# ANNUAL REPORT 2011-'12

Kerala Forest Research Institute

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## Kerala Forest Research Institute

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

Peechi – 680 653, Thrissur, Kerala

**Cover page Pictures**

**Front Cover**

*Raorchestes akroparallagi* (Contributed by Mr. Sandeep Das)

**Back cover**

"Tree Goddess" – A sculpture at Teak Museum, KFRI-Nilambur campus

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# DIRECTOR'S REPORT

The United Nations General Assembly declared 2011 as the International Year of Forests to raise public awareness of the challenges faced by world's forests and the people who depend on them. The logo of Forests 2011 expresses the theme of "Forests for People" acclaiming the pivotal role of people in sustainable management, conservation, and development of forests. All populaces on this planet have their physical, economic and spiritual health entwined to the health of forests as it plays a vital role in preserving a stable global climate and environment. This year's theme of "Forests for People" not only highlights our relationship with forests and humanity's role in ensuring their well-being and development but also serves as a catalyst in bringing those stimuli together and building impetus towards greater public partaking in forestry accomplishments around the world. From international policy changes to school and community projects, this year has seen an exceptional level of attention consigned on our forests, and the challenges facing them.

Natural forests worldwide are being negatively affected increasingly by precipitously growing land-duse change. The escalation in agricultural expansion, infrastructure development, timber extraction, climate change, fire and alien invasive species are taking their toll on the health of natural forests. This situation is aggravated by the lack of social and institutional arrangements and weak, ineffective policies. Market fiascos, corruption, population pressure and poverty only aggravate the problem. Undervaluation and undermining the value of forests due to its limited market exchange often leads to inadequate allocation of funds to the forestry sector. Acceptance of ecological services of forests like availability of fresh air, hydrological values, flood control, soil conservation, carbon sequestration, climate stabilization, biodiversity conservation and overall environment enrichment, eco-tourism among others are recent outcome of the sustained awareness and mass communication efforts of the past few decades.

As more and more scientific information on global warming accumulates, climate change is emerging as perhaps the greatest environmental challenge of the twenty-first century. The world's forests have a major role to play in the transition to a new, greener economy. In recent years, estimates for deforestation and forest degradation were shown to account for 20-25 per cent of greenhouse gas emissions, higher than the transportation sector. Forests have the ability to absorb about one-tenth of global carbon discharges projected for the first half of this century into their biomass, soils and products and store them. Reducing Emissions from Deforestation and Forest Degradation (REDD) is a set of steps designed to use market/financial incentives in order to reduce the emissions of greenhouse gases from deforestation and forest degradation.

Sustainable management of forests propounds multiple benefits and if managed with the right programs and policies, the sector can lead the way towards more sustainable, greener economies. State control and ownership of forests has been the norm ever since the advent of traditional forest laws. However, reforms are evolving in quite a few countries with the handing over responsibility for forest management to local authorities and communities. New laws have been enacted to give local people official tenure rights over their forest resources. These reforms are broadening, although slowly, and providing valuable lessons for other countries to emulate. In a new report, The State of the World's Forests 2012 (SOFO 2012), the UN Food and Agriculture Organization makes the case that better and more sustainable use of forestry resources can make a significant contribution to meeting many of the core challenges, including reducing poverty and hunger, minimizing the impacts of climate change, and creating alternative and more sustainable sources of bio-products and bio-energy for human use.

KFRI too has played its share by striving to influence, encourage and assist societies throughout the world to conserve biological diversity in forests and tree-dominated landscapes and ensure that the use of forest resources is equitable and ecologically sustainable.

**Dr. K.V. Sankaran**
Director

# THE INSTITUTE

The origin of Kerala Forest Research Institute (KFRI) dates back to over three decades. The Institute was established in 1975 by the Government of Kerala as an autonomous organization under the Travancore-Cochin Literary, Scientific and Charitable Societies Act (1955). With the formation of Kerala State Council for Science Technology and Environment (KSCSTE) in 2003, the Institute was brought under the Council along with other Science and Technology institutions of the State. KFRI is one of the leading forestry research institute dedicated to tropical forestry. The Institute has been instrumental in developing solutions to diverse problems faced in tropical forestry and these findings have helped in evolving strategies for conservation and sustainable use of forest resources of the State.

## Campus

### Peechi

The main campus of KFRI is located in Central Kerala at Peechi, about 20 km east of Thrissur City in a 28 hectare (ha) Reserve Forest area adjacent to Peechi-Vazhani Wildlife Sanctuary. Various research Divisions and adjoining facilities are housed within the main campus.

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.

## Vision

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.

## Mission

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, socioeconomics, indigenous knowledge, value addition of forest products, participatory forest management and livelihood improvement of forest dwellers by scientific management of for est 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 190 which include 49 scientists, 57 administrative staff and 9 technical staff. In addition, 75 project personnel attached to various research projects provide the necessary research support.

A Management Committee (MC) chaired by the Institute's Director oversees the administration and management of KFRI. The Committee approves and manages both administrative and financial matters. The Research Council (RC) is another vital body responsible for overseeing and guiding the

formulation and implementation of various research programmes. The Research Council is composed of eminent scientists in forestry research in the Country. The RC also monitors the quality and content of research undertaken by the Institute and provides guidance for improvement.

The routine administration of the Institute is looked after by the Director in accordance with the decisions of the Management Committee. An Administrative Section and an Accounts Section coordinated 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 effective implementation of multidisciplinary research in forestry and to disseminate the research findings to the stakeholders. Each Division is headed by a Programme Coordinator and each Department, by a Head. Besides the Divisions, there is a Central Instrumentation Unit as a common facility. A Research Monitoring and Evaluation (RME) Unit is also functioning to facilitate monitor and evaluate research in various Divisions.

# Research Divisions

## Sustainable Forest Management

The Division consists of Tree Physiology, Silviculture and Soil Science Departments. The main areas of research of the Division are: seed technology, 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, raising green belts in coastal areas, control of riverbank erosion by planting, evaluation of factors affecting plantation productivity, soil nutrient management for important forestry species, composting technology for soil amelioration, and environmental physiology, especially water use, photosynthesis and microclimate. Monitoring weather parameters is also being undertaken by the Division.

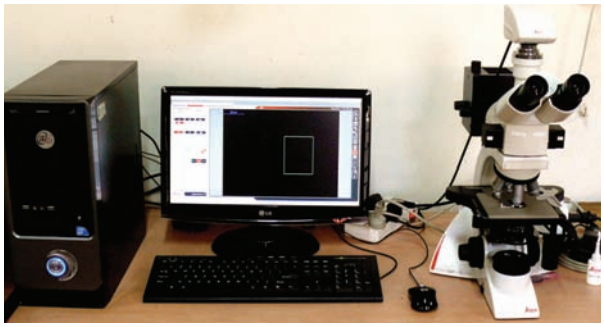
## Forest Genetics and Biotechnology

Departments of Genetics and Tree Breeding, and Biotechnology are the components of the Division. The main research activities of the Division are in the fields of 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 also been some aspects of research in the Division. Tissue culture of important forestry species and medicinal plants and low cost micro-propagation technology are other activities undertaken in the Division.

## Forest Management Information System

The information needs of the stakeholders of forestry sector are met by the Division of Forest Management Information System using modern tools of statistics, Geographic Information System (GIS) and remote sensing. Creation of databases 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 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



Departments of Forest Ecology, Botany, Wildlife and Non-Timber Forest Products (NTFP) constitute the Division. The thrust areas of research of the Division are ecosystem and landscape analysis, rehabilitation and restoration, population ecology, 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 Department deals with inventorisation of fauna, endangered animals, man-wildlife interaction and wildlife census. Nursery and plantation technology of selected indigenous timber species, phytochemical analysis of medicinal plants, ethno-biological studies and cultivation of medicinal plants and other NTFPs such as bamboos and rattans, are other activities of the Division.

