulam, Peechi and Payyannur. Five accessions of *Ipomoea mauritiana* were collected from Vazhachal, Peechi, Begur, Nenmara and Kalpetta. Only two accessions of *Salacia oblonga* could be collected from Vellanimala and Kuttiyadi. *Salacia fruticosa* and *Salacia chinensis* were also collected. Three accessions of *Merremia turpethum* were collected from Feroke, Nilambur and Aluva. The propagules were planted in the medicinal plants garden of the Institute.

The growth performance of the rooted cuttings of vegetatively propagated *Saraca asoca, Salacia oblonga, Ipomoea mauritiana* and *Merremia turpethum* was

Merremia turpethum

monitored. There was not much difference in the growth of rooted cuttings and seedlings in the case of *Merremia turpethum* and *Ipomoea mauritiana*. The growth of seedlings of *Saraca asoca* was comparatively better than the rooted cuttings in the field planted conditions. The average yield per plant was determined for *Ipomoea mauritiana, Trichosanthes cucumerina* and *Merremia turpethum* by harvesting.

Fifteen thousand rooted stem cuttings were distributed to the Kerala Forest Department, Kerala State Medicinal Plants Board, Police Academy, Thrissur, and NGOs and the public on request. Further, 7000 seedlings raised during the project period were also distributed. About fifty rooted cuttings of *Saraca asoca* from different accessions were planted in the Institute Campus as part of establishing the germplasm collections. Five hundred and sixty rooted cuttings of *Salacia oblonga* were given to the botanical gardens of colleges, schools and to the public. About 1500g seeds of *Trichosanthes cucumerina* were distributed to the farmers. Among the planting materials raised during the project period, *Saraca asoca* and *Trichosanthes cucumerina* were the species with highest demand.

Qualitative and quantitative analysis of biological active principles Baicalein, Luteolin and Psoralen from *Oroxylum indicum, Premna integrifolia* and *Aegle marmelos* respectively and its allied species

Baicalein, a trihydroxy flavonoid, originally isolated from *Scutellaria baicalensis* shows a wide range of biological activities including antioxidant, anticancer and antiviral properties. The presence of baicalein and aglycon form baicalein have been reported from other *Scutellaria* species and indigenously growing plant, *Oroxylum indicum*. Psoralen, a phototoxic phytoallexin which naturally occurs in *Psoralea corylifolia* L. is used in the treatment of vitiligo, psoriasis, eczema, etc. Recent report suggests that *Aegle marmelos* may possess the compound psoralen. The presence of baicalein in two species of *Scutellaria* and psoralen in *Aegle marmelos* and *Murraya koenigii* detected by medium pressure liquid chromatography was partially confirmed by High Pressure Liquid Chromatography.

For the baicalein content, the chloroform and acetone extracts of *Scutellaria* were analysed. The separation was performed using reverse-phase C18 column at 25°C with a flow rate of 1 ml/min of the solvent actonitril. The absorbance for the baicalein was monitored at 274 nm with a UV detector SPD-10A and CLASS VP software. The retention time of standard baicalein (Sigma) was 3.3 min. Peaks in the same

Aegle marmelos fruit

Premna serratifolia

retention time (3.3 min) were also detected in chloroform as well as acetone extracts of both species of *Scutellaria*. The concentration of baicalein in the extracts was also calculated using the standard. In the species collected from Nelliyampathy, the concentration of baicalein was 0.229 and 0.210 mg/g dry weight (root) in acetone and chloroform extracts, respectively whereas the concentration was 0.134 and 0.150 mg/g respectively in species collected from Wayanad.

For the HPLC analysis, the chloroform as well as acetone extracts of *Aegle marmelos* and *Murraya koenigii* were analysed using standard psoralen (Sigma). The retention time of standard psoralen observed with the solvent system, acetonitril: water was 4.5 min. Peaks in the same retention time were also detected in the extracts of both *Murraya koenigi* and *Aegle marmelos*. Among the plants screened, comparatively high amount of psoralen was detected in *Murraya koenigii* while only trace amounts were observed in *Aegle marmelos*.

Developing appropriate technology for community level production of charcoal and activated carbon from coconut stem wood and shell for industrial use

The Fluidized Bed Reactor (FBR) technology was found appropriate for the community level production of activated carbon from charcoal. Designs of a pilot scale continuous vertical carbonizing plant and a pilot scale FBR plant for production of activated carbon were developed. Both the plants were installed at the project site of SUBICSHA-a community-based organization at Perambra, Kozhikode, Kerala. Trial runs were conducted in both the plants; the yield and quality of product were assessed. The newly developed plants were found capable to produce better yield compared to traditional methods of production. The production parameters for desired quality products were optimized.

As far as conversion of waste coconut stem wood was concerned, it was found that the plant could produce stem wood charcoal with moderate yield and quality. The

inherent quality of coconut stem wood charcoal, mainly its poor hardness, made it unsuitable for the manufacture of granular activated carbon. However, the stem wood charcoal was suitable for use as direct fuel or as an ingredient for fuel briquettes.

View of the newly developed plants for community level production of charcoal and activated carbon

Economic analysis of the pilot plants showed that a minimum up-scaling of the plants to process up to 6 tonnes of coconut shells per day was financially viable for self-sustaining. The activation plant was found reaching its breakeven point within the first year itself. Both the plants developed were found pollution-free and techno-economically viable and appropriate to cluster or community level production of charcoal and activated carbon. The design and technology is due for patenting and commercialization. Commercialization of the technology developed will help to achieve livelihood improvement of the poor and marginalized coconut farmers and better profit to coconut-based industries through value addition.

Bamboo for affordable shelter: Demonstration of appropriate construction practices and construction of durable model bamboo house

Designs were developed for the permanent and modular bamboo houses. The construction work of the permanent structure of the bamboo houses was completed. Preservative treated bamboo was used for floor, walls and roof. Cement plaster was applied over bamboo structural layers. Ferro-cement columns and beams were used along with bamboo structural elements. Design of a modular portable house was developed and fabricated, which is of potential use in disaster management, eco-

tourism areas, tsunami-affected coastal areas, forests, etc. where construction of permanent structures is not practical for various reasons.

View of the permanent bamboo house

Portable bamboo house

Conservation and sustainable management of non-timber forest products through a participatory approach in the Western Ghats, Kerala

This project envisaged to develop an improved and effective participatory management system of stakeholders and demonstrate its impacts on conservation and sustainable management of NTFPs in the study areas. The study was conducted in Begur area of Wayanad District. A number of meetings of the stakeholders were

A stakeholders' meeting

Visit to the study area

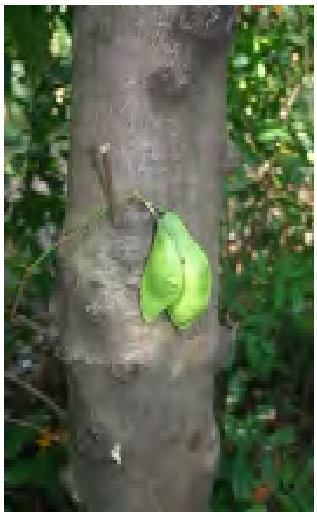
conducted to develop effective participatory management in the study area. An advanced training programme on bamboo handicraft was organised to enhance their income. A training programme on honey collection was also organised. A society of tribals to undertake bamboo handicraft was formed as part of the project. KFRI and URAVU jointly met the Forest Department to get funds for forestry operation. The Forest Department received funds from National Rural Employment Guarantee Programme (NREGP) which was used to generate employment in the forestry sector. Because of this, the employment conditions improved. Since the income from non-forestry sources showed an increasing trend, the income from the collection of NTFPs showed a decreasing trend, indicating that there was only less collection of NTFPs. The income received from NTFP collection was very low because the tribals preferred other gainful jobs.

Evaluation of *Saraca asoca*, *Kaempferia rotunda*, their substitutes and medicinal preparations with respect to phytochemical and biological properties

The experimental plants, *Kingiodendron pinnatum, Cynometra travancorica, Cynometra beddomei* and *Humboldtia brunonis* were collected from from Wyanad, *Humboldtia vahliana* and *Lagenandra toxicaria* from Vazhachal, *Lagenandra ovata* from Pandimotta, *Kaempferia rotunda* from Centre for Medicinal Plants Research, Kottakkal and *Saraca asoca* from the medicinal plants garden of KFRI. Bark and leaf samples were dried and powdered and were extracted successively using various solvents such as petroleum ether, chloroform, acetone and methanol. Phytochemical study included comparative analysis of secondary metabolites such as polyphenols, flavanoids and terpenoids between *Saraca asoca* and its substitutes, *Kaempferia rotunda* and its substitutes. In biological studies, antioxidant and anti-inflamatory assays were carried out.

Cyanometra travancorica

Kingiodendron pinnatum



Saraca asoca

The solvent extracts of plants were separated through TLC with various solvent systems for phytochemical screening. When comparing polyphenols more or less similar patterns were obtained for *Saraca asoca* its substitutes. When analysing for polyphenolics, *Kaempferia rotunda* produced 12 and 7 bands, but substitute plants produced only 3 and 2 bands with acetone extracts using chloroform : acetic acid (9:1) and ethyl acetate: benzene (9:11) respectively. When comparing *Saraca asoca* and its substitutes for flavanoids only 2 bands were obtained by using ethyl acetate : benzene (9:11) and sprayed with Vanillin-HCl. Results show more or less similar patterns in all the samples. In total, six bands were obtained when chloroform: acetic acid (9:1) was used as solvent system and sprayed with 10% aqueous lead acetate. *Kaempferia rotunda* did not produce clear banding pattern.

When comparing *Saraca asoca* and its substitutes for terpenoid content, 8 bands were obtained for *S. asoca* when ethyl acetate: benzene (9:11) was used as a solvent system and 0.2% aqueous potassium permanganate was used as spray reagent. A total of 5 bands were obtained when chloroform: acetic acid (9:1) was used as solvent system. Results showed more or less similar patterns, but the band with Rf 0.45 was observed in *Humboldtia vahliana* and *Kingiodendron pinnatum*. In total 3 bands were obtained for *Lagenandra toxicaria* with solvent system, ethyl acetate: benzene (9:11). *Lagenandra ovata* and *Kaempferia rotunda* did not show clear banding pattern.

Antioxidant property was analyzed by determining the scavenging effects of free radicals such as superoxide, hydroxyl radical and lipid peroxidation generated with in vitro assay system. In anti-inflamatory assay, acute and chronic assay systems were performed. To induce acute and chronic inflammation, carrageenan and formalin respectively, were used. The results of biological studies clearly demonstrated that the extract of both bark and leaf offered protection against the generation of free radicals such as superoxide, hydroxyl, and inhibited tissue lipid peroxidation. The results also suggest the protection against inflammation in a dose-dependent manner.

Awareness Programmes

Organising educational programmes at Teak Museum, Subcentre, Nilambur

Different educational programmes including workshops on teak cultivation were organised for students, teacher trainees, nature club members and the general public visiting the Museum to create awareness about teak and the importance of conservation of nature, forests and wildlife. A study on social awareness of traditional teak wood articles used in the households of Nilambur and Malappuram areas of Kerala State was conducted through visitor survey.

A summer course was organised during 23 to 30 April 2008. Thirty students participated in the one-week programme. Classes on importance of forests and their conservation, field visits to Conolly's plot, plant collection and techniques of herbarium

Summer course

Visit to Conolly's Plot

preparation, etc. were arranged during the programme. In connection with the Teak Museum Day, a documentary fest on nature, conservation of forests and wildlife, and environmental aspects was organised during May 21-31 for the general public and other organized groups. A workshop on Teak Cultivation and Management was organised on 28th August 2008 for 20 'Prerak' members of Literacy Mission, Nodal Continuing Education Centre (NCEC), Arecode. Lecture sessions on teak cultivation, nursery management, pest management in nursery and plantations, field visits to teak nursery and teak plantations were organised during the workshop.

During 3-8 October 2008, wildlife week activities were organised for members of nature club, nature education centres and various student groups. Classes on wildlife topics, quiz competition and film shows on nature, forests and wildlife were conducted. A total number of 639 participants and 42 officials attended the wildlife week activities. Teak study camps were organized during 13- 24 January 2009 for teacher trainees and student groups. A total number of 575 participants and 61 teachers attended the camp. World Forestry Day programme was organised on 21 March 2009 for members of Nilambur Literacy Mission (Malappuram Dist.). A total number of 52 participants and two officials attended the Programme.

A study was conducted on social awareness of traditional teak wood articles used in households of Nilambur and Malappuram areas of Kerala as part of the educational programmes by interviewing the visitors. A visitor survey work sheet was given for different sections of the people visiting the museum. So far the survey has been conducted among 962 students, 280 teachers, 340 agriculturists and 271 general visitors. The survey reveals that most of the household items are not known to younger generations; students have the least knowledge. Many of these household items are not used by the people now and are replaced by metal or plastic substitutes.

Establishment of a Bamboo Technical Support Group for South Zone under National Bamboo Mission

Interaction Workshop on 'bamboo resource development and utilization'(L) and Field visit (R)

Nine training programmes were organized for field functionaries. A total of 122 participants attended the programme from Maharashtra, Kerala, Karnataka, Tamil Nadu and Andhra Pradesh. Lecture notes for field functionaries were compiled for printing as a training manual. Seven Exposure visits were organized for progressive farmers. Necessary technical support was provided to Kerala State Bamboo Steering Committee by attending their meeting and providing required information.

Field visits to bambusetum, nursery, bamboo factories and bamboo growing areas were also conducted as part of the training programmes.

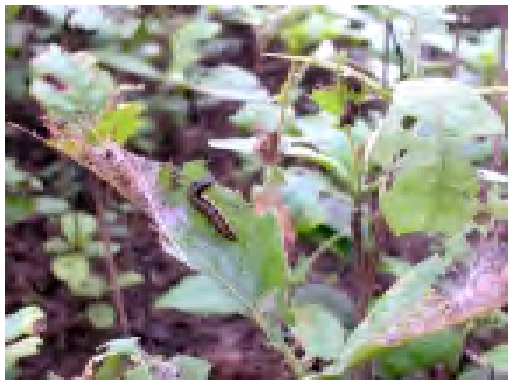
Pest/disease control

Studies on controlling teak defoliator outbreaks by seeding the baculovirus, HpNPV in epicentre populations

The project aimed at developing a pest management strategy to control the teak defoliator, *Hyblaea puera* (Lepidoptera; Hyblaeidae) combining the present knowledge on the characteristics of the population dynamics of the pest and the mode of transmission of its potential microbial pathogen, the HpNPV. During the period, field populations of *Hyblaea puera* occurring in 7500 ha of teak plantations in the study area (Nilambur) were monitored, mapped and screened for natural baculovirus load. Vertical transmission of HpNPV in laboratory/ natural populations of *H. puera* was studied with the view that a weak virus application late in the larval period would produce a population of infected adults which could contribute to development of epizootic.

Laboratory experiments were conducted to quantify the impact of sublethal infection on the growth and reproductive parameters of the insect. Experiments were also

Laboratory culturing of HpNPV



H. puera larva on teak seedling

conducted to see if resistance build-up occurred when the insects were sublethaly infected. Finally, lattice spraying of HpNPV was done at an epicentre population of the insect and the growth and reproductive parameters of the insect were quantified. The study indicated that virus dosages around a hundred polyhedral occlusion bodies when ingested by teak defoliator larvae resulted in mortality of 60% of the population. The insects that survived the above-said dose retained the baculovirus in their body in an unexpressed form and transmitted the disease to the next generation. The impact of vertical transmission included reduction in pupation, adult emergence, male and female longevity, egg laying period and fecundity. However, the sex ratio remained unchanged. One third of the offsprings which received the vertically transmitted baculovirus died and the survivors showed reduced pupation rate, adult emergence rate, fecundity and longevity. HpNPV when vertically transmitted reduced the reproductive potential of the insect during the parent and first filial generation so as to inflict 100 percent mortality in the second filial generation.

The study indicated that sublethal seeding of baculovirus during the epicentre phase of the eruptive outbreaks of teak defoliator could cause viral epizootics which, in turn, could suppress population buildup and prevent large scale outbreaks. Detailed field studies involving control of the teak defoliator epicenter populations using the concept of vertical transmission impacts would confirm findings of the present study.

Transfer of technology of biological control of the teak defoliator pest to the Kerala Forest Department for field implementation and entrepreneurs for commercial production

The culture of host insect *H. puera* was maintained as part of mass production and formulation of HpNPV. The culture would cater to the requirement of *Hyblaea* larvae for HpNPV multiplication. HpNPV was produced as a routine activity so that the at any required time point the formulation could be developed.

A database of teak farmers in Kerala and Karnataka who have taken planting

Field demonstration of *H. puera* control using HpNPV

HpNPV formulation

material from KFRI nursery was prepared. They were contacted and informed about the availability of technology for teak defoliator management.

Sustainable Forest management

Optimizing management of bamboo stands using growth simulation model

A set of 22 semi-permanent sample plots were laid out in bamboo plantations and natural bamboo stands representing various age groups, stocking levels and site conditions in different parts of the State of Kerala. The plot size varied from 30m x

A typical bamboo stand

30m to 50m x 50m depending upon the age/stocking status of the plots. Observations on clump diameter on all the clumps, height of selected clumps (i.e., smallest, medium, and largest of the clumps) and number of culms of different size classes in the selected clumps were recorded from the sample plots. The status of clumps not selected for detailed observations on any feature was derived through regression analysis. Girth at breast-height and identity of the miscellaneous species in the plots were also recorded. Geographical position in terms of latitude, longitude, and altitude were recorded along with other site features including the slope of the sample plots. Soil samples were collected from each sample plot using soil augur. These samples were collected from 0-10 and 10-20 cm depth levels.

The mean clump diameter in the 22 plots ranged from 0.83 m to 3.79 m. The number of clumps per ha varied from 72 to 444, the number of immature culms per ha varied from 573 to 1780 and the number of mature culms per ha varied from 818 to 3239. The average height of the tallest culms varied from 10.1m to 22.5 m.

Human dimensions of Forestry

Role of bamboo in sustainable rural livelihood in South India

In Kerala, the marginalized bamboo dependent (MBDs) communities (Sambava, Paraya and Kavara) are the socially and economically weaker sections of the society involved in the unorganized bamboo-based activities. Their production methods are highly time-consuming laborious. The market prospects of the products made by the MBDs are not encouraging and this calls for strategic initiatives for their improvement. A market analysis of the bamboo products highlighted that the opportunity cost is greater than the earned benefit and the community is under-

Bamboo products

Bamboo artisans at work

paid even during the peak period of sales. Although the MBDs have innate traditional skills and indigenous knowledge, they are caught in a diminishing circular flow of development. This sector continues to be of traditional nature. Consequently the income and employment generated are less/ declining, and thus

they continue to remain marginalized from the mainstream of development. All these factors have affected the livelihood of the MBDs. The major constraints that hinder the growth of this traditional sector are related to production, marketing and utilization of bamboos/ products. As the new economic policy has opened up market for the Indian manufacturers including those working in the traditional and non-traditional bamboo sector, enhancing efficiency and competence is vital for the sustainable market existence of the sector. The role of bamboo in supporting the livelihood security of the MBDs is yet to be documented. Besides, the economic and livelihood potential of bamboo has not received much attention of the researchers in India. This project is proposed to fill this gap focusing on the south Indian states.

Structure and functioning of bamboo handicraft industry in South India

Bamboo-based handicraft production in South India is carried out both in the traditional and non-traditional sectors. In the traditional sector, production of mats and baskets is the major activity undertaken by traditional workers. Non-traditional sector mainly involves in the production of other handicraft products which are produced by traditional and non-traditional workers (members of all castes/ religions).

Although both the traditional and non-traditional sectors use bamboo or reed as raw material, their problems relating to production, marketing and technology are different. Unemployment and exploitation of labour in the industry are rampant. Due to a variety of reasons, traditional sources of supply of raw materials are declining. Institutional support for its development is inadequate. The potential of bamboo handicrafts has not been properly tapped; for instance, export of some of these items to other countries and proper marketing within the country have not received adequate attention. Intermediaries still play an important role in the industry which often hinders its progress. Profitability in the manufacturing of handicraft products is very low due to a variety of reasons. Technological progress is inadequate because of structural and financial constraints. The technical and financial capabilities of the new generation artisans to meet challenges in the industry in the context of globalization are less. Thus, the future of this industry depends on the resolution of several problems confronting it. This study is an attempt to examine various socio-economic problems of bamboo handicraft industry in South India and to suggest strategies and action plan for its development.

Standardization of bamboo cultivation practices for homesteads of Kerala

About 30 bamboo species suitable for homesteads of Kerala were shortlisted, including many thornless species which can be grown in homesteads of even 5-10 cents. A model cluster of skilled women with an associated labour bank, who can help the farmers / land owners in various aspects of bamboo cultivation, was

Seedlings raised in nurseries by Women's Self Help Groups

developed in Pananchery Panchayath. The cluster was provided the required technical support for making it self-sustainable and enabling taking up various extension activities useful to the land owners besides developing sustainable agroforestry models in leased lands.

PARTICIPATION IN SEMINARS/ SYMPOSIA/WORKSHOPS

C. Mohanan and E.M. Muralidharan

attended International Conference on Improvement of Bamboo Productivity and Marketing for Sustainable Livelihood held at New Delhi during 15-17 April 2008. Dr. Mohanan presented a paper entitled 'Potential Diseases and Disorders of Bamboos in India and their Management' and Dr. Muralidharan, on 'Plantlet Regeneration through Somatic Embryogenesis from Nodal Explants of *Bambusa balcooa* and *Dendrocalamus brandisii* Shoot Cultures Grown in vitro' (Muralidharan, E.M., Saritha, M.S., Shali, T.P. and Seethalakshmi, K.K.).

E.A. Jayson

attended the Environment Congress organised by the Centre for Environment and Development, Trivandrum and co-chaired a session on 25 April 2008.

C.N. Krishnankutty

presented a paper on 'Methodology of the Wood-balance Study in Kerala' at the Expert Consultation on Production and Consumption Study of Wood organised by the Forest Survey of India, at NASC Complex, ICAR Campus, New Delhi on 28-29 April 2008.

N. Sasidharan

participated in the Seminar on *Saraca asoca* at Thrissur on 4 May 2008, organized by the State Medicinal Plants Board, Kerala and presented a paper 'Production of Planting Materials of *Saraca*'.

participated in the National Seminar on Medicinal Plants organized by the Ayurveda Research Institute, Poojapura at Trivandrum during 24-25 May 2008 and presented a paper '*In situ* Conservation of Medicinal Plants in Kerala'.

participated in the Workshop on Medicinal Plants Cultivation organized by Kerala Forest Department in KFRI on 25 August 2008 and presented a paper on 'Cultivation Practices of 11 Medicinal Plants Prioritized for Cultivation by the Kerala Forest Department'.

V.P. Raveendran

attended the Training Programme on Direct Trainer Skill (DTS) during 18-25 August 2008 at the Institute of Management in Government, Kerala, Thiruvananthapuram.

C. Mohanan

attended the 9th International Congress of Plant Pathology (ICPP 2008) at Torino,

Italy, during 24-30 August 2008 and presented a paper entitled 'Outbreak of Pink Disease in Teak (*Tectona grandis* L. f.) Plantations in Kerala, India and its Management'.

T. Surendran

participated in the One day Seminar on Medicinal Plants at KFRI, organized by Kerala Forest Department (Research Wing) and KFRI on 25 August 2008.

E.A. Jayson

attended the Seminar entitled 'People and Tiger' at Periyar Tiger Reserve during 22-23 September 2008.

T. Surendran and C.K. Somen

participated in the National Seminar on Grassroot Innovators and Intellectual Property Rights organized jointly by KFRI, KSCSTE and Patent Office Chennai at KFRI during 26-27 September, 2008.

K.K. Seethalakshmi, U.N. Nandakumar, M.S. Muktesh Kumar, E.M. Muralidharan and C.K. Somen

attended the Training Programme on Bamboo Technology and Trade Development at State Forest Research Institute, Jabalpur during 29 September-5 October 2008. Dr. Seethalakshmi gave lectures on 'Bamboo: Germplasm Conservation and Management'; Dr. Nandakumar, on 'Thirty Commercially Important Bamboo Species of India' Dr. Muralidharan, on 'Tissue Culture of Bamboo' and Dr. Somen, on 'Germplasm Conservation and Management in Bamboos'.