## Wood Science and Technology

The Division undertakes research and extension activities related to wood structure, properties and utilization, and evolves processing technology for timber and has facilities like wood preservation plant, drying kiln and instruments like Universal Testing Machine (UTM), image analyzer, NIR spectroscope, among others. 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 on bamboos, reeds and canes have been undertaken.

## Forestry and Human Dimensions

The Division consists of Forest Economics and Sociology Departments. The main areas of research in this Division are: livelihood and recreation, environmental conservation, natural/forest resource management, economic valuation, sustainable utilization of non-timber forest products, policy issues and strategic planning. Other areas are 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 achievements of the Division.

## Forest Health

Forest Entomology and Forest Pathology are the two Departments under this Division. The main areas of research include 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. Ecofriendly technologies are being developed to manage the pests, diseases and weeds in forest plantations, 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, among others. The mass production technology of the biopesticide 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.

## Library and Information

KFRI 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. The Institute being a member of international bodies like APAFRI, IRGWP, IUCN and IUFRO, has the privilege of accessing publications from these organizations. More than 90 journals including 30 foreign journals are subscribed by the library. Online Public Access Catalogue of books and back volumes is available. In addition, the library provides 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.

# Facilities

KFRI houses different International, National networks and State level facilities at our Peechi campus.

## 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, KFRI. 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.

## Bamboo Technical Support Group

The Bamboo Technical Support Group –South Zone which is hosted by KFRI is one of three such groups set up in the country to support the National Bamboo Mission (Ministry of Agriculture and Co-operation) in its mission of bringing integrated development of the bamboo sector. The BTSG- South Zone caters to the requirements of the six states in the South of India viz., Kerala, Karnataka, Tamil nadu, Andhra Pradesh, Goa and Maharashtra. The most popular of BTSG – South activities has been the various training programmes that were organized in the past few years. Field functionaries and farmers involved in cultivation and utilization of bamboo have been imparted training that covers different aspects of the diversity of bamboo species, their biology, diverse range of uses it is put to, the methods of propagation, establishment and management of plantations, harvesting and utilization. The faculty is drawn mostly from the scientists from various disciplines of KFRI which has been in the forefront of research in bamboo for the past three decades.

## 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 are 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.

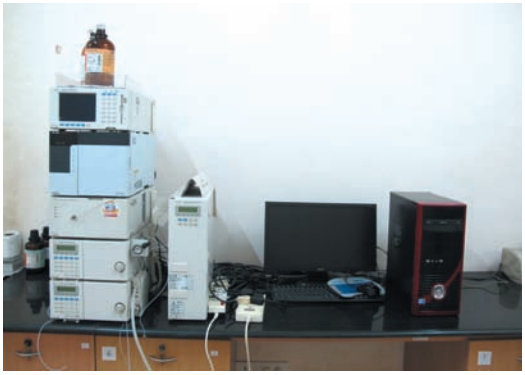
## Kerala Forest Seed Centre

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, testing 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 im-

portant 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.

## The Central Instrumentation Unit

Gas Chromatograph - Mass spectrometer



High-performance liquid Chromatography

The CIU was set up to facilitate access to sophisticated analytical instruments by researchers in KFRI. The major instruments in CIU are Shimadzu SCL-10Avp High Performance Liquid chromatograph (HPLC) Fluorescence/ PDA detectors) and solvent recycler, Shimadzu Gas Chromatograph (GC) Model: GC 17A with FID and TCD detectors, Shimadzu QP2010 GC MS, Eurovector CHNS Elemental Analyzer ( Model: EA 3000), Skalar San++ Auto Analyzer, BWB Technologies Model BWB-1 Flame Photometer, XPLORER XP 2001 UV-VIS Spectrophotometer, Shimadzu Micro analytical Balance, Ankersmid Particle Size Analyser, ACE Soil $CO_2$ Exchange System, The CIU also has a sample preparation lab and other instruments like Muffle Furnace, Precision water bath, Analytical balance, rotary shaker, ultrapure water systems, Sound level meter among others. The CIU also offers the facilities to researchers from other organizations on payment.

# RESEARCH AND EXTENSION PROGRAMMES

## I. Completed Research Projects

### Enriching live collections of wild orchids and ferns of Kerala and preparation of a manual. *KFRI Research Report No. 381* (MS Mukteshkumar. 2011)

Conservation of endangered species, both *in situ* and *ex situ* preservations, are important. The in situ conservations, as in National Parks and Bioreserves, provide natural protection and intact environment, the ex situ conservation as in the green houses and botanical gardens can give material for closer observations and detailed studies, both for academic purposes and economic utilization. Considering the rapid decline in the natural resources there is urgent need to conserve and manage the existing rare and endangered species for posterity. To facilitate education for the students, teachers, researchers and even the common man to know the diversity of pteridophytes and orchids this project was taken up with the objectives to enrich the live collections of ferns and orchids maintained in the pteridophyte/orchid house at KFRI campus. From among the useful pteridophytes collected, 66 species known to be highly useful have been included in this manual in order to highlight the importance of pteridophytes and their medicinal value and to create awareness among the public for conservation of this beautiful group of plants. Each species is dealt with a short description, distribution, medicinal uses, parts used, chemical constituents and other known uses from India and elsewhere have been compiled for the manual.

### Establishment of Bio-resources Nature Trial at Nilambur in the Kerala part of Western Ghats. *KFRI Research Report No. 385* (UM Chandrasekara. 2011)

The Kerala Forest Research Institute has developed about 10 ha of land into a Bio-resources Nature Park at its Sub Centre at Nilambur. The Bioresources Nature Park has conservation themes for the lower groups of plants such as, algae, bryophytes and pteridophytes, plants found in specialized ecological niche such as xerophytes (cacti and succulents) and hydrophytes (aquatic plants), beneficial plants (eg. medicinal plants) and ornamental plants (eg. orchids), with special reference to endemic and rare, endangered and threatened (RET) species. The specific aim of the project was to improve facilities in different theme areas like Fern House and Bryophyte House, to collect plant propagules of endangered and endemic ferns, bryophytes and angiosperms and to assemble them in appropriate theme area in the Bio resources Nature Trail, thereby help in increasing public awareness of the value of biodiversity conservation needs. Emphasis has also been given to collect plant propagules of endangered and endemic ferns, bryophytes and angiosperms and assemble them in appropriate theme area in the Bio resources Nature Trail. Twenty-one rare and endemic bryophyte species, forty-eight fern species (twenty-five rare and twenty-three common species) and seventeen angiosperm species belonging to different conservation status have been planted in the Bio-resources nature Trail.

### Pink disease in Teak plantations in Kerala and its management. *KFRI Research Report No. 386* (C Mohanan. 2011)

Young teak plantations in the State are affected by pink disease caused by *Erythricium salmonicolor* and often outbreak of disease occurs resulting in heavy damage to the stands. Different Forest Circles of the State. A total of 26 teak plantations of the age group 2- to 7-years-old were selected in the Central, Southern and Northern Forest Circles of the State undertaken to assess the disease situa-

Teak tree with Pink disease

tion in young teak plantations and to work out possible disease management measures. The disease survey revealed that pink disease occurs in all the 26 teak plantations selected for the study, however, incidence rate and severity vary depending upon the rainfall and microclimatic conditions, especially relative humidity in the site and age of the plantations. Mean disease incidence in this plantation was 65 per cent and mean disease severity index (dsi) was 0.78. High rainfall together with persistence of very high atmospheric humidity for a long period in the teak stands; possible high genetic variability and coexistence of genetically different strains of pathogen in the same locality are possible factors for high incidence, development, and fast spread of the disease. Presence of large stretches of plantations of *Hevea brasiliensis, Acacia mangium, A. auriculiformis or Eucalyptus tereticornis* on the peripheral areas of teak stands possibly influences the microclimate, especially the relative humidity of the area. As these plantation species are potential hosts of *Erythricium salmonicolor,* there is also possibility of existence of genetically different strains of pathogen and also build up of inoculum potential of the pathogen. Presence of heavy weeds and undergrowths in the teak stands further contributes in maintaining the conducive environment for the growth and development of the pink disease pathogen.Results of laboratory screening of fungicides showed that both the systemic fungicides, Calixin 80 EC (Tridemorph) @ 0.01 % a.i. and Contaf 5 EC (Hexaconazole) @ 0.001 % a.i. are highly effective in arresting the colony growth of *E. salmonicolor.* The contact fungicide Fytran (Copper oxychloride) was also effective @ 0.3% a.i. For managing the pink disease in plantation, application of Calixin @ 0.1% a.i. or Contaf@ 0.001 % a.i. as spray on main stem will be effective. However, to avoid or reduce the incidence of pink disease in young teak plantations, the scheduled silvicultural operations including weeding have to be carried out timely and promptly.