U.M. Chandrashekara

attended the National Seminar on Coastal Wetland Ecosystems of Kerala on 16-17 October 2008 at Department of Botany, Sree Narayana College, Kannur and presented a paper entitled 'Ecological and Socio-cultural Dimensions of Sacred Groves of Kannur and Kasaragod Districts'.

C. Mohanan

attended National Seminar on Advances in Plant Pathology for Sustainable Agriculture held at Tamil Nadu Agricultural University, Coimbatore during 23-24 November 2008 and presented a paper entitled 'Wild Edible Fungi of the Western Ghats: Biodiversity and Economic Potential' (C. Mohanan and P.M.Sumesh)

George Mathew

delivered the keynote address (Ecology and Conservation Implications of Mangroves of Kerala) in the National Seminar on Mangroves: Significance and Conservation Strategies organized by the Dept. of Zoology, Govt. Arts and Science College, Calicut on 28 November 2008.

U.M. Chandrashekara

attended a Seminar on Medicinal and Insecticidal Properties of Botanicals on

28-29 November 2008 at Marthoma College, Chungathara (Nilambur) and presented a paper 'Ethnomedicine of the Panian Tribes in Vaniampuzha Forests, Kerala'.

N. Sasidharan

participated as a resource person in the Training Programme on Capacity Building in Plant Taxonomy organized by the Botanical Survey of India, at Shillong during 10-11 November 2008 and gave lectures on 'Computer-aided Tree Identification Programme' and 'Electronic Checklist on the Flowering Plants of Kerala'.

participated in the valedictory session of the National Symposium on Industrial Biotechnology. Made a felicitation and distributed prize to the winners of the contest papers in the symposium at Sahrdaya College, Kodakara, Thrissur on 17 November 2008.

K.K. Seethalakshmi

attended a National Seminar on Progress, Prospects and Problems in Bamboo Research at the Department of Botany, Mercy College, Palakkad, Kerala on 14 November 2008 and gave a talk on 'Potential of Bamboo and Bamboo Industries'.

C. Mohanan

participated in the IUFRO-APFISN - Asia and the Pacific Forest Health Workshop on Forest Health in a Changing World held at Kuala Lumpur, Malaysia during 1-3 December 2008. He presented a paper entitled 'Forest Health Management in India: Present Scenario and Future Challenges'.

T. Surendran

participated in the one day Seminar on Participatory Forest Management organized jointly by Kerala Forest Department and KFRI at KFRI on 6 December 2008

E.M. Muralidharan

participated in the National Conference on Bamboo for Livelihood during 15-17 December 2008 organised by the Tripura Bamboo Mission, Agartala and presented the paper 'Bamboo Agroforesty in Kerala' (Muralidharan, E.M., Seethalakshmi, K.K. and Raveendran, V.P.).

N. Sasidharan

participated in the Brain Storming Session on Plant Taxonomy and Biodiversity at National Bureau of Plant Genetic Resources, New Delhi, organized by NBPGR and Botanical Survey of India on 16 December 2008. He made a presentation on 'Interactive Identification Package for Plants'.

participated in the Workshop on Collection and Management of NTFPs organised by M.S. Swaminathan Research Foundation, Kalpetta on 9 January 2009 for SC&ST

Panchayath Presidents and Members of Wayanad District. He gave a talk on the 'NTFP Resources of Kerala and the Sustainable Collection Practices'.

participated in the Workshop on Nature Education on 15 January 2009 organised by Swadeshi Science Congress Kerala at KFRI, Peechi. He gave a lecture on 'Flowering Plants Diversity of Kerala'.

A.R.R. Menon

participated in a State Level Seminar organized by KSLUB on Significance of Wetlands in Kerala's Development on 13 January 2009 at Kochi.

K.K. Seethalakshmi, C. Mohanan, T. Surendran, A.R.R. Menon, E.A. Jayson and M.P. Sujatha

attended the National Workshop on Global Warming and its Implications for Kerala during 19-21January 2009 at Trivandrum, Kerala. Dr. Seethalakshmi presented two papers: 'Bamboo Plantations: An Approach to Carbon Sequestration' (Seethalakshmi, K.K., Jijeesh, C.M. and Balagopalan, M.) and 'Recent Developments in the Bamboo Sector' (Seethalakshmi, K.K.). Dr. Sujatha presented a paper on 'Strategies for Enhancing Soil Carbon Sequestration and Productivity of Forest Plantations in Kerala'.

N. Sasidharan

participated as a resource person in the Training Programme on Capacity Building in Plant Taxonomy organized by Botanical Survey of India at Coimbatore on 22 January 2009. He gave lectures on 'Computer-aided Identification Packages' and 'Electronic Checklist on the Flowering Plants of Kerala'.

participated in the 21st Kerala Science Congress held at Kollam during 29 January - 1 February 2009. He chaired the session on Plant Science.

M. Balasundaran

attended the National Seminar on Biotechnology at MET's College of Engineering, Mala, Thrissur on 3 February 2009 and presented a paper on 'Molecular Methods in Microbial Taxonomy'.

R.C. Pandalai

attended the Seminar on Bamboo Development organised by Rajasthan Horticulture Development Society at Maharana Pratap University of Agriculture and Technology, Udaipur during 17-18 February 2009. He presented a paper on 'Management and Preparation of Bamboo Nursery, Plantation, Cultivation Practices and Harvesting Techniques'.

N. Sasidharan

participated as a resource person in the Training Programme on Plant Taxonomy for College Teachers organized by MSSRF, Kalpetta and Indian Association of

Angiosperm Taxonomy at Kalpetta, during 19-20 February 2009. He gave lectures on 'Tree Identification Packages' and 'Electronic Checklist on Flowering Plants of Kerala'.

M. Balasundaran

participated in the National Workshop on Biofertilizer Production Technology at St. Mary's College, Thrissur during 3-5 March 2009 and presented two papers: 'Soil Fertility Improvement through Application of Biofertilizers' and 'Biofertilisers : Their Role in Soil Health Improvement and Integrated Nutrient Management'.

R.C. Pandalai

attended a Workshop on Training and Capacity Building for Sustainable Development by Enhancing the Skill and Knowledge of Tribal VSS Members organized by WWF -India in association with the Kerala Forests and Wildlife Development and Ministry of Tribal Development, Govt. of India, on 11 March, 2009 at Adimali. He delivered a lecture on 'Nursery Techniques and Planting of Forest Trees'.

K.K. Seethalakshmi

attended the National Symposium on Glacial Overview of Tuberculosis at St. James College of Pharmaceutical Sciences, Chalakudy, Kerala during 20-21, March 2009. She presented an invited paper 'Herbal Medicines for Tuberculosis' (Seethalakshmi K.K. and Sheela Karalam).

SEMINARS/ SYMPOSIA/ WORKSHOPS ORGANIZED

K.M. Bhat, as Coordinator of TEAKNET, organized the Steering Committee meeting on 21 April, 2008 at Hanoi, Vietnam during Asia-Pacific Forestry Week, 21-26 April, 2008, at Hanoi.

U.M. Chandrashekara Organised a Training Workshop on Taxonomy and Ecology of Soil Flora and Fauna on 12-13 February 2009 at KFRI Sub Centre with the financial support from Kerala State Biodiversity Board Thiruvananthapuram and TSBF-SARNet, New Delhi

A National Seminar on Grassroot Innovators and Intellectual Property Rights was organized jointly by KFRI, KSCSTE and Patent Office Chennai at KFRI during 26-27 September, 2008. The seminar was inaugurated by Sri. T.C. James, Director,

Dept. of Industrial Policy and Promotion. Govt. of India, New Delhi. Dr. W.M. Dhumane, Jt. Controller, Patent office, Mumbai, Sri. V. Rangasamy, Asst. Controller, Patent office, Chennai and Dr. C. M. Joy, Registrar, KFRI felicitated on the occasion. The inaugural function was followed by technical sessions of the seminar.

A Seminar on Participatory Forest Management was organized jointly by Kerala

Forest Department and KFRI at KFRI on 6 December 2008

A One day Seminar on Medicinal Plants was organised at KFRI, jointly by Kerala Forest Department (Research Wing) and KFRI on 25 August 2008.

A Workshop on Nature Education was organised on 15 January 2009 by Swadeshi Science Congress Kerala at KFRI, Peechi.

OUTREACH PROGRAMMES

V. Anitha

- handled training classes on 'Economic and Livelihood Potential of Bamboo' for the field functionaries of the Bamboo Technical Support Group for South Zone.

M. Balasundaran

- gave technical help to Forest Range Officer, Vellikulangara on Methods of Regeneration of Sandal.
- took classes for Wood Science and Technology PG students on 'Biotechnological Detection of Wood Bio-deterioration'.

U.M. Chandrashekara

- took classes to Forest Department trainees (Forest Guards to IFS probationers' level) on various aspects of forest conservation and management.
- produced plant propogules of different tree species and bamboo and supplied at the nominal price to the Government Departments, NGOs and farmers to promote tree farming both within and outside Kerala.
- gave training to farmers and forest staff on management of teak nursery.

T.K. Dhamodaran

- acted as a resource person for various training courses on Bamboo Utilization.

George Mathew

- participated as Resource Person in 'Confluence 2008-2009' organised by Sree Narayana College, Alathur on 13-11-2008 and delivered a talk on 'Butterfly Conservation'.

E.P. Indira

- served as Course Coordinator for Training Programme on Conventional and Molecular Methods of Tropical Tree Improvement for Higher Productivity to two Myanmar officials under ITTO funding during 18- 27 November 2008.
- reviewed many scientific papers for Indian Journal of Forestry and Journal of Non-timber Forest Products.
- as an Examiner, evaluated the Ph.D. thesis of a student of Gandhigram Rural University during October 2008. Also conducted the Viva voce examination for Ph.D. of a student of Bharathiar University in November 2008.

K. Jayaraman

- delivered a lecture on 'Data Needs for Sustainable Forest Management' in the Training Workshop on Collection, Compilation, Validation and Dissemination of Forestry Statistics for Indian Forest Service (IFS) Officers, 21-25 April, 2008.

E.A. Jayson

- delivered an invited talk entitled 'Avifauna of Kerala' to the M.Sc. Wildlife Biology students of AVC College, Mayiladuthurai, Tamil Nadu on 7 March 2009.
- visited the Thamarassery Range as per the request Forest Department and survey the crop damage in the area and submitted a report to ameliorate the problem in Sept. 2008.
- visited Choolannur Peafowl Sanctuary and surveyed the protected area to advise the park management on the removal of undergrowth from the Sanctuary. Report submitted to the Wildlife Warden in December 2008.
- gave a lecture to teachers at Academic Staff College of Calicut University on 8 January 2009 on 'Human -Wildlife Conflict'.
- offered three classes to the High School Students on the subject 'Animal Diversity in Kerala' who were participating in the camp at Peechi Wildlife Sanctuary during 4 and 30 October 2008, 3 November 2008 and 4 February 2009.
- took class to the Foresters and Guards who were attending the refresher course at Arippa Forest School, Arippa during 18 November 2008.
- attended a meeting convened by Hon. Minister for Forests to review the Bird monitoring programme initiated in the memory of Dr. Salim Ali at Trivandrum on 12 January 2009.
- Reviewed two scientific papers for the Journal, Indian Forester during August 2008.

C.N. Krishnankutty

- as a resource person gave a lecture on 'Wood-balance study: Methodology and Database' in the training course on Collection, Compilation, Validation and Dissemination of Forest Statistics for Indian Forest Service Officers during 21- 25 April 2008.
- as a resource person, to handled a Session on 'Estimation of Bamboo Resource in Farmlands' as part of the Training for Field Functionaries under the National Bamboo Mission Bamboo Technical Support Group for South Zone, during 4-9 August, 21-27 September,12-19 October, 9-16 November, 23-30 November and 14-20 December 2008.

A.R.R. Menon

- acted as a resource person and gave a lecture on 'Sampling Techniques and

Vege- tation Analysis' in a Workshop on Plant Taxonomy for Taxonomy Teachers and Researchers. MSSR Foundation, Kalpetta during 19-23 February 2009.