Teak plantation affected with Pink disease

Moreover, for achieving best result on disease management in teak plantation, more information on the genetic variability of pink disease pathogen and disease etiology is warranted.

## Bamboos of Andaman & Nicobar Islands (Part I). *KFRI Research Report No. 387* (MS Mukteshkumar. 2011)

Andaman & Nicobar islands are the largerst archipelago system consisting of 306 islands, over 300 islets and constitute one of the hotspot of biodiversity. There are 3,552 plant species known from these islands. There is high degree of endemism in these islands. In Andaman & Nicobar islands only 8 species belonging to 5 genera are known to occur. Five species viz. *Dinochloa nicobariana, Pseudobambusa kurzii, Schizostachyum andamanicum, S. kalpongianum,* and *S. rogersii* are endemic to these islands. Recent report on the occurrence of *Dendrocalamus calostachys, Schizostachyum dulloa* and *S. polymorphum* from the wild is to be re- examined. Probably the said species might have been recently introduced to the Island and cultivated. In the present report description of all the naturally occurring bamboos in Andaman and Nicobar Island is given. The illustrations are provided only for the newly described species. Critical comments or notes have been provided whereever necessary.

## Handbook on Mushrooms of Kerala. *KFRI Research Report No. 388* (C Mohanan. 2011)

Mushrooms are fungi, distinguished by having epigeous and hypogeous macroscopic fruiting bodies. Most mushrooms belong to the Phyla Basidiomycota and Ascomycota and their fruiting bodies vary much in shape, size, colour, texture, odour and taste. Mushrooms are also important component of the different forest ecosystems and play a major role in ecosystem dynamics, such as litter decomposition, nutrient cycling and nutrient transport. Most of the mushrooms are saprobes and occur on soil, humus, decaying wood, litter, dung, among others. A total of 166 genera and 550 species of mushrooms falling in 51 families belonging to Basidiomycota and Ascomycota have been reported from different forest ecosystems of the State, thereby depicting a rich mushroom flora. Among the mushrooms recorded, terricolous, humicolous and lignicolous form the major groups, while coprophilous or mushrooms inhabiting on dung of herbivores are the insignificant group. The book contains eight chapters: Introduction on mushrooms, Morphology and life cycle of mushrooms, Collection, processing and describing mushrooms, Edible and poisonous mushrooms, Poisonous mushrooms and mushroom toxins, Mushroom diversity, and Common



*Cantharellus cibarius*


*Agaricus endoxanthus*

mushrooms. Taxonomic details, economic potential, distribution, among others of about 70 most significant and representative mushrooms with colour photographs are given under the chapter on Common mushrooms.

## Biodiversity of Terricolous and Lignicolous Macro fungi of the Western Ghats, Kerala. *KFRI Research Report No. 389* (C Mohanan. 2011)

A total of 550 species of macrofungi belonging to 166 genera falling in 51 fungal families of Basidiomycota and Ascomycota were encountered in different forest ecosystems of the State. Among the forest ecosystems studied, moist-deciduous and semi-evergreen forests support maximum number of macrofungi, followed by evergreen and shola forests. The grassland ecosystem supports only a few macromycetes, while *Myristica* swamp forests harbor an array of different interesting groups of macrofungi. Macrofungal species assemblage, species abundance and frequency are very characteristic in the shola forests. Of the 51 macrofungal families, members belonging to Agaricaceae, Amanitaceae, Boletaceae, Entolomataceae, Hygrophoraceae, Inocybaceae, Lyophyllaceae, Marasmiaceae, Pluteaceae and Tricholomataceae are the major players in ecosystem functioning. In the family Agaricaceae, 10 genera and 53 species were recorded. Occurrence and distribution pattern of ectomycorrhizal macrofungi in different forest ecosystems depend largely on the distribution of host plant species, irrespective of the ecosystem specific environmental gradients. Most saprophytic macrofungal species exhibit definite patterns of distribution in different forest ecosystems which are highly influenced by the environmental factors, mainly rainfall and atmospheric humidity. Among the 550 species of macrofungi recorded from the Western Ghats of Kerala, more than 360 species are new record for the State, more than 300 species are new record for the country and 15 are hitherto unrecorded macrofungi.

*Amanita hemibapha*

*Ganoderma lucidum*

## Rust fungi of Kerala – Biodiversity and biosystems. *KFRI Research Report No. 390* (C Mohanan. 2011)

A systematic study was carried out on rust fungi in West coast tropical evergreen forests, West coast tropical semi-evergreen forests, South Indian moist deciduous forests, Southern subtropical broadleaved hill forests, Southern montane wet temperate forests, southern tropical dry deciduous forests, grasslands, forest plantations and forest nurseries of the Kerala part of the Western Ghats. A rich rust fungal flora was recorded from all the forest ecosystems in the Western Ghats surveyed. A total of 95 species of rust fungi belonging to 25 genera were found associated with diseases of 117 host species belonging to 80 host genera under 43 host families. Among the 43 host families, Fabaceae, Poaceae, Acanthaceae, Verbanaceae, and Euohorbaceae recorded maximum number of plant species affected with different rust fungi. As the rust fungi are host-specific, the geographical distribution pattern largely depends on the distribution of host species and also the prevailing environmental factors.


*Zaghouania oleae*

## Planting stock production of selected commercial species of bamboos. *KFRI Research Report No. 391* (CK Somen, KK Seethalakshmai, KK Unni, VP Raveendran. 2011)

Planting stock of 25 commercial species of bamboos belonging to 10 genera was produced using macro and micro-propagation techniques within short period. The propagules were produced in the nurseries at the Field Research Centre, Veluppadam and the main campus of KFRI, Peechi. Seedlings of *Bambusa bambos, B. tulda, Dendrocalamus hamiltonii, D. strictus, Melocanna bambusoides, Ochlandra travancorica* and *O. scriptoria* were raised in nursery beds and potted in polythene bags. Macro-proliferation of seedlings of *Bambusa tulda* previously raised in the nursery was carried out by splitting the rhizome portion bearing two or more shoots. Vegetative propagation of *Bambusa balcooa, B. vulgaris* (green), *B. vulgaris var striata* (yellow), *Dendrocalamus brandisii, D. giganteus, D. longispathus, D. stocksii, D. sikkimensis, Gigantochloa atroviolacea,* and *Thyrsostachys oliveri* was done by treating culm cuttings with growth regulators *viz.* naphthalene acetic acid (NAA) and indole butyric acid (IBA). The proliferation capacity was about 2.5 times (1000 seedlings to 2500 propagules). A total of 83,570 propagules were produced of which 24,336 plants were supplied to farmers, voluntary organisations, schools and Government Departments for different types of planting activities such as boundary or block planting, strip planting on river banks and bio-shield in coastal areas, landscaping, establishment of bambusetum, explants for tissue culture laboratories among others. The remaining planting stock is maintained in the nurseries at FRC, Velupadam and KFRI Campus, Peechi. Macroproliferation is being continued and the planting stock will be distributed as per the requirement for plantations in future.

## Phylogeny of selected woody bamboos of the world. *KFRI Research Report No. 392* (MS Mukteshkumar, M Balasundaran, TB Suma. 2011)

The Bamboo Phylogeny Project was undertaken by the Bamboo Phylogeny Group (BPG), an international collaboration of bamboo scientists. The following four species of woody bamboos namely *Ochlandra stridula* Moon ex Thwaites, *Ochlandra travancorica* (Bedd.) Benth., *Davidsea attenuata* (Thwaites) Soderstrom & Ellis, *Pseudoxytenanthera monadelpha* (Thw.) Soderstrom & Ellis and one species of herbaceous grass *Streptogyna crinita* P. Beauv., were selected and used for molecular studies as well as morphological scorings. Morphological characters were analysed and some of the characters that cannot be coded or scored were excluded. Characterizations of species and OTUs have been developed. The Sequenced DNA of all the five selected species has been uploaded in the Bamboo Phylogeny Website and the homology obtained through NCBI-BLAST are also provided. The data matrix and character states selected are also given. The Phylogeny aspect is being carried out at the IOWA State University and hence, it is not included in this report.

*Ochlandra stridula*

*Davidsea attenuata*

## Bamboo for affordable shelter: Demo nstration of appropriate construction practices and construction of durable model bamboo house. *KFRI Research Report No. 393* (TK Dhamodaran, R Gnanaharan. 2011)

The project envisages designing bamboo houses appropriate to Kerala conditions and demonstrating the best construction practices for using bamboo for affordable housing. Preservative treated bamboo was used for the construction of floor, wall (plastered bamboo grid wall), and roof. Country bricks were used wherever unavoidable. A bamboo house structure was designed appropriate to the Kerala conditions, constructed and demonstrated. The attic floor of the house demonstrates the use of bamboo for trusses, rafters, purlins and joists and their jointing methods. Being the maiden attempt for demonstration, the cost of construction came almost equal to a brick-cement construction. However, experiences from the present attempt will definitely help to reduce the cost in future constructions. The potential of bamboo ply boards for developing portable modular houses especially suitable for ecologically sensitive forest areas, pilgrim centers, calamity affected areas, ecotourism and resorts

## Forests and agricultural ecosystem analysis to assess ecosystem health and identify rehabilitation strategies in the Kerala part of Nilgiri Biosphere Reserve. *KFRI Research Report No. 394* (UM Chandrasekara. 2011)

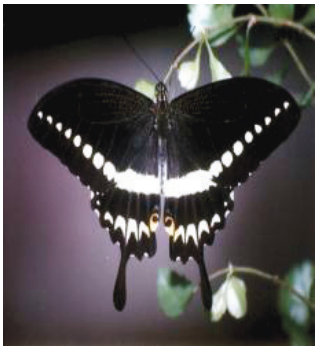
The Kerala part of NBR covering an area of 1455 km$^2$ is rich in biological diversity due to the presence of a wide range of biophysical and climatic conditions. However, like any other protected areas, the NBR is also facing the threat of forest degradation and natural resource depletion at a landscape level, particularly in village-fringe forests. The present study was conducted to analyse the vegetation structure and composition in village-adjacent forests and in the relatively undisturbed forests of the Biosphere Reserve and also to determine the causes and level of disturbance in the village-adjacent forests. The study also aimed to assess the changes in cropping patterns in the villages, their impact on forest resource flow into the village landscape units and to identify forest rehabilitation strategies.

## Mass production of HpNPV, a biopesticide for the teak defoliator management. *KFRI Research Report No. 396* (VV Sudheendrakumar, RV Varma, TV Sajeev. 2011)

Mass production of HpNPV, a potential bio pesticide against the teak defoliator *Hyblaea puera* (Cramer) was attempted. During the study period HpNPV amounting to a total of 2.2X1013 POBs was produced sufficient for application in about 4000 ha of teak plantation. As an activity of the project, attempts were made to transfer teak defoliator management technology to the Forest Divisions of Nilambur north and south. Trainings on various aspects of defoliator management using HpNPV biopesticide were conducted for the benefit of the Forest Department field staff including foresters, forest guards and watchers. In the second phase training was given on the HpNPV application methods. Under the research component of the project, the shelf life of the formulated HpNPV product was evaluated. The study showed decrease in activity of the biopesticide formulation with increase in the storage time. A documentary on teak defoliator management was also produced for distribution among teak farmers.

## A Handbook on the butterflies of Nilgiri Biosphere Reserve. *KFRI Research Report No. 398* (George Mathew. 2011)

Available information on 282 species of butterflies so far recorded from the Nilgiri Biosphere Reserve was consolidated. The number of species recorded under various families are: Papilionidae-19 species; Pieridae-29 species; Lycaenidae-88 species, Erycinidae: Riodinae-1 species, Libytheinae-1 species; Amathusidae-1 species; Nymphalidae-59 species; Satyridae-25 species and Hesperiidae- 58 species. Of the 282 species recorded in this study, 104 are rare, 21 endemic, and 19 protected. Due to the fast depletion of their natural habitats, many species recorded as 'common' are also becoming rare in their range of distribution. Considering the high proportion of rare and endemic species found in this area, conservation strategies involving implementation of strict legislation against destruction of biodiversity of this area; captive breeding and reintroduction in the case of rare, threatened and endemic species; implementation of habitat enrichment programmes and enhancing public awareness on species conservation are proposed.



*Papilio liomedon Moore*

## Bamboos of Penisular India (Part II). *KFRI Research Report No. 399* (MS Mukteshkumar. 2011)

In Peninsular India, Bambusoideae is represented by 22 species and two varieties under seven genera. *Ochlandra Thwaites* is the dominant genus of South India comprising eleven species and one variety so far reported from South India and widely distributed. In the present report the species *Ochlandra travancorica* var. *hirsuta* Gamble, *O. sivagiriana*(Gamble) Camus and *O. soderstromiana* Muktesh & Stephen are synonymised under *O.travancorica* (Bedd.) Benth. The following species namely, *Ochlandra beddomei, O. scriptoria, O. travancorica* and *O. wightii* are typified. Critical and detailed study revealed that true monadelphous condition does not exist in the genus Ochlandra. Based on the affinities, the species under the genus *Ochlandra* are grouped as *Travancorica* group and *Scriptoria* group. A new combination under the genus *Dendrocalamus* is proposed. A species from the genus *Oxytenanthera* is transferred to the genus *Dendrocalamus*. The species *Dendrocalamus strictus* was typified. After a detailed study, the variety *Bambusa bambos* var. *gigantea* is treated as a synonym of *Bambusa bambos*. In the present study, the genus name *Oxytenanthera* is retained. The spelling in the specific epithet of *O. bourdillonii* and *O. ritchiei* are corrected and *O. bourdillonii* typified. The genus *Arundinaria* in South India previously treated under *Sinarundinaria* has been reverted to the genus *Arundinaria* and *A. wightiana* is typified. *Teinostachyum wightii* was previously treated under the genus *Schizostachyum* as *S. beddomei.* The basionym *Teinostachyum wightii* is accepted and typified in the present study. According to the present study, there are 22 native species of bamboos in South India. Out of the 22 species, 20 are distributed in Kerala, 6 in Karnataka, 5 in Tamil Nadu and 2 in Andhra Pradesh. Among these, 13 species are endemic to this phytogeographic region. In the Southern Western Ghats bamboos form a major component of the biodiversity. They show a high degree of endemism and most of the species have a restricted distribution. Recently, some of the so far known endemic species are found distributed in Sri Lanka. This gives an indication of the affinities of the Sri Lankan flora with the flora of South India.

## National Carbon Project: Spatial assessment of vegetation and soil carbon pool of northern Kerala. *KFRI Research Report No. 400* (ARR Menon, Thomas P Thomas. 2011)

The project focus on three major components and aims to understand Vegetation Carbon pools, Soil Carbon pools and Soil-Vegetation Carbon fluxes in the context of the 11th Five Year Plan laying extra thrust to understanding the terrestrial Carbon Cycle through a "National Carbon Project". Pilot studies have been done in India to estimate forest /vegetation carbon and these estimates are spread over a decade and are based on different approaches viz: historical records, ecological data and population based forest biomass, scales and classification schemes and objectives. The Northern Kerala region is the major thrust area of the current project in assessment of terrestrial vegetation biomass in the country using ground sampling and satellite remote sensing data. Under this subproject, determination of soil organic carbon in surface and sub-surface soils of forests of Northern Kerala is covered in the present study. A cluster based sampling using remote sensing data for stratification was suggested at national level by ISRO and the same methodology was adopted in the current work. Information on trees outside Forests (TOF) was generated in three phases: land use classification and mapping; identification of tree-cover classes; and measurement of tree characteristics. Satellite images and aerial photos were suitable for the first two. Highresolution satellite images are likely to allow the identification of single trees (or crowns) and can be a data source for a large-area TOF inventory.