- delivered lectures on 'Inventory of Bamboo Stocking using Remote Sensing and GIS' in the Training Course on Priority Species, Resource Estimation, Plantation Development, Post-harvest Technology and Socio-economic Livelihood Potential of Bamboos on 28 November 2008 and 19 December 2008.
- served as resource person in 'Remote Sensing Application and Disaster Management' in R.Sankar Birth Centenary Celebrations Seminar Series-CONFLUENCE 2008-2009 at S.N.College, Alathur on 4 November 2008.
- Gave a talk on 'GIS and Remote Sensing Application' in a Workshop on Geographical Information System and Remote Sensing on 17 July 2008 and another talk on 'Geoinformatics- Tools in Education and Resource Management' at Socio-Economic Foundation Unit, Thrissur.
- gave lectures on 'Inventory of Bamboo Stocking using Remote Sensing and GIS' in Training course on Propagation, Cultivation, Management and Post-harvest Technology of Bamboos on 25 June 2008.
- gave lectures on 'Generating Forestry Data using Remote Sensing Tools' in Training Course on Collection, Compilation, Validation and Dissemination of Forest Statistics for Forest Officials on 24 April 2008.
- served as resource person in 'Biodiversity Conservation at Landscape Level using Remote Sensing and GIS' in AICTE Training Programme on GIS Techniques for Environmental Governance, Urban Management and Rural Development on 3 May 2008.
- gave a talk on 'Forest Status of Kerala' Nature Lecture Series at M.G. University, Kottayam on 19 October 2008.
- took a class on 'Remote Sensing' at Govt. Model School, Thrissur on 9 May 2008, at Govt. H.S., Poonkunnam, Thrissur on 21July 2008, at St. Antony's H.S., Ammadom on 14 November 2008 and at Model School, Thrissur on 3 January 2009.
- served as resource person in 'Remote Sensing and GIS Applications in Resource Management' for UGC-Acad. Staff College Refresher Course for College Teachers; at Calicut University on 7 January 2009 and at Kerala University on 26 February 2009.
- took a class on Remote Sensing for senior citizens, Poomukha Sandhya Group, Thrissur on 3 January 2009.

C. Mohanan

- delivered lectures on 'Diseases and their Management in Teak and Bamboo Stands' for participants attending the training under National Bamboo Mission & Bamboo Technical Support Group on Forest Seed Health Management.

- carried out extension work on controlling the diseases in forest nurseries andplantations in different localities in the State and gave reports to the Kerala Forest Department.
- carried out extension works on managing the disease problems in *Casuarina equisetifolia, Acacia mangium* and *Eucalyptus pellita* plantations and *Eucalyptus urophylla*, *E. pellita*, and *Paraserianthes* and sent reports to Kerala Forest Development Corporation Ltd.

M.S. Muktesh Kumar

- participated as a resource person in a series of the training programmes held for field functionaries under the Bamboo Technical Support Group for South Zone, Sponsored by National Bamboo Mission, New Delhi.

E.M. Muralidharan

- gave lectures during the training programmes on 'Propagation, Cultivation, Manage ment and Post-harvest Technology of Bamboos' conducted at KFRI (9-15 March 2008, 3-10 August 2008, 20-29 May 2008, 22-28 June 2008)
- gave lectures during the training programmes on 'Priority Species, Resourse Estimation, Plantation Development, Post Harvest Technology and Socio-economic Livelihood Potential of Bamboos conducted at KFRI (Sep. 22-27, 2008, 12-19 October 2008, 9-16 November, 14-20 December 2008)

U.N. Nandakumar

- served as examiner to a) II Semester M.Sc Forestry Students of KAU on 'Management of Urban, Extension and Community Forests' -July 2008 and b) I Semester B.Sc (Hon) Forestry students of KAU 'Principles of Silviculture' in Feb 2009
- provided Expert Opinion on 'Ecologically Fragile Land Issue' in a High Court case to KFD in June, 2008
- provided lectures to District, Block, Grama Panchayath representatives, officials, farmers and women self help groups on Solid Waste Management, National Rural Employment Guarantee Act & Decentralized Planning, Food, Energy & Environmental Security, Biodiversity Management and Watershed Planning on various occasions during April 2008-Jan 2009.

R.C.Pandalai

- delivered three lectures on 'Nursery, Plantation and Harvesting Techniques for Bamboos' in connection with the TANHODA Training Programme to Field Level Officers of Tamil Nadu (16 July 2008, 22 July 2008 and 05 August 2008)
- delivered lectures on 'Nursery, Plantation and Harvesting Techniques for Bamboos' during various Training Programme of BTSG-National Bamboo Mission on 'Priority

Species, Resource Estimation, Plantation Development, Post-Harvest Technology and Socio-Economic Livelihood Potential of Bamboos'. All the training programmes were conducted at KFRI, Peechi.

- served as a course coordinator for the Training Programme on Collection, Processing and Storage of Seeds of Forestry and Medicinal Plants under FRLHT Programme. Also acted as a resource person and delivered two lectures on 'Seed collection in Medicinal Plants with Special Reference to Seeds Collected for the FRLHT Programme' and 'Forms, Performas to be Used and Records to be Maintained in Connection with Seed Collection'.

P.K.C. Pillai

- conducted field visit and offered recommendations for tree planting at Souhrudaramam, Thanal Charitable Trust, Kiraloor, Thrissur, on 7 May 2008.

V.P. Raveendran

- functioned as Coordinator/ Associate Coordinator for various TrainingProgrammes conducted at KFRI such as 'Tree Farming in Agroforestsry Systems and Wastelands', 'Collection, Compilation, Validation and Dissemination of Forest Statistics', 'Propagation,Cultivation, Management and Post-Harvest Technology of Bamboos'.
- delivered a lecture on 'Bamboo Species Suitable for Propagation and Traditional Methods of Propagation' for the agricultural officers from Tamil Nadu Agricultural University , Forest College and Research Institute, Mettupalayam under TANHODA-NBM Programme in KFRI on 16 and 23 July 2008
- gave a talk on 'Bamboo: Traditional Methods of Propagation' and conducted Field Demonstation of Vegetative Propagation to the farmers from Myrada Krishi Vigyan Kendra, Gopichettipalayam, Tamil Nadu during their visit (5 December 2008) as part of the TANHODA- NBM training on at KFRI and to farmers from Trichy (27 January 2009)
- delivered a lecture on 'Bamboo- Traditional Methods of Propagation' in the Training Workshop 'Bamboo - A Global Cooling Agent' as part of the National Workshop on Global Warming and its Implication for Kerala at Techno Park, Trivandrum on 20 January 2009
- delivered a lecture on 'Bamboo Species Suitable for Propagation and Traditional Methods of Propagation' to the farmers from Karassery Panchayath (28 January 2009) and to the farmers from Villupuram, Tamil Nadu and Maharashtra (29 January 2009), Thanjur/Thiruvarur, Tamil Nadu (24 February 2009) and Dindigal, Tamil Nadu (19 March 2009) during their visit to KFRI.

C. Renuka

- provided leaf samples of available palm species to scientists of CPCRI, Kasaragod for scientific study .

- scrutinized a project proposal on 'Endangered/Economically Important Species of *Calamus*' submitted to Ministry of Science and Technology for funding and submitted the comments.
- edited a scientific paper for Indian Journal of Forestry.
- supplied the details on the nursery practices of rattan to the DFO, Sreekakulam, Andhra Pradesh.

P. Rugmini

- delivered two lectures on 'Experimental Designs in Forestry' in the Training Course on Conventional and Molecular Methods of Tropical Tree Improvement for Higher Productivity during 17-27 November 2008 supported by ITTO Teak Project.

N. Sasidharan

- participated in the meeting on 22 September 2008, organized by the Botanical Survey of India to finalize the list of plants which are on the verge of extinction or likely to become extinct under section 38 of the Biological Diversity Act 2002. Made a presentation on the critically endangered species recorded from Kerala.
- gave a lecture on plant identification methods to the students and research scholars of Amala Cancer Research Centre, Thrissur, on 19 May 2008. Also gave lectures on Computer-aided Tree Identification and Non-Timber Forest Produces of Kerala to the Foresters and Forest Guards Trainees of Forest School, Arippa, on 12 February 2009.
- evaluated the dissertation of M.Sc. Horticulture student, College of Horticulture, Thrissur and also conducted the viva voce for awarding the Masters Degree.
- identified the plant referred from Department of Botany, Government Victoria College, Palakkad on 27 September 2008. Also identified the Plants in the Medicinal Plants Garden at Chozhiakode, Kulathupuzha as per the request of Dy. Conservator of Forests (Research, South) on 10 February 2009.
- prepared the question paper for written examination for the award of Fellowship in Botany of the Kerala State Council for Science, Technology and Environment, Kerala. Also acted as a member of the board for conducting interview for selection of candidates for awarding Fellowships on 18 December 2008.
- participated in the Technical Committee meeting organized by Kerala Forest Development Corporation on 2 September 2008 for establishing a Botanical Garden at Munnar.

K.K. Seethalakshmi

- as resource person handled classes on 'Flowering, Seed Handling and Seedling Production in Bamboos' and 'Vegetative Propagation' during various Training

Programmes on Propagation, Cultivation, Management and Post-Harvest Technology of Bamboos. She also organized a demonstration programme on seed handling and vegetative propagation.

- gave an invited talk on bamboo and its potential at Rotary Club Thrissur on 31 October 2008.

C.K. Soman

- provided training to research students, school/college teachers and students on the use of various analytical and field equipments during their visit.
- conducted field demonstration classes to trainees of Bamboo Technical Support Group from various states on 17 July 2008, 23 Septmber 2008, 27 November 2008 and 28 December 2008.

T. Surendran

- acted as a resource person and imparted training and demonstration on 'Clonal Propagation of Teak' to a group of progressive farmers from Vidharbha (MP) during their training program in KFRI.
- delivered a lecture on 'Nursery Practices: Vegetative Propagation' during the training course on 'Tree Farming in Agroforestry Systems and Wastelands' conducted at KFRI on 20-29 May 2009
- provided training and demonstration on Clonal Propagation of Teak to a group of forest officers from Myanmar.
- provided training and demonstration on Clonal Propagation of Teak to Forester Trainees from Arippa Forest School, to a batch of Wood Science Students of Kannur University and a batch of M.Sc. students of Devagiri College, Kozhikode during their visit to KFRI.

P.K. Thulasidas

- as part of KFRI Ext. 01/02, provided wood testing services to various end users like Neyveli Lignite Corporation, TELK Angamaly, Kerala Council for Historical Research, Customs, and other stakeholders.
- served as resource person and handled wood anatomy lecture classes and practical training in the Wood Science laboratory for 11 M.Sc. Wood Science & Technology students of Kannur University during 16-21 March 2009.

NOMINATION TO NATIONAL/ INTERNATIONAL COMMITTEES

M. Balasundaran

was nominated as Expert member, Board of Studies in Environmental Sciences, Kerala University.

K.M. Bhat

served as Dy. Coordinator IUFRO Division 5 (Forest Products) since 2000 and founder Coordinator of Teakwood Working Party (IUFRO Div. 5.06.02).

was elected as Board Member of International Academy of Wood Science for the period 2006-2012.

was nominated as Member of Editorial Board, Wood Science and Technology - a refereed international journal from Germany.

T.K. Dhamodaran

was nominated as Technical Expert Member of the Special Purpose Vehicle (SPV) of the Kerala Furniture Consortium, Ernakulam District, Valluvanadu Wood Consortium, Malappuram District and their Equipment (Plant & Machineries) Purchase Committee constituted by the State Government.

E.P. Indira

was nominated as a member of the 'Regional Variety Testing Committee' of IFGTB to streamline the process of registration and release of clones in southern states of Tamil Nadu, Kerala, Puducherry, Andaman & Nicobar Islands and Lakshadweep.

was nominated as a Member of Board of Examiners for the M.Sc. Plantation Development Course, Calicut University.

E.A. Jayson

was selected as a member of the Management Effectiveness Evaluation Committee of the Ministry of Environment and Forests. He visited Mookambika Wildlife Sanctuary in Karnataka (13-15 October 2008) and Eravikulam National Park (7-8 November 2008) and submitted the report to the Ministry.

C.N. Krishnankutty

was invited for giving a lecture on 'Wood-based Industries in Kerala and Future Wood Availability' on 9 April 2008 at the State-level meeting of the Central Empowered Committee appointed by the Hon'ble Supreme Court, chaired by Mr. T.M. Manoharan, IFS, PCCF, Government of Kerala.

E.M. Muralidharan

was selected as member of Steering Committee for the 2009 International Conference in Biotechnology on 'Use of Biotechnologies for Food and Agriculture in Developing Countries: Learning from the Past and Planning for the Future'. He attended the first meeting held on 10-11 July 2008 at FAO Headquarters, Rome.

was nominated as Subject Expert in Biotechnology for the XX Annual Research Council meeting of Indian Cardamom Research Institute. He attended the review meeting held on 19 August 2008 at ICRI, Myladumpara.

N. Sasidharan

was selected as a member of the Committee for Screening and Evaluation of Project Proposals received for financial assistance from National Medicinal Plant Board.

participated in the General Body meeting of the Medicinal Plants Board, Kerala as a Member of the Board at Thiruvananthapuram on 21January 2009.

was appointed as a member of the Selection Board for the award of KSCSTE Fellowship in Botany.

K.K. Seethalakshmi

was nominated as Member, Expert committee on Science and Technology for Women, Department of Science and Technology, Government of India.

PUBLICATIONS

Scientific Papers in Journals

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Sivaram, M. and Sasidharan, N. 2008. InventNTFP 1.0 (Inventory analysis for the sustainable management of Non-timber Forest Products). Evergreen 59,60: .

Seethalakshmi, K.K., Jijeesh, C.M. and Raveendran, V.P. 2008. Seed and seedling attributes of *Melocanna baccifera* and *Ochlandra travancorica*. Journal of Bamboo and Ratttan 7(1&2): 101-108.

Sivaperuman, C. and Jayson, E.A. 2009. Population dynamics of wetland birds in the Kole wetlands of Kerala, India. Journal of Scientific Transactions and Technovation, 2(3): 152-162.

Sudheendrakumar, V.V., Sajeev, T.V. and Biji, C.P. 2008. Optimization of in vivo mass production of HpNPV in teak defoliator, *Hyblaea puera* (Cramer). Entomon 33(3): 171-180.

Sudheendrakumar, V.V., Sajeev, T.V. and Biji, C.P. 2008. A new insect rearing container for in vivo mass multiplication of NPV of *Hyblaea puera*. J. Biol. Control 22(1): 217-219.

Thulasidas, P.K. and Bhat, K.M. 2009. Log characteristics and sawn timber recovery of home-garden teak from wet and dry localities of Kerala, India. Small-scale Forestry 8: 15-24.

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and Marketing of Teak Wood Products of Planted Forests. Kerala Forest Research Institute, Peechi, Kerala, India. pp. 117-125.

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Indira, E.P., Nair, Pramod N. and Sabna Prabha, S. 2008. Evaluation of genetic diversity in teak populations in Kerala using DNA markers. In: A.K. Mandal, S.A. Ansari and C. Narayanan (eds.) Forest Biotechnology in India. Satish Serial Publishing House, Delhi, India. pp. 25-30.

Indira, E.P., Nair, Pramod N., Sabna Prabha, S. and Hugo Volkaert 2008.Genetic diversity and contemporary gene flow in teak. In: K.M. Bhat, M. Balasundaran, K.V. Bhat, E.M. Muralidharan, P.K. Thulasidas (eds.) Processing and Marketing of Teak Wood Products of Planted Forests. Kerala Forest Research Institute, Peechi, Kerala, India. pp. 205-213.

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Surendran, T. 2008 Modern tools for clonal teak plantations In: M.Govinda Rao, K.K.Suresh, I. Sekar , K. Baranidharan. and V. Karikalan(eds.) Proceedings of National Seminar on Modern Tools in Plantation Forestry. Forest College and Research Institute, Mettupalayam, Tamil Nadu.

Swarupanandan, K. and Muraleedharan, P.K. 2008. Restoration of mangrove in Kerala for coastal protection: Constraints and policy options. Paper presented in a Seminar on Mangrove in India: Biodiversity Protection and Environment organized by Ministry of Environment and Forests, New Delhi and Institute of Wood Science and Technology, Bangalore during Feb.7-8, 2008.

Wilsy Wilson, Nishad, V.M. and Balasundaran, M. 2009. Protease producing thermophilic microorganisms from different organic sources: Preliminary study on a *Bacillus* sp. and enzyme characterization. In: E.P. Yesodharan (ed.) Proceedings of the 21st Kerala Science Congress 28-31 January 2009, Kollam, pp. 193-195.

ACADEMIC PROGRAMME

Ph. D. Programme

Mr. P.K. Thulasidas was awarded Ph.D. (Wood Science & Technology) by FRI University, Dehra Dun in November 2008 for his thesis entitled 'Timber properties of teak (*Tectona grandis* L.f.) grown in the homesteads of Kerala' under the guidance of Dr. K.M. Bhat, Programme Coordinator, Forest Utilisation Division.

Mr. K.A. Sreejith was awarded Ph.D. by FRI University, Dehra Dun in December 2008 for his thesis entitled ' Ecological and ecophysiological studies on the successional status of tree seedlings in tropical wet evergreen and semi-evergreen forests of Kerala' under the guidance of Dr. U.M. Chandrashekara, Scientist-in-Charge, KFRI Sub-centre, Nilambur.

Mr. K.C. Rajesh Kumar was awarded Ph.D. by FRI University, Dehra Dun for the thesis entitled 'Biodiversity of plant pathogenic fungi in natural forests in the Kerala part of Western Ghats' under the guidance of Dr. C. Mohanan, Scientist-in Charge, Forest Pathology Discipline.

Ms. Sabna Prabha was awarded Ph.D. degree by FRI University, Dehra Dun in December 2008 for her thesis entitled 'Analysis of mating system and contemporary gene flow in natural teak forest and plantations through DNA marker studies' under the guidance of Dr. E.P. Indira, Scientist-in-Charge, Forest Genetics and Tree Breeding Discipline.

The following Ph.D. theses were submitted to FRI University during the period.

Sl. No.	Name	Topic for research approved by FRI	Month	Supervisor
1	Sreekanth, P.M.	Population genetic structuring and gene flow estimates in *Tectona grandis* L. using AFLP markers	June 2008	Dr. M. Balasundaran
2	Haseena, A.	Morphological, biochemical and molecular characterisation of thermophilic microorganisms in aerobic composting	September 2008	Dr. M. Balasundaran
3	Raju Paduvil	Post-harvest damage by *Dinoderus* beetles in bamboos and its management	December 2008	Dr. R.V. Varma
4.	Ramachandran,V.S.	An ecological study of the vegetal mosaics and conservation options in the Nelliampathy Plateau, Kerala, India	February 2009	Dr. K. Swarupanandan
5.	Joyce Jose	Animal diversity of *Myristica* swamps in Southern Kerala with emphasis on herpetofauna	March 2009	Dr. K. K. Ramachandran

M. Sc. Attachment Programme

More than 50 applications were received from M.Sc. students of different colleges/ universities for academic attachment at KFRI. After short listing, the following students were selected for carrying out their dissertation work at KFRI.

Sl. No.	Name of the student	Supervising guide	University	Title of the thesis	Subject
1	Parvathy, M.	Dr. M. Balasundaran	St. Thomas College, Thrissur (Calicut University)	Genotypic comparison of *Santalum album* L. and its adulterant *Osyris wightiana* Wall. ex Wight using RAPD markers	Botany
2	Divya Menon, K.	Dr. M. Balasundaran	St. Thomas College, Thrissur (Calicut University)	Genotypic characterization of two species of *Tectona* using RAPD technique	Botany
3	Deepthi	Dr. M. Balasundaran	Sree Sankara Vidyapeedom College Perumbavoor (M.G. University)	Molecular characterization of *Catharanthus roseus* using ISSR markers	Biotechnology
4	Divya, K.V.	Dr. M. Balasundaran	Mar Athanasius College (M.G. University)	Genotypic characterization of *Dalbergia latifolia* Roxb. using RAPD markers	Biotechnology
5	Ramya, T.G.	Dr. M. Balasundaran	Sree Sankara Vidyapeedom College Perumbavoor (M.G. University)	Molecular characterization of *Hibiscus rosasinensis*	Biotechnology
6	Siji Mol, K.	Dr. E.M. Muralidharan	Nehru Arts and Science College, Coimbatore (Bharathiar University)	Comparison of three basal nutrient media in micropropagation of *Bambusa tulda*	Biotechnology
7	Namitha, P.	Dr. E.P. Indira	Indira Gandhi College of Arts and Science, Kothamangalam (M.G. University)	Molecular characterisation and estimation of gene diversity in a natural teak population at Vazhachal through microsatellite markers	Biotechnology
8	Renjini, R.	Dr. E.P. Indira	Indira Gandhi College of Arts and Science, Kothamangalam (M.G. University)	Evaluation of gene diversity and genetic differentiation in two teak provenances through DNA marker studies	Biotechnology

9	Keerthy Vijayan	Dr. E.M. Muralidharan	Sree Sankara Vidyapeedom College, Perumbavoor (M.G. University)	Effect of basal media on shoot multiplication in micropropagation of *Bambusa balcooa*	Biotechnology
10	Mridula Raghavan	Dr. V.V. Sudheendra kumar	Indira Gandhi College of Arts and Science, Kothamangalam (M.G. University)	*In vivo* cloning and characterisation of HpNPV isolate	Biotechnology
11	Shamla Shamsudeen	Dr. T.V. Sajeev	St. Mary's College Thiruvalla (M.G. University)	Comparison and amplification potential of various isolates of HpNPV	Microbiology
12	Geethu, K.B.	Dr. T.V. Sajeev	Indira Gandhi College of Arts and Science, Kothamangalam (M.G. University)	Quantitative tracking of baculovirus infection in teak defoliator larvae	Biotechnology

TRAINING AND EXTENSION ACTIVITIES

Training Programmes Organised

Sl. No.	Project No.	Date and Year	Title	Sponsor	Course Coordinator
1	Ext.141/08	21- 25 April 2008	Collection, Compilation, Validation and Dissemination of Forest Statistics	Ministry of Environment and Forests	Dr. M. Sivaram
2	Ext.142/08	28-30 April 2008	National Green Corps Training for Master Trainers	Kerala State Council for Science, Technology and Environment	Dr. K.V. Mohammed Kunhi
3	Ext.140/08	20-29 May 2008	Tree farming in Agro forestry systems	Tamil Nadu Forest Department and wastelands	Dr. S. Sankar
4	Ext. 144/08	9-19 June 2008	Crash Course for the M. Sc. Wood Science and Technology students of the School of Wood Technology, Kannur University.	Kannur University	Dr. T. K. Dhamodaran
5	Ext. 136/08	22-28 June 2008	Propagation, Cultivation, Management and Post-Harvest Technology of Bamboos	Directorate of Horticulture, Rajasthan	Dr. K.K. Seethalakshmi
6	Ext. 536/07	3-10 Aug 2008	Propagation, Cultivation, Management and Post-Harvest Technology of Bamboos	National Bamboo Mission BTSG	Dr. K.K. Seethalakshmi
7	Ext. 147/08	22-27 Sept. 2008	Priority Species, Resources Estimation, Plantation Development, Post-harvest Technology and Socio-economic Livelihood Potential of Bamboos	Directorate of Horticulture, Rajasthan and Forest Divisions of A. P., Maharashtra, Tamil Nadu and Karnataka	Dr. K.K. Seethalakshmi
8	Ext. 536/07	12-19 Oct. 2008	Priority Species, Resourse Estimation, Plantation Development, Post-Harvest Technology and Socio-economic Livelihood Potential of Bamboos	National Bamboo Mission and BTSG	Dr. K.K. Seethalakshmi

9	Ext. 536/07	9-16 Nov. 2008	Priority Species, Resourse Estimation, Plantation Development, Post-Harvest Technology and Socio-economic Livelihood Potential of Bamboos	National Bamboo Mission and BTSG	Dr. K.K. Seethalakshmi
10	Ext. 151/08	18-27 Nov. 2008	Conventional and Molecular methods of tropical tree improvement for higher productivity	ITTO Myanmar	Dr. E. P. Indira
11	Ext. 536/07	24-29 Nov. 2008	Priority Species, Resourse Estimation, Plantation Development, Post-Harvest Technology and Socio-economic Livelihood Potential of Bamboos	National Bamboo Mission and BTSG	Dr. K.K. Seethalakshmi
12	Ext. 153/08	5-6 Dec. 2008	Intra -District Training programme for farmers under Agricultural Technology Management Agency (ATMA)	Directorate of Agriculture Kodakara & BTSG	Dr.K. C. Chacko
13	Ext. 536/07	14-20 Dec. 2008	Priority Species, Resourse Estimation, Plantation Development, Post-Harvest Technology and Socio-economic Livelihood Potential of Bamboos	National Bamboo Mission and BTSG	Dr. K.K. Seethalakshmi
14	Ext. 154/09	11-14 Jan. 2009	Study on Teak	ITTO Myanmar	Dr. K. C. Chacko
15	Ext.158/09	15-21 March 2009	Crash course for the M.Sc. Wood science and Technology students of the school of Wood Technology, Kannur University	Kannur University	Dr. E.J. Maria Florence