## Clonal seed orchard management for higher seed productivity in Teak. *KFRI Research Report No. 401* (KK Seethalakshmi, George Thomas, EM Muralidharan, M Balagopalan, CK Somen. 2011)

For genetic improvement of planting stock of teak, clonal seed orchards were established in Kerala during 1979- 81 by bud grafting selected plus trees from different geographic origins. Even after 15 years of growth, flowering and seed production in most of the clones were not promising. It was suspected that lack of flowering may be due to growth of root stock instead of scion during the establishment of grafts, stock - scion interaction, nutritional imbalances, physiological reasons like hormonal inadequacy, insufficient light, temperature, moisture, among others. The study undertaken in the seed orchard at Kalluvettamkuzhi, Arippa, to find out the nature of flowering and seed production in existing clones revealed that the percentage of flowering varied from 2-3 in 1999 and 2000 increased to 5 in 2001 and 2002, phonological phase fruiting were spread over a period of seven months (i.e., from June to December), clones differed in flower production per inflorescence, fruit production varied from 65g/tree to 300g/tree and the average fruit production was 125g/tree. Cluster analysis of RAPD data revealed five distinct clusters. The results indicated that the stock and scion of a clone were highly similar at the DNA level and the scions did not reveal any relation to the plus trees from which they were derived. In addition, the flowered and non-flowered clones were genetically distinct. Since the number of samples analysed was limited a definite conclusion could not be drawn from these results. No polymorphism could be found in isozyme analysis in the material collected from seed orchards also.The foliar nutrient contents N, P, K, Ca and Mg showed considerable variation within clones and between clones. Eco-physiological studies in the orchards showed that parameters like light, temperature or rainfall were not a limitation for seed production at Kalluvettamkuzhy. This may be due to the wider spacing (8 x 8 mm minimum) given while planting the ramets. The results obtained in the study points to the possibility of graft failure in the ramets and the low variability between the clones and ramets used in the study. Use of rooted cuttings of micropropagated plants and adopting a more favourable spacing in future clonal seed orchard is suggested.

## Macro fungi of Kerala: Biodiversity and biosystematics. *KFRI Research Report No. 402* (C Mohanan. 2011)

This Handbook is intended to provide a systematic account of the macrofungi in different forest ecosystems of the Kerala part of the Western Ghats. The Kerala State represents an epitome of the Western Ghats in many respects and the diverse types of forest ecosystems support unique assemblage of biological communities including macrofungi. High rainfall, immense litter load on forest floor together with tropical humid climate provide a conducive environment for the growth and development of macrofungi on different substrata. However, information on macrofungi of the State is very meagre and limited to certain groups of Agaricales. Representative forest areas in different forest ecosystems were systematically surveyed and more than 4000 macrofungal specimens were collected and processed Altogether 550 macrofungal species belonging to 166 genera

*Dacryopinax elegans*

under 51 families were identified and described. Of these, a large number of genera and species are reported for the first time from India; more than 360 species are new records from the State and 15 new taxa are described.

### Pollination of Teak in Kerala Phase 2: Control of premature fall of Teak flower and fruit. *KFRI Research Report No. 403* (EJ Maria Florence, K Mohandas. 2011)

Teak (*Tectona grandis* Linn.) is a valuable and widely planted hardwood tree species in the tropics. Low fruit production and poor germination are the major problems associated with its propagation. One of the main reasons for the poor fruit production is premature flower and fruit fall. A preliminary survey in Thrissur district of Kerala State, India indicated that one of the reasons for premature flower and fruit fall was fungal infection on floral parts. The survey revealed that the premature flower/fruit fall is widespread throughout the state and is due to fungal infection by *Phomopsis tectonae* on floral parts and fruits. The study highlights that spraying of 0.5 per cent of Carbendazim (Bavistin) or Chlorothalonil (Kavach) on the teak inflorescence at the bud formation stage is effective in preventing the infection and enhancing the seed setting.

### Establishment of a tree protection helpline for the state of Kerala. *KFRI Research Report No. 404* (VV Sudheedrakumar, TV Sajeev. 2011)

The project was initiated to help tree growers by giving them advice on pest and disease management associated with tree crops. Both the private sector and public sector tree growers were expected to be benefited by this service. During the study period most of the queries receieved were from the Forest Department. The pest and disease problems were associated with teak and eucalyptus. The data indicated the need for popularizing the activities of the helpline so as to extend the service to more clients.

### Macro propagation of two commercial Bamboos - *Bambusa Balcooa* and *Dendrocalamus Brandisii. KFRI Research Report No. 405* ( KK Seethalakshmi, VP Raveendran. 2011)

Technologies for large–scale production of planting stock are not available for many commercial bamboo species. This project was undertaken to standardize propagation techniques for production of planting stock of two priority species of Bamboos, *Bambusa balcooa* and *Dendrocalamus brandisii*. Experiments conducted with culm cuttings of *B. balcooa* showed 100 per cent rooting and the response depended on concentration of growth regulator treatment and position of cuttings. Attempts to use branch cuttings showed varying results. About 30 per cent rooting was obtained in *B. balcooa* when cuttings were collected and planted in March. Experiments carried out inside the field propagation unit at Kottappara, which contained trenches covered with polythene sheet (polytunnel) for maintaining high humidity did not give any results. For *D. brandisii*

*Dendrocalamus brandisii*

culm cuttings were used to standardize the protocol of vegetative propagation using five different concentrations of two growth regulating substances, three seasons and three different positions. In general, the cuttings collected from the basal portions of the culm during the summer season and treated with IBA gave maximum rooting response. Cluster analysis revealed that the cuttings collected during summer season from basal portion of the culms treated with 100 ppm of IBA as the superior treatment. Branch cuttings did not give any positive result in this species.

### Documentation and conservation of small mammals in the sacred groves of Kerala, Penisular India. *KFRI Research Report No. 406* (P Padmanabhan. 2011)

A survey of small mammals (weighing less than 5 kg) covering approximately 300 sacred groves of the State was conducted from 2005 to 2009. The floristic composition was highly influenced due to the anthropogenic pressures, cattle grazing, edaphic and climatic factors. Survey and socio-cultural aspects of sacred groves was studied and threats to the sacred groves documented. The role of small mammals in the sacred grove ecosystem was analyzed. Protection was comparatively higher in religiously protected scared groves. Sixty species of small mammals were documented, of which 75 per cent were bats and rodents. Numbers of small mammals documented were 3 species of Insectivore, 27 species of *Chiroptera*, one species of *Primates,* one species of *Pholidata,* 14 species of *Rodentia,* 4 species of *Carnivore,* one species of *Lagomorpha* and one species of *Artiodactyla*. Fragmentation of sacred groves, urbanization, disappearance of old belief system, waste disposal, alteration of habitat, removal of biomass, fragmentation of sacred groves due to partition of joint families and formation of nuclear families, felling of old trees and thereby destruction of roosting sites of small mammals were main threats. Sacred groves which were religiously protected and bigger in size gave more protection to mammals. The study suggests that prevention of further fragmentation, giving economic remuneration and award for protection of groves, declaring sacred groves as community forestry center with assistance from Government agencies will prevent further fragmentation and protect biodiversity rich sacred groves from extinction.