Extension activities carried out

Sl. No.	YEAR & MONTH	PROBLEM ATTENDED	CLIENT	PERSONS INVOLVED
1.	2008 April	Query about availability of bamboo propagules	Mr. Anil Kumar Sahu IFS Conservator of Forests Regional General Manager Chattisgarh Forest Development Corporation, Bilaspur	Dr. K. C. Chacko
2.	2008 April	Sapling borer infestation in teak plantations	Forest Range Officer Vadasserikkara	Dr. George Mathew

3.	2008 April	Information on establishing Teak plantation	Mr. A.G. Dhaygude Brahman Lane, Atpadi Tal. Atpadi, Dist. Sangli Maharashtra - 415 301	Dr. K. C. Chacko
4.	2008 April	Advice on management of plantations	The Manager KFDC Ltd., Sub Unit II Peringammala PO Via Pacha Palode, Thiruvananthapuram	Dr. U. N. Nandakumar
5.	2008 May	Leaf drying in Acacia mangium plantation	Shri. N. Sudhir IFS Divisional Forest Officer Malayattor Division Kodanad PO	Dr. K. Mohanadas Dr. George Mathew
6.	2008 May	Wood sample testing	The Addl. Chief Manager FC Division Transport Dept. NLC Limited, Neyveli - 2 Cuddalore Dist. Tamil Nadu	Dr. K. M. Bhat
7.	2008 May	Wood sample testing	Mr. Krishnakumar Sr. Manager (Materials) Transforms & Electricals Kerala Ltd. Angamaly South 683 573	Dr. K. V. Bhat
8.	2008 June	Wood sample testing	Mr. Krishnakumar Sr. Manager (Materials) Transforms & Electricals Kerala Ltd. Angamaly South 683 573	Dr. K. V. Bhat
9.	2008 June	Wood sample testing	Deputy Ranger Chakkikkuzhi Forest Station Kavalamukkatta PO Pookkottumpadam Malappuram Dist.	Dr. K. M. Bhat
10.	2008 June	Wood sample testing	Ms. Sree Balaji Timbers 119, Meenkarai Road Zamin Uthukuli Pollachi - 642 004, Tamil Nadu	Dr. K. M. Bhat
11.	2008 June	Field inspection Report - HNL	The Managing Director Hindustan News Print Ltd. News Print Nagar P. O Kottayam District 686 616	Dr. K. C. Chacko Dr. M. Balagopalan Dr. C. Mohanan Dr. R. C. Pandalai Dr. K. Mohanadas
12.	2008 June	Landscape planting and water harvesting in Shobha Hermitage estate.	Sri. K. Muralidharan Manager, Shobha Hermitage Panniyankara PO Vadakkenchery - 678 683 Palakkad	Dr. R. C. Pandalai Dr. K. Mohanadas Dr. K. C. Chacko

13.	2008 July	Wood sample testing	Mr. Saju Contractor Kalladakkanam House Chalakkudy P. O	Dr. K. M. Bhat
14.	2008 July	Wood sample testing	Col. Pratap (Retd) General Manager Vaidyaratnam Oushadhasala Pvt. Ltd. Chuvannamannu PO, Trichur	Dr. K. M. Bhat
15.	2008 July	Assistance to the Commissioner Advocate	The Dy. General Manager Hindustan Newsprint Ltd. Newsprint Nagar - 686 616 Kottayam	Dr. K. C. Chacko
16.	2008 August	Information of Teak Plantation	Tushar H. Gaware C/3, Maurya Vihar, Near Sahajanand Soc. Kothrud, Pune, 411 038, Maharashtra	
17.	2008 August	Wood sample testing	Junior Telecom Officer (Civil) Civil Sub Division-I Vth Floor BSNL centre P.O. Road, Thrissur	Dr. K.V. Bhat
18.	2008 August	Wood sample testing	The Additional Chief Manager FC Division, Transport Department NLC Limited, Neyveli-607 802 Cuddalore Dist., Tamil Nadu	Dr. K.M. Bhat
19.	2008 September	Wood sample testing	The Additional Chief Manager FC Division, Transport Department NLC Limited, Neyveli-607 802 Cuddalore Dist., Tamil Nadu	Dr. K.V. Bhat
20.	2008 October	Wood sample testing	The Additional Chief Manager Civil/Mtce./North zone Neyveli Lignite Corporation Ltd., Township Administrative Office Block-10, Neyveli 607801 Tamil Nadu	Dr. K.V. Bhat
21.	2008 October	Note on 'Problem of Teak productivity in Kerala'	Sri. V.K. Sinha IFS Additional PCCF Forest HQ, Vazuthacaud Thiruvananthapuram	Dr. K. C. Chacko Dr. C. Mohanan Dr. Thomas P. Thomas
22.	2008 October	Wood sample testing	The Additional Chief Manager FC Division, Transport Department	Dr. K.V. Bhat

			NLC Limited, Neyveli-607 802 Cuddalore Dist., Tamil Nadu	
23.	2008 October	Wood Sample testing	Prof. P. J. Cherian, Director Kerala Council for Historical Research, P. B. No. 389, Vylopilly Samskruthi Bhavan, Nalanda, Thiruvananthapuram	Dr. K.V. Bhat
24.	2008 October	Wood Sample testing	Prof. P.J. Cherian, Director Kerala Council for Historical Research, P. B. No. 389, Vylopilly Samskruthi Bhavan, Nalanda, Thiruvananthapuram	Dr. K.V. Bhat
25.	2008 November	Mortality of eucalyptus seedlings	Shri. K.P. Shaji, Forest Range Officer, Adimali Forest Range Office, Koompanapara Post, Idukki. Pin - 685 651	Dr. George Mathew
26.	2008 November	Wood Sample testing	The Manager Cochin International Airport Ltd. Kochi Airport P.O. Ernakulam - 683111	Dr. K.V. Bhat
27.	2008 November	Wood Sample testing	The Manager Romko Umas Enterprises 158, Valayamadevi Road Neyveli, Tamil Nadu	Dr. K.V. Bhat
28.	2008 November	Wood Sample testing	Mr. P. Sukumaran DGM (SRM) Cochin Shipyard Limited Cochin - 682015	Dr. K.V. Bhat
29.	2008 December	Wood Sample testing	The Proprietor M/s. Eastern Treat Wood Industries Industrial Development Area Nalam Mile, Aluva - 683105	Dr. K.V. Bhat
30.	2008 December	Wood Sample testing	The Additional Chief Manager FC Division, Tranport Department NLC Limited, Neyveli -2 Cuddalore Dist. Tamil Nadu	Dr. K.V. Bhat
31.	2009 January	Wood sample testing	Mr. R. Krishna Kumar Asst. General Manager (Materials) Transformers & Electricals Kerala Ltd Angamally South P.O. Ernakulam - 683 573	Dr. K. V. Bhat

32.	2009 February	Wood sample testing	M/S Sree Poornathrayeesa Seva Samgham Thripunithura, Kochi -682 301	Dr. K. V. Bhat
33.	2009 February	Wood sample testing	Mr. D. Thilagar Joseph Assistant Commissioner (SIIB) Office of the Commissioner of Customs, Custom House, New Harbour Estate, Tuticorin - 628 004	Dr. K. V. Bhat
34.	2009 February	Wood sample testing	Mr. D. Thilagar Joseph Assistant Commissioner (SIIB) Office of the Commissioner of Customs, Custom House, New Harbour Estate Tuticorin - 628 004	Dr. K. V. Bhat
35.	2009 February	Presence of Boron preservative detected on surface of the wood	Mr. Ajith Kumar. V. Senior Engineer Hindustan Prefab Limited Govt. General Hospital Kozhikode	Dr. T. K. Dhamodaran
36.	2009 February	Wood sample testing	Manging Director Handicrafts Development Corporation of Kerala Ltd. Post Box No. 171 Regd. Ofice: Puthenchanthai Thiruvananthapuram - 695001	Dr. K. V. Bhat
37.	2009 February	Wood sample testing	Mr. Ajith Kumar. V. Senior Engineer Hindustan Prefab Limited (Govt.of India Enterprises) Govt. General Hospital Kozhikode	Dr. K. V. Bhat
38.	2009 February	Wood sample testing	Mr. P. K. Rajeev J.E. (Civil) Powergrid Corporation of India Ltd. Construction Area Office, Plot No. 49& 50 Ward No. 12, Kodhai Nagar Near KVBOA Matriculation School, Karur - 639002, Tamil Nadu	Dr. K. V. Bhat
39.	2009 March	Wood sample testing	M/S Sree Balaji Timbers 119, Meenkarai Road Zamin Uthukuli, Pollachi - 642004 Tamil Nadu	Dr. K. V. Bhat

40.	2009 March	Wood sample testing	The Additional Chief Manager Civil/Maintanance/North zone Township Administrative Office Block - 10, Neyveli - 607801 Tamil Nadu	Dr. K. V. Bhat

Exhibitions Conducted

Sl. No.	Title of the Exhibition	Period	Name of the Organization	Name of Resource Persons
1	International India trade Fare-Exhibition at Pragathi Maidan in Delhi	14 days (14.11.08-27.11.08)	Exhibition at Pragathi Maidan, Delhi	At site: Dr. K.C. Chacko Dr. K.V. Sankaran Dr. K. Mohanadas Dr. S. Sankar Preparations: Sri. K.M. Prasanth Sri. C. Krishnan Sri. V. Thatha
2	Bamboofest, Kochi	3 days (12.12.08-14.12.08)	Bamboofest, Kochi	At site: Dr. K. Mohanadas Preparations: Sri. K.M. Prasanth Sri. C. Krishnan Sri. V. Thatha
3	National Food and Agro-Biodiversity Festival (Annam)	5 days (27.12.08-31.12.08)	CISSA	At site: Dr. K. Mohanadas Preparations: Sri. K.M. Prasanth Sri. C.K. Vincent
4	Flower show	7 days (21.1.09-27.1.09)	Thrissur Agri - Horticultural Society	At site: Dr. K. Mohanadas Preparations: Sri.K.M. Prasanth Sri. C.K. Vincent
5	Science Congress	4 days (28.1.09-31.1.09)	21st Kerala Science Congress, Kollam	At site: Dr. K. Mohanadas Preparations: Sri.K.M. Prasanth

BALANCE SHEET AS AT 31ST MARCH, 2009

Kerala Forest Research Institute- Peechi

LIABILITIES	Sch	31/03/2009	31/03/2008	ASSETS	Sch	31/03/2009	31/03/2008
GENERAL FUND	I	52507475.00	52507475.00	FIXED ASSETS	V	92429180.48	84599172.04
				ADVANCE FOR CAPITAL ASSET		0.00	1600000.00
CURRENT LIABILITIES	II	16055739.00	18750567.01	CURRENT ASSETS	VI	61091825.93	35928585.03
				LOANS & ADVANCES	VII	639509.80	1015073.80
BALANCE OF EXTERNAL PROJECT	III	15387931.13	14407645.89	EXTERNALPROJECTS:			
INSTITUTE PROJECT	III	7641860.90	0.00	CURRENT ASSETS	VIII		0.00
CAPITAL RESERVE CREATED ON ACQUISITION OF FIXED ASSETS		91025676.48	83627527.98	LOANS & ADVANCES	IX		0.00
WORK IN PROGRESS RESERVE		1403504.00	2571645.00	CONSULTANCY PROJECTS:			
OTHER RESERVES & SURPLUS		390423.00	390423.00	OVERSPENT BALANCE OF CONSULTANCY PROJECTS	IV	149308.00	69890.00
				PLAN PROJECT OVER SPENT		364.00	11852364.00
				CORPUS FUND:			
				TERM DEPOSIT WITH BANK		5111744.70	5111744.70
				INCOME & EXPENDITURE	X	24990676.60	32078454.31
TOTAL		**184412609.51**	**172255283.88**	**TOTAL**		**184412609.51**	**172255283.88**

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2009

Kerala Forest Research Institute- Peechi

EXPENSES	Sch	31/03/2009 Rs. Ps.	31/03/2008 Rs. Ps.	INCOMES	Sch	31/03/2009 Rs. Ps.	31/03/2008 Rs. Ps.
Salaries & Allowances	A	32720285.00 Government	36777249.00	Grant from	F	41700000.00	38500000.00
Staff Expenses	B	6695157.00	5276264.00	Receipts from Corpus Fund			
Establishment Expenses	C	5193483.00	4387850.00	Prior Period Income			
Administrative Expenses	D	927272.00	383147.00	Other Receipts	G	12110041.71	9627311.84
General Expenses	E	1186067.00	1396894.25				
Provision for Arrears etc			0.00				
Expenses out of Plan fund	*	20463907.00	20020180.00	Proportionate amount transferred from Plan fund account towards Revenue expenditure incurred out of Plan fund	*	20463907.00	20020180.00
Revenue expenses for External Projects	**	18429056.86	17523160.95	Proportionate amount transferred from External projects Grant received Account towards Revenue expenditure incurred for External project	**	18429056.86	17523160.95
Depreciation w/off.	***	11750230.12	11438116.92	Proportionate amount transferred from Capital Reserve Account towards depreciation w/off. In the Income & Expenditure Account	***	11750230.12	11438116.92
Excess of Income Over Expenditure			7087777.71	Excess of Expenditure over Income			94092.41
TOTAL		**104453235.69**	**97202862.12**	**TOTAL**		**104453235.69**	**97202862.12**

INTERNAL COMMITTEES

To implement various programmes and activities in the Institute the following Committees have been constituted which have been functional during the period.