### Developing a safer (biological) preservative against bamboo borer based on traditional knowledge. *KFRI Research Report No. 407* (RV Varma, Raju Paduvil. 2011)

During the course of an early study on post- harvest technology to economize bamboo resource utilization, a few biological preservatives based on traditional knowledge were tested. Amongst these, a biological preservative based on traditional knowledge from carpenters involved with temple construction was the most promising. Here an attempt was made to refine the procedure and protocols connected with the preparation of this bio-preservative. The main objective was to scientifically develop a protocol and evaluate the product consisting of 9 biological products against borers and termites attacking bamboo. The laboratory tests proved the efficacy of the preservative against borers attacking bamboo and also under field conditions prevented termite attack. Commercial production procedure of this bio-preservative and evaluation through an interactive process to gain acceptance among the user agencies have to be explored.

### Natural enemies of red palm mite in India. *KFRI Research Report No. 408* (VV Sudheendrakumar, KV Sankaran, P Mujeeb Rahman. 2011)

Red Palm Mite (RPM), *Raoiella indica Hirst* (Arachnida: Acari: Tenuipalpidae), is a pest of coconut, areca, date palm and many other ornamental as well as commercial palm species. The aim of the

project was to study the population dynamics of this mite and to survey the natural enemies associated with it in its native range so as to develop a biocontrol strategy to tackle the problem. *Areca catechu* and *Cocos nucifera* are the major host plants in India and feeds on the underside of the palm fronds. Field and laboratory studies were carried out in order to assess the relationships between RPM, its natural enemies and other factors such as climate and host. Spatial and temporal surveys were carried out in coconut and arecanut during 2008 and 2009. Two sites were chosen for each species (Palakkad and Peechi for coconut and Kunnamkulam and Nilambur for arecanut), that are drier and wetter, climatically. Various predators like *Amblyseius* spp., *Stethorus keralicus* among others were also recorded during the study. Laboratory studies proved that phytoseiid feeds on red palm mite, but rearing and bioassay was difficult because phytoseiids always showed escaping behaviour from the arena. Wind-dispersal traps were installed in the field to study the mechanism of dispersal of RPM and study indicated aerial dispersal occurred when the populations were dense on the tree canopy. The data analysis indicate the increase in populations of RPM is not only linked to temperature, but also to the host plant, number of predatory mites present, humidity and rainfall. The results highlighted that the most abundant predator associated with RPM is the phytoseiid mite. There were high numbers of phytoseiid mites during the months of December and January but there was a significant drop in numbers in the later period. Phytoseiid mites were highly correlated to rainfall of the previous month, and negatively correlated to RPM populations, even though laboratory data has shown that these mites do feed on RPM. From this information, it could be postulated that the predator is indeed adapted to feeding on RPM but it is poorly synchronised. RPM on the other hand, has an abundance of suitable host plants and ideal weather conditions for population expansion.

### Resource enhancement and processing of Cane and Bamboo species suitable for handicrafts. *KFRI Research Report No. 409* (KK Seethalakshmi. 2011)

This is the cumulative report of the work done by Kerala Forest Research Institute, Peechi as a part of the UNDP GOI project on Cane and Bamboo species suitable for handicrafts sponsored by Ministry of Textiles. The project comprised of the following: 1. Setting up integrated gene pool banks, 2. Survey and documentation of cane and bamboo species used in-handicrafts, 3. Adopting techniques like macro-proliferation and tissue culture in addition to traditional rhizome planting, 4. Develop packages for nursery and silviculture techniques, 5. Establish germplasm banks for propagation and conservation techniques, 6. Set up tissue culture and plant multiplication nurseries, 7. Set up farms with NGos/ farmers, 8. Set up Oil-curing units, 9. Conduct training and 10. Publicity and awareness

### Taxonomy of Indian palms. *KFRI Research Report No. 410* (C Renuka. 2011)

Palms, belonging to the family Palmae (Arecaceae) are one of the multiuse monocots, occurring mostly in the tropical regions of the world. In India the family is represented with 22 genera and 106 species and are of restricted distribution in three major geographical regions viz: Peninsular India, North and North Eastern India and Andaman & Nicobar islands. Out of the five subfamilies of Arecaceae, India is represented by four, Calamoideae, Nypoideae, Coryphoideae, and Arecoideae. The largest genus, *Calamus* with 47 species is followed by *Phoenix* with 8 species and *Daemonorops* with 6 species. The rest are with five or less than five species. Out of 106 species, about 43 species are endemic. Palm populations in the wild are decreasing. Genera like *Borassus, Calamus, Coryphn,* among others, are threatened because of their constant and increasing utilization. Overexploitation is one of the major threats to the survival of many wild palm species. Some inherent characteris-

tics of palms such a monocarpic flowering, poor germination of seeds and poor establishment of seedlings among others have also contributed to retard natural regeneration of palm population. Conservation and sustainable utilization of this resource assumes great importance in the context when forest wealth of the country as a whole has been on the decline. In the absence of concrete efforts towards their replenishment, some of these wild palms are likely to face the threat of extinction.

*Nypa fruticans* flower

*Nypa fruticans*

## Biodiversity conservation for Muthikulam High Value Biodiversity Area. *KFRI Research Report No. 411* (Renuka C *et al*., 2011).

Muthikulam High Value Biodiversity Area is located in Mannarkad Forest Division, which borders the North-western portion of the Western Ghats on the northern side of Palakkad gap in Mannarkad Taluk of Palakkad District. The present Mannarkad Forest Division comprises three Ranges viz., Mannarkad, Attappady and Agali with headquarters at Mannarkad, Mukkali and Kalkandy respectively. Subsequent to the nationalization of private forests, the vested forests of Palakkad District were brought under a newly created Palakkad Special Division with effect from 10.5.1971. With a view to have a compact area of administrative units with boundaries in consonance with the district and taluk boundaries, for even distribution of the protection task and for better administrative convenience, the three forest divisions in Palakkad District namely Palakkad, Palakkad Special and Nemmara were amalgamated and reorganized. Accordingly, the present Mannarkad Division came into being with all Reserve Forests and Vested Forests of Mannarkad Taluk, Palakkad District.

Muthikulam forest

## Conservation and management of sacred groves in Kerala. *KFRI Research Report No. 412* (UM Chandrasekhara. 2011)

Recognising the importance of sacred groves, both in terms of conservation of biodiversity and cultural diversity, and in view of the threats faced by the groves, the Government of India has launched a Scheme `Protection and Conservation of

Sacred groves' within its programme `Intensification of Forest Management'. As a part of this Central Government sponsored Scheme, the Department of Forests and Wildlife, Government of Kerala (KFD) initiated the `Protection and Conservation of Sacred Groves' project in Kerala. The study revealed that the total area of sacred groves ranged from 0.04 ha to 24.0 ha and in majority of the groves, area occupied by the vegetation was more than 76 per cent of total area of the grove. Many sacred groves held water resources in the form of ponds, streams or wells. Mainly four major forest types, namely evergreen, semi-evergreen, moist deciduous and mangrove forests were seen among twenty-eight sacred groves and the forest patches showed different degrees of degradation. A total of 670 angiosperm species, 154 butterfly species and 122 bird species were recorded from these sacred groves. Among them, 133 angiosperm species, 5 butterfly species and 8 bird species were endemic. In this document, the need of a Sacred Grove Biodiversity Network (SGBN) of Kerala State as a broad programme of biodiversity monitoring is also projected. Altogether 26 management strategies were recognized for the conservation and protection of these sacred groves. KFRI prepared the Management Plan for each of the twenty eight sacred groves which provides details of cultural and ecological significance of the grove, the contribution by the owner and the local community in the conservation efforts, institutional mechanism whereby all stakeholders lend their support to the conservation of the sacred grove, budget estimates for management activities and mechanisms for monitoring and evaluating the management activities.