1. CONSULTATIVE GROUP FOR FORESTRY RESEARCH MANAGEMENT (PROGRAMME ADVISORY GROUP)

(vide Council (M) Order No. 45/2003/KSCSTE dated, Thiruvananthapuram, 12-11-2003 & Council (M) Order No.104/06/KSCSTE dated, Thiruvananthapuram, 15-3-2006)

1.	The Principal Chief Conservator of Forests	..	Chairman
2.	The Additional Principal Chief Conservator of Forests	..	Member
3.	The Chief Conservator of Forests (Planning & Research)	..	..
4.	The Chief Conservator of Forests (Wildlife)	..	..
5.	The Chief Conservator of Forests (Tribal Welfare & Economic Development)	..	..
6.	The Chief Conservator of Forests (World Bank Projects)	..	..
7.	The Chief Conservator of Forests (Development)	..	..
8.	The Chief Conservator of Forests (Protection)	..	..
9.	The Chief Conservator of Forests (FMIS)	..	..
10.	The Chief Conservator of Forests (HRD)	..	..
11.	The Chief Conservator of Forests (Administration)	..	..
12.	The Chief Conservator of Forests(Vigilance)	..	..
13.	The Chief Conservator of Forests (Social Forestry)	..	..
14.	The Regional Chief Conservator of Forests (North)	..	..
15.	The Regional Chief Conservator of Forests (South)	..	..
16.	The Conservator of Forests (Biodiversity)	..	..
17.	The Conservator of Forests (Working Plan & Research)	..	..
18.	The Deputy Conservator of Forests (Research) North	..	..
19.	The Deputy Conservator of Forests (Research) South	..	..
20.	The Managing Director, Kerala Forest Development Corporation	..	..
21.	The Associate Dean, Forestry Faculty, Kerala Agricultural Univ.	..	..
22.	The Director, Tropical Botanic Garden & Research Institute, Palode	..	..
23.	The Director, Institute of Forest Genetics & Tree Breeding, Coimbatore	..	..
24.	The Managing Director, Oushadi, Thrissur	..	..
25.	The Director, Centre for Earth Science Studies, Thiruvananthapuram	..	..
26.	The Director, Centre for Water Resources Development & Management	..	
27.	The Director, Rajiv Gandhi Centre for Biotechnology	..	..
28.	`URAVU' Wynad (N.G.O.)	..	..
29.	The Director, Medicinal Plant Research Centre, Arya Vaidya Sala Kottakkal	..	..
30.	The Managing Director, Hindustan Newsprint Ltd., Kottayam	..	..
31.	The Managing Director, Kerala State Wood Industries Ltd., Nilambur	..	
32.	The Managing Director, Kerala State Bamboo Corporation Ltd.	..	..
33.	The Director, Salim Ali Centre for Ornithology and Natural History Coimbatore	..	..

34.	Director, Kerala Forest Research Institute, Peechi	..	..
35.	Research Co-ordinator, Kerala Forest Research Institute, Peechi	..	..
36.	Programme Co-ordinator, Training & Extension Division, KFRI	..	Convenor

2. PURCHASE COMMITTEE

(vide Council (M) Order No. 37/2003/KSCSTE Thiruvananthapuram, Dated, 29-10-2003)

One Scientist F or above:	Dr. Jose Kallarackal	..	Chairperson
One Scientist nominated by the Director	Dr. K.C. Chacko	..	Member
Registrar		..	Convenor

3. BUSINESS DEVELOPMENT GROUP

Director	..	Chairperson
Dr. VV Sudheendrakumar	..	Working Chairperson
Dr. RC Pandalai	..	Member
Dr. Thomas P Thomas	..	Convenor

4. COMMITTEE TO PREVENT SEXUAL HARASSMENT ON WOMEN AT KFRI

(Vide KSCSTE letter No.1763/B6/03/KSCSTE dated 5-12-2003)

Dr. EP Indira, Scientist, KFRI	..	Chairperson
Dr. KK Seethalakshmi, Scientist, KFRI	..	Member
Smt. KN Rajamma, Senior Section Officer, KFRI	..	..
Dr. George Mathew, Scientist, KFRI	..	..
Dr. PK Muraleedharan, Scientist, KFRI	..	..
Smt. Seetha Sadanandan, C/o Kudumbasree State Poverty Eradication Mission Ward 16, Cheenikkadavu, Kannara Panancherry Panchayath, Trichur Dist.	..	..
Smt. VK Leela, Senior Section Officer, KFRI	..	Member Convenor

5. INTERNAL RESEARCH GROUP (IRG)

Director	..	Chairperson
Dr. K. Swarupanandan	..	Convenor
Dr. V Anitha	..	Associate Convenor
All scientific staff	..	Members

6. FOREST SEED CENTRE ADVISORY COMMITTEE

Director	..	Chairperson
Conservator of Forests (WP & R), KFD	..	Member
Conservator of Forests (Central Circle), KFD	..	..
Research Coordinator, KFRI	..	..
Silvicultural Research Officer (North), KFD	..	..
Silvicultural Research Officer (South), KFD	..	..
Silviculturist, KFRI	..	..
Scientist-in-Charge, FSC	..	Convenor

7. TEAK MUSEUM & NATURE TRAIL ADVISORY COMMITTEE

Dr. C Renuka	..	Chairperson
Dr. TV Sajeev	..	Member
Scientist-in-Charge, KFRI Sub Centre, Nilambur	..	"
Smt. Sani Lookose, Teak Museum Curator	..	Convenor

8. LIBRARY & INFORMATION NETWORKING ADVISORY COMMITTEE

Smt. N Sarojam	..	Chairperson
Dr. M Balasundaran	..	Member
Dr. EP Indira	..	..
Dr. CN Krishnankutty	..	..
Shri AR Rajan	..	..
Dr. Mammen Chundamannil	..	Convenor

9. Ph.D. PROGRAMME AND M.Sc. STUDENTS ATTACHMENT ADVISORY COMMITTEE

Dr. EA Jayson	..	Chairperson
Dr. M Balasundaran	..	Associate Chairperson
Dr. EM Muralidharan	..	Member
Dr. ARR Menon	..	Member
Dr. George Mathew	..	Convenor
Invitee(s)	..	Respective guide(s)

10. INTELLECTUAL PROPERTY RIGHTS, PATENT AND MATERIAL TRANSFER COMMITTEE

Dr. KM Bhat	..	Chairperson
Dr. EM Muralidharan	..	Member
Dr. MP Sujatha	..	..
Dr. V Anitha	..	..
Dr. VV Sudheendrakumar	..	Convenor

11. PROJECT EVALUATION AND MONITORING COMMITTEE

Dr. VV Sudheendrakumar	..	Chairperson
Dr. RC Pandalai	..	Member
Dr. M Sivaram	..	..
Dr. EM Muralidharan	..	Convenor

12. EQUIPMENT/INFRASTRUCTURE DEVELOPMENT COMMITTEE

Dr. C. Mohanan	..	Chairperson
Dr. M. Balagopalan	..	Member
Dr. P. Vijayakumaran Nair	..	..
Dr. EM Muralidharan	..	..
Dy. Registrar (Admn)	..	Convenor
Shri PA Sulaiman	..	Invitee

13. SEMINAR COMMITTEE

Dr. PK Muraleedharan	..	Chairperson
Dr. EJ Maria Florence	..	Member
Dr. T. Surendran	..	Convenor

14. NEWSLETTER COMMITTEE

Dr. Muktesh Kumar	..	Editor
Dr. K.V Bhat	..	Associate Editor
Dr. P. Rugmini	..	..
Shri KH Hussain	..	..

15. ANNUAL REPORT COMMITTEE

Dr. KV Bhat	..	Chairperson
Dr. TK Dhamodaran	..	Member
Shri Sathisa Kumar, Dy. Registrar (F)	..	..
Dr. CK Soman	..	Convenor

16. CAMPUS DEVELOPMENT COMMITTEE

Dr. UN Nandakumar	..	Chairperson
Smt. VK Leela	..	Member
Dr. UM Chandrashekhara	..	..
Shri D. Skariah	..	..
Dr. KV Mohammed Kunhi	..	..
Shri PK Thulasidas	..	Convenor

17. GARDEN COMMITTEE

Dr. N. Sasidharan	..	Chairperson
Mr. PK Chandrasekhara Pillai	..	Associate Chairperson
Dr. Thomas P.Thomas	..	Convenor

18. SPORTS COMMITTEE

Dr. K Mohanadas	..	Convenor
Dr. T. Surendran	..	Member
Shri VP Ravindran	..	..
Shri PA Sulaiman	..	..

19. CAFETARIA COMMITTEE

Dr. KK Ramachandran	..	Chairperson
Shri K. Venugopalan, Dy. Registrar (A)	..	Member
Smt. Sabitha Balakrishnan	..	..
Shri James Tidode	..	Convenor

20. STORES COMMITTEE

Dr. KK Seethalakshmi	..	Chairperson
Dr. N. Sasidharan	..	Member
Dr. M. Sivaram	..	..
Shri V. Asokan	..	Convenor

21. WEBSITE COMMITTEE

Director	..	Chairperson
Dr. Jose Kallarackal	..	Working Chairman
Registrar	..	Member
Dr. KC Chacko	..	..
Dr. KV Bhat	..	..
Shri AR Rajan	..	Convenor

LIST OF STAFF

There were 57 Scientific, 8 Technical and 68 Administrative Staff in the Institute. Apart from this, there are persons working on contract basis, project staff working for different research projects and security staff on contract basis.