## Commercial volume tables for selected home garden trees of Kerala. *KFRI Research Report No. 413* (CN Krishnankutty. 2011)

Teak (*Tectona grandis* Linn.), jack (*Artocarpns heterophyllus* Lamk.), anjily (*A. hirsutus* Lamk.), matty (*Ailanthus triphysa* Dennst.) and mango (*Mangifera indica* Linn.) are the commercially and economically important trees in home gardens of Kerala. Different types of commercial volume prediction equations were developed for each species through regression analysis, using data on diameter at breast-height of sample trees before felling and corresponding volume of commercial timber measured after felling. Diameter of each tree was calculated from the girth over-bark measured at the breast-height level (1.37 m from ground). Volume was measured under-bark of logs or billets above 40 em midgirth over-bark of teak, matty and mango trees. It was measured under-sapwood of logs above 60 em mid-girth over-bark of jack and anjily trees. Using the best fitting prediction equation selected from the set of equations estimated for each species, commercial volume estimates were predicted for those values of diameter corresponding to the values of girth at breast-height from 60 cm upwards with an interval of 5 em. By tabulating the girth at breast-height in em and volume in

m", commercial volume tables were prepared for each species. The tables provide volume estimates corresponding to different values of girth at breast-height of trees which can easily be measured at site. The volume tables are useful to tree growers and purchasers including timber traders, for quickly obtaining an estimate of commercial volume in a tree without felling it and thereby calculating its stumpage price.

## Regeneration study of selected Terminalias in Kerala. *KFRI Research Report No. 414* (PK Chandrasekhara Pillai, UM Chandrasekhara. 2011)

The present investigation was conducted in the Kerala part of Western Ghats from Northern to Southern Forest Circles representing all the Ranges belonging to each Forest Division. The study envisaged to assess demographic details of *Terminalia crenulata, T. paniculata, T. travancorensis* and their regeneration status in natural populations. A total of 218 plots were enumerated (51.7 ha) throughout Kerala. Seeds of *T. crenulata, T. paniculata* and *T. travancorensis* were subjected to viability test and pre-sowing treatments to enhance germination under laboratory condition. A trial for vegetative propagation of the species was also carried out. Overall species richnes (R=26.93) and diversity (H=3.71) of the study sites showed a high value. Generally, density of *T. paniculata* was higher than that for *T. crenulata* with a significant difference between Forest Circles (P=0.01 for *T. paniculata* and P=0.05 for *T. crenulata*). The study indicated that *T. paniculata* is more or less stable compared to *T. crenulata*. However, occurrence of *T. travancorensis* is limited to the few localities in Kerala. Regeneration enumeration was carried out from all the temprory plots established in each Forest Division. Generally, regeneration of *T. paniculata* was more when compared to *T. crenulata*. Regeneration in the study sites had a density of 73.58 for *T. paniculata*, 18.47 for *T. crenulata* and 0.019 for *T. travancorensis.* The study revealed that germination of *T. paniculata* was very low due to infertility and heavy pest infestation. With respect to *T. travancorensis,* weathering treatment of seeds was needed to get a better germination. Juvenile shoots from the established seedlings responded to rooting hormones. Optimum combination for better rooting was IBA+Kinetin at 6000 ppm.

*T. crenulata* - seedling

## Multilocational field trials for selected Bamboo species in Kerala. *KFRI Research Report No. 415* (VP Raveendran, KK Seethalakshmi, KK Unni. 2011)

The bamboo multilocational trials in Kerala under National Mission on Bamboo Application were undertaken by KFRI in the private farm land and Government non-forest lands in Palakkad district. The trials carried out were: 1. Multilocational species trial: performance of eight species, viz., *Bambusa bambos, B. tulda, B. nutans, B. balcooa, Dendrocalamus hamiltonii, D. asper, Guadua angustifolia* and *Ochlandra travancorica.* 2. Spacing trials: Effect of different spacing on growth and performance of *Ochlandra travancorica* 3. Bamboo-based cropping systems: Intercropping in *Bambusa bambos* plots 4. Clump management: Adoption of different practices for management of congested *Bambusa bambos* clumps. Observations were recorded at six monthly intervals for a period of four years. When

the performance of three different types of planting stock was compared, rooted cuttings (*B. balcooa, B. nutans* and *D. hamiltonii*) performed better than seedlings and TC plants. The highest biomass per culm was observed in *B. balcooa.* From the observations made for three years on spacing trial of *O. travancoria,* it is clear that the seedlings planted at 9m x 4.5m x 4.5 m and 5m x 5 m produced the highest number of culms and thereby the maximum yield. The intercropping with *B. bambos* was found to be promising in the initial years. The clump management plots are ready for initiating the management activities and further studies are required for arriving at more meaningful conclusions.

## Evaluation of the effectiveness of water submersion method for protection of Bamboo from borer damage. *KFRI Research Report No. 416* (KV Bhat, M Balasundaran. 2011)

The activity of starch hydrolyzing enzyme amylase by microorganisms was responsible for the starch depletion. The total microbial population comprising bacteria, fungi and actinomycetes within bamboo tissues increased drastically within 15 days after submersion. Increase of aerobic microorganisms in stagnant water was not considerable where as their population increased in running water. Thus anaerobes were the most active starch degraders in stagnant water whereas, aerobes could degrade starch only in running water where oxygen is continuously replenished. The increasing populations of starch degraders within the submerged bamboo tissues and in bamboo-soaked water explain the decline in starch content when submerged under water. It is thus evident that water submersion treatment leads to depletion of storage starch in bamboo culms due to microbial activity and makes it less attractive to borers.

## Strengthening *ex-situ* conservation Evergreen Trees. *KFRI Research Report No. 417* (KK Unni. 2011)

A total of 181 species representing 45 families and 132 genera have been raised in the conservatory plot. Among these, the species such as *Actinodaphne malabarica, Aglaia barberi, Aglaia malabarica, Atuna travancorica, Beilshmiedia wightii, Canarium strictum, Chrysophyllum roxbourghii, Cynometra beddomei, Diospyros paniculata, Dipterocarpus bourdillonii, Dipterocarpus indicus, Humboldtia bourdillonii, Hydnocarpus macrocarpa, Hydnocarpus pentandra, Kingiodendron pinnatum,Mesua thwiatesii, Otonephelium stipulaceum, Poeciloneuron indicum, Pterospermum rubiginosum, Syzygium stocksii, Syzygium travancoricum, Vepris bilocularis* among others are rare endemic and threatened trees of Western Ghats. The growth of some selected species planted were monitored at 6 months intervals for the sapling stage and yearly intervals for the tree stage. The general perfomance of seedlings raised in the consevation plot showed some major difference in the growth rate. The ex-situ conservation of various species is maintained at FRC, Velupadam for addition of species and also as a source of maintained data for various studies.

*Humboldtia bourdillonii*

## Studies on controlling Teak defoliator outbreaks by seeding the baculovirus HpNPV in epicenter population. *KFRI Research Report No. 418* (VV Sudheendrakumar, TV Sajeev. 2012)

The *Hyblaea puera* nucleopolyhedrovirus (HpNPV) is an ideal biocontrol agent for management of

the teak defoliator, *H. puera* because of its host specificity, virulence and eco-friendly nature. However, application of HpNPV in extensive teak plantations is quite difficult owing to the rugged terrain of the plantation and height of the trees. The project was undertaken in the above context to develop a landscape level teak defoliator management strategy using the virus combining the knowledge on the population dynamics of the insect and the vertical transmission characteristics of the pathogen. The trials on probable resistance of *H. puera* larvae to sublethal virus infection showed that the successive offspring generations were more susceptible to virus infection thereby ruling out the possibility of such a phenomenon in *H. puera.* The results indicated that one time low dose application of HpNPV during the epicentre phase of the teak defoliator population could contribute to the reduction in the insect population not only in the parent population but also in the F1 generation. This method of HpNPV application in the teak defoliator epicentres may be practiced for management of the teak defoliator at landscape level.