Scientific Staff

Dr. K.V. Sankaran, Director

No.	Name	Designation	Date of joining
1	Dr. K.V. Sankaran	Scientist -G	21-05-1982
2	Dr. R. Gnanaharan, Ex-Director (on leave)	Scientist -G	14-09-1979
Research Monitoring & Evaluation Unit			
3	Dr. C.K. Soman	Scientist -B	06-12-1978
Sustainable Natural and Plantation Forest Management			
4	Dr. Jose Kallarackal, Programme Coordinator	Scientist -F	14-12-1987
5	Dr. M. Balasundaran, Scientist I/C(F), Biotechnoloy	Scientist -EII	12-04-1979
6	Dr. E.P. Indira, Scientist I/C(F), Genetics and Tree Breeding	Scientist -EII	28-02-1979
7	Dr. K.K. Seethalakshmi, Scientist I/C(F), Tree Physiology	Scientist -EII	13-09-1979
8	Dr. T. Surendran	Scientist -EII	30-07-1979
9	Dr. R. C. Pandalai, Scientist I/C(F), Silviculture	Scientist -EI	14-03-1983
10	Dr. U.N. Nandakumar	Scientist -EI	23-03-1983
11	Dr. E.M. Muralidharan	Scientist -EI	27-05-1991
12	Dr. M.P. Sujatha	Scientist -EI	11-12-1987
13	Dr. S. Kumaraswamy	Scientist-B	28-09-1998
14	Shri P.K.Chandrasekhara Pillai	SSA	18-10-1983
Instrumentation			
15	Dr. M. Balagopalan, Programme Coordinator Scientist I/C(F), Soil Science	Scientist -EII	14-03-1978
Forest Ecology and Biodiversity Conservation			
16	Dr. Renuka, C, Programme Coordinator	Scientist -EII	10-06-1977
17	Dr. K.K.N. Nair, Scientist I/C(F), Forest Botany	Scientist -EII	26-08-1982
18	Dr. P. S. Easa	Scientist -EII	16-08-1978

19	Dr. K.K. Ramachandran, Scientist I/C(F), Wildlife	Scientist -EII	17-08-1978
20	Dr. M.S. Mukteshkumar	Scientist -EII	18-09-1980
21	Dr. E.A. Jayson	Scientist -EII	16-12-1981
22	Dr. K. Swarupanandan, Scientist I/C(F), Forest Ecology and Conservation	Scientist -EI	20-07-1979
23	Dr. U.M. Chandrashekara, Scientist I/C, Nilambur Sub Centre	Scientist -EI	15-07-1992
24	Shri P. Padmanabhan	Scientist -B	07-02-1979
25	Dr. K. Yesodharan	Scientist -B	18-04-1980
26	Shri. K.K. Unni	SSA	11-12-1978
Forest Protection			
27	Dr. George Mathew, Programme Coordinator, Forest Protection	Scientist -EII	08-07-1977
28	Dr. C. Mohanan, Scientist I/C(F), Forest Pathology	Scientist -EII	16-05-1979
29	Dr. V.V. Sudheendrakumar I/C(F), Forest Entomology	Scientist -EII	19-02-1979
30	Dr. K. Mohanadas	Scientist -EI	01-06-1982
31	Dr. T.V. Sajeev	Scientist -C	06-02-1997
Forest Utilization			
32	Dr. K. Mahabala Bhat, Programme Coordinator	Scientist -F	12-01-1979
33	Dr. N. Sasidharan, Scientist I/C(F), NWFP	Scientist -EII	25-02-1977
34	Dr. T.K. Dhamodaran	Scientist -EI	02-08-1982
35	Dr. K.V. Bhat, Scientist I/C(F), Wood Science and Technology	Scientist -EI	31-05-1982
36	Shri P.K. Thulasidas	SSA	28-06-1984
Forestry and Human Dimensions			
37	Dr. P.K. Muraleedharan, Programme Coordinator (In-Charge)	Scientist -EII	24-05-1982
38	Dr. S. Sankar	Scientist -F	19-09-1981
39	Dr. C. N. Krishnankutty	Scientist -EII	24-09-1981
40	Dr. Mammen Chundamannil	Scientist -EI	29-05-1982
41	Dr. V. Anitha	Scientist -B	07-09-1998
Forest Information Management System			
42	Dr. K. Jayaraman, Programme Coordinator	Scientist -F	02-05-1984
43	Smt. P. Rugmini	Scientist -EII	17-11-1978
44	Dr. P. Vijayakumaran Nair, Scientist I/C(F), GIS	Scientist -EII	01-11-1980
45	Dr. A.R. R. Menon, Scientist I/C(F),Remote Sensing	Scientist -EII	19-09-1979
46	Dr. M. Sivaram	Scientist -B	04-12-1998

Extension and Training			
47	Shri K.C. Chacko, Programme Coordinator	Scientist -F	22-09-1977
48	Dr. Thomas P. Thomas	Scientist -EII	31-12-1979
49	Dr. E.J. Maria Florence	Scientist -EII	22-09-1980
50	Dr. K.V. Mohammed Kunhi	Scientist -B	24-10-1994
51	Smt. Sani Lookose, Curator, Teak Museum	Scientist -B	07-08-2002
52	Shri V.P. Raveendran	SSA	25-02-1993
Library and Information			
53	Shri K. Sankara Pillai, Librarian,		
Programme Coordinator (In-Charge)		Scientist -C	05-07-1980
54	Shri A.R. Rajan, Scientist I/C(F), LAN	Scientist -EI	01-12-1978
55	Smt. N. Sarojam, Asst. Librarian	Scientist -B	06-07-1981
56	Shri K.H. Hussain	SSA	28-12-1981
57	Shri. K.F. George	SSA	23-12-1994

Technical staff

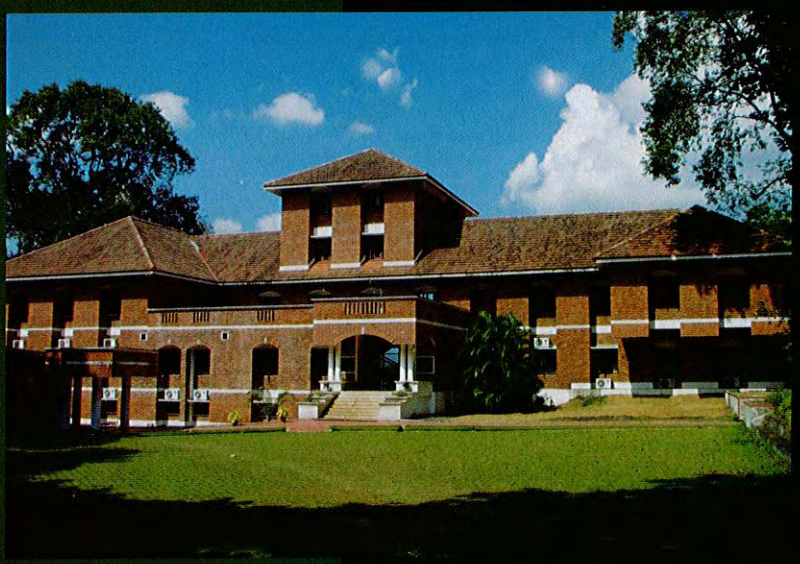
1.	Shri. P.P. Sunny	Sr. Spl. Grade Technical Officer	23-04-1979
2.	Shri. U.Y. John	Spl. Grade Technical Officer	09-01-1981
3.	Shri. C.A. Jose	Sr. Spl. Grade Technical Assistant	07-05-1982
4.	Shri. D. Skariah	Spl. Grade Technical Assistant	01-09-1983
5.	Shri. K.C Subramanian	Spl. Grade Technical Assistant	22-07-1985
6.	Shri. K.M. Velayudhan	Spl. Grade Technical Assistant	10-03-1986
7.	Shri. M.R. Anilkumar	Spl. Grade Technical Assistant	30-01-1989
8.	Shri. P.B. Sajeeva Rao	Spl. Grade Technical Assistant	30-01-1989

Administrative staff

1.	Shri. K. Thulaseedharan Nair	Registrar (on deputation leave)	15-03-2002
2.	Dr. C.M. Joy	Registrar	On deputation
3.	Shri. P. Achuthankutty	PS to Director	03-01-1983
4.	Smt. V.K. Leela	Sr. Section Officer	02-07-1979
5.	Smt. K.N. Rajamma	Sr. Section Officer	02-07-1979
6.	Shri. M. Achuthan kutty	Internal Auditor	On deputation
7.	Shri. A. Ramakrishnan	PA to Registrar	16-11-1977

8.	Shri. M.S. Sukumaran	Section Officer	09-01-1980
9.	Sri. V. Asokan	Sr. Office Superintendent	16-10-1976
10.	Smt. K.M. Suseela	Sr. Assistant Office Manager	18-04-1980
11.	Shri. K. Rajendran	Assistant Office Manager	01-07-1986
12.	Shri. P.A. Sulaiman	Assistant Office Manager	12-08-2003
13.	Shri. K.A. Gopalan	Assistant Office Manager	20-05-1987
14.	Smt. Mary Kuruvilla	Sr. Assistant Office Manager	07-07-1980
15.	Smt. Sabitha Balakrishnan	Office Assistant	03-09-1999
16.	Smt. Shirly Issac	Office Assistant	26-08-2003
17.	Smt. K. Annapoorni	PA to Research Coordinator	12-07-1982
18.	Smt. Grace Andrews	Spl. Grade Confidential Assistant	27-01-1987
19.	Shri. P.M. Venugopalan	Spl. Grade Typist	22-05-1978
20.	Shri. E.O. James Tidode	Spl. Grade Typist	31-01-1979
21.	Shri. K.P. Manoj	Sr. Typist	28-08-1992
22.	Shri. T.M. Abdul Vahab	Sr. Word Processing Assistant	27-01-1989
23.	Shri. K.S. Karunakaran	Sr. Clerical Assistant	01-12-1978
24.	Shri. T. Prabhakaran	Sr. Clerical Assistant	23-10-1976
25.	Shri. T. Chandran	Sr. Spl. Grade Driver	19-10-1976
26.	Shri. P.I. Madhavan	Sr. Spl. Grade Driver	22-10-1976
27.	Shri. K. Girijavallabhan	Sr. Spl. Grade Driver	22-03-1977
28.	Shri. S. Shahul Hameed	Sr. Spl. Grade Driver	06-06-1977
29.	Shri. P. Mohandas	Spl. Grade Driver	06-08-1979
30.	Shri. T.C. Paul	Senior Driver	01-07-1994
31.	Shri. V.C. Chandran	Senior Driver	01-07-1994
32.	Shri. K.M. Mathen	Driver	31-03-2001
33.	Shri. M.C. Mohandas	Sr. Attendant	24-10-1977
34.	Shri. P.A. Sankarankutty	Sr. Attendant	30-01-1978
35.	Shri. K.R. George	Sr. Attendant	18-07-1978
36.	Shri. K.R. Sevaraman	Sr. Office Messenger	22-01-1979
37.	Shri. A.V. Velayudhan	Sr. Attendant	13-06-1979
38.	Shri. K.K. Ahammad	Sr. Attendant	02-08-1979
39.	Shri. P.S. Raman	Sr. Attendant	02-04-1980
40.	Shri. M.C. Reghunathan	Sr. Attendant	08-04-1980

41.	Shri. V.N. Balakrishnan	Attendant	24-07-1981
42.	Shri. K.C. Subramanian	Attender	06-10-1982
43.	Smt. N. Baby	Attender	24-11-1995
44.	Shri. A.C. Antony	Sr. Attender	10-11-1982
45.	Smt.Ricy Eliner Varkey	Computer LAN Assistant	02-03-2006
46.	Smt. K.K. Vanaja	Helper	26-08-2003
47.	Miss.K. Aparna	Helper	23-8-2004
48.	Shri. P. Rajeesh	Helper	14-06-2000
49.	Shri. K. Syed Mohammed	Spl. Grade Watcher	24-07-1985
50.	Shri. K. Nanu	Spl. Grade Watcher	12-06-1986
51.	Shri. T.P. Padmanabhan	Sr. Cook	06-01-1981
52.	Shri. K. Mohanan	Sr. Ticket Vendor	09-11-1981
53.	Shri. C.K. Vincent	Sr. Gardener	17-12-1991
54.	Smt. A.M. Lalitha	Sr. Helper	01-08-1986
55.	Smt. T.G. Chandrika	Sr. Helper	01-03-1988
56.	Shri. V.K. Mohandas	Sr. Helper	01-01-1992
57.	Shri. N.I. Thankappan	Sr. Helper	01-01-1992
58.	Shri. E.P. Ulahannan	Sr. Helper	01-01-1992
59.	Smt. A.K. Ammini	Helper	03-01-1986
60.	Smt. E.V. Thanka	Helper	03-11-1986
61.	Smt. K.V. Bharathy	Helper	03-11-1986
62.	Shri. C.J. John	Sr. Helper	01-08-1986
63.	Shri. V. Mohammed Ali	Sr. Helper	01-08-1986
64.	Shri. P. Mohammed	Sr. Helper	01-08-1986
65.	Shri. C.P. Shoukathali	Sr. Helper	01-03-1986
66.	Shri. K. Mohammed	Sr. Helper	01-01-1992
67.	Shri. K.K. Mohammed	Helper	05-07-1994
68.	Shri. N.K. Rajan	Nursery man	31-07-2007



Kerala Forest Research Institute

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Peechi – 680 653, Thrissur Dt., Kerala