### Establishment of a pilot scale clonal plantation of promising plus trees of Teak. *KFRI Research Report No. 419* (T Surendran, KC Chacko, JK Sharma. 2012)

Establishment of a pilot scale clonal plantation of promising plus trees of teak (*Tectona grandis* L.F) was envisaged in this project.To raise the plantation, selected plus trees were cloned using the technique standardized at Kerala Forest Research Institute, Peechi. The technique mainly involves production of juvenile shoots on branch cuttings of plus trees, in the mist chamber. The produced juvenile shoots were rooted in the mist chamber to obtain true to type rooted cuttings (ramets) of the plus trees. After rooting the cuttings were hardened in the hardening chamber, before being taken out for field planting. A few days hardening in the open nursery were also provided to ensure field survival of rooted ramets. An area of about 1.0 ha was selected at Veliyanthode in Nilambur Range of Nilambur Forest Division (North) and the pilot scale plantation was established using the rooted ramets of teak plus trees.

### Strengthening and Computerization of KFRI Herbarium. *KFRI Research Report No. 420* (K Yesodharan, KKN Nair. 2012)

Computerization of KFRI Herbarium was undertaken to digitize the information about the herbarium specimens for easy accessibility with the help of internet and world wide web (www) throughout the world. Databases also include the actual herbarium specimens as digital images with all accompanying information available on the herbarium sheet label. The digital database of the herbarium specimens was developed by selecting 33 variable characters by using software package DELTA. Digital herbarium database has some edge over traditional one as the herbarium will not have any pathogenic attack, no bio-degradation problems, no space problem, minimum maintenance cost, among others. In addition, this database can be used for information retrieval, generation of conventional key and interactive key, and to get full description, brief description and diagnostic features of plants, current status of the plants, socio-economic values, among others.

### Improvement of Teak through genetic evaluation. *KFRI Research Report No. 421* (EP Indira. 2012)

Selection and evaluation of plus trees through progeny trials are crucial steps in genetic improvement programmes. A progeny trial plot was established under the present study at Nilambur with 64 families (progenies of 64 plus trees) to evaluate the breeding value of these plus trees. The trial was monitored for growth up to the age of five years after field planting. The results of the present study

revealed that there is no influence of geographical origin of the families on growth performance. With respect to girth at breast height, the best cluster of families comprised progenies of plus trees T4, 6 and 24 from Nilambur, 19,136 and 137 from Konni, 105 and 106 from Kannavam, 48 and 150 from Arienkavu, 50 and 104 from Wayanad and 121 from Parambikulam. The phenotypic and genotypic coefficients of variation as well as family heritability were moderate for height and girth in general. The progeny trial can accomplish the purpose of a seed orchard after removing the poor trees and allowing a minimum of 10m spacing between trees. The present study conducted using microsatellite markers, to determine the genetic similarity between plus tree clones and to exclude close relatives in further improvement programmes, showed possibility of demarcation of various clones from each other even with two microsatellite markers except in two clones where three markers were necessary. The study also showed good genetic variability between clones. The clustering of ten clones revealed that all the clones from Arienkavu belonged to one group. Clone T20 from Konni was closer to Arienkavu clones rather than Nilambur clones. Plus tree clones T1 and T10 from Nilambur formed one cluster while T3 from Nilambur stood separately.

### Microbial diversity in grassland shola forests of Wayanad and Munnar. *KFRI Research Report No. 422* (EJ Maria Florence, M Balasundaran, KV Sankaran. 2011)

Soil microbial diversity and fungi involved in litter decomposition was studied for a period of two years in the shola forests of Munnar and Wayanad. The sholas selected were Mannavan shola, Pambadum Shola and Manthan shola in Munnar Forest Division and Meppadi shola and Brahmagiri shola in Wayanad Forest Division. The density of fungal population varied between sholas. The population of fungi was highest in Pambadam shola and lowest in Manthan shola. Both in Pambadum and Manthan shoal the bacterial population was higher at a soil depth of 0-10 cm. The actinomycete population was also high in Manthan shola at 0-10 cm and 10-20 cm depth. In Mathan shola, the fungal density of fully decomposed leaf was low. *Aspergillus, Penicillium, Trichoderma, Verticillium* and *Pestalotiopsis* were the common dominant genus identified from all sholas. Among the actinomycetes, the genus *Streptomyces* dominated in all sholas. Seventeen species of fungi are new records to Kerala.

### Stock assessment and yield regulation for Teak plantation in Kerala. *KFRI Research Report No. 423* (K Jayaraman, B Shivaraju. 2012)

As of 2011 the total extent of teak plantations was 56,509.45 ha. An assessment of site quality distribution of the area showed that only 3 per cent of the area belonged to site quality class I. Nearly 33 per cent of the area was of site quality class II and 56 per cent was of site quality class III. Around 8 per cent of the area fell under site quality class IV. The plantations reached a stable age class distribution after 100 years. The major output of the study is the information generated at the individual plantation level on number of trees/ha, basal areas/ha, mean diameter, mean height, site index, site quality, stocking status, growing stock and proportion of miscellaneous species. The information derived at the Divisional level include area, site quality distribution, stocking status, growing stock, productivity and proportion of miscellaneous species.

### Evaluation of *Saraca asoca, Kaempferia rotunda,* their substitutes and medicinal preparation with respect to Phytochemical and biological properties. *KFRI Research Report No. 424* (N Sasidharan, Jose Padikkala. 2012)

*Lagenandra ovata* and *L. toxicaria* are found to be substituted for *Kaempferia rotunda.* The present

study assessed the phytochemical and biological properties of *Saraca asoca* and its substitutes like *Kingiodendron pinnatum, Cynometra beddomei, C. travancorica, Humboldtia vahliana*, *H. brunonis*, *Kaempferia rotunda* and its substitutes like *Lagenandra ovata* and *L. toxicaria* and *'Asokarishtam'* prepared with preferred species as well as substitutes. On estradiol induced keratinization, *K. pinnatum* was found as effective as *S. asoca* in reducing the cornification in rat uterus. Arishtams prepared with *S. asoca* and substitutes were analyzed for their therapeutic efficacy. Among the Arishtams prepared with substitutes, *K. pinnatum* was the most effective. The results of the phytochemical and biological studies suggest that *Lagenandra ovata* and *L. toxicaria* cannot be substituted for *Kaempferia rotunda.*

*Kaempferia rotunda*

*Saraca asoca*

## Protocol for residual nutrients in the soil. *KFRI Research Report No. 425* (M Balagopalan, P Rugmini. 2012)

The present study was undertaken to find out the status of nutrients in soil at different periods after application in teak plantations and to develop a protocol for evaluation of residual nutrients in the soil. The assessment was done in the teak plantations established in the years 2002 and 2003 at Pariyaram and Vellikkulangara Forest Ranges in the Chalakkudy Forest Division with root trainer seedlings and stumps. The soil samples from the experimental sites were analysed for general characteristics and initial N, P, K, Ca and Mg status. In both the locations, the effects due to treatment, period and the interaction between period and treatment turned out to be highly significant with regard to height in root trainer seedlings as well as stumps. The interaction between period and treatment was highly significant, indicating that the treatments differed in their height growth pattern across time. Pair-wise comparison between treatments at each period showed that the nutrient treatment recommended by KFRI differed significantly from all the other treatments.The total N, and available P, K, Ca and Mg contents at the time of application of fertilisers and during three months of application revealed that there was an increase in the nutrient status which gradually decreased and approached close to the initial levels after three months at both locations. The persistence of the fertilisers in the soils revealed that within three months time, most of them were either degraded, adsorbed or leached. The etiquette for residual nutrients as well as the effect of nutrients on growth revealed that the recommendation of 30g each of N, P, K. Ca and Mg in the first year and double the dose in the second and third years and rather than applying the whole dosage in single application, it would be prudent to apply in two or three split doses. Though economically and administratively unwieldy, from the scientific angle, this practice is highly beneficial.

## Timber supply situation in Kerala: Projection for the Year 2010-11. *KFRI Research Report No. 426* (CN Krishnankutty, Mammen Chundamannil. 2012)

This study was initiated to make an estimate of the timber supply situation in Kerala for the year 2010-11. The projected demand for timber during 2010-11 in Kerala is 22,28,000 $m^3$ roundwood. The households sector accounted for 24 per cent and industries sector 45 per cent of the total de-

mand. Export of wooden packing cases and other timbers to the neighbouring States, accounted for around 31 per cent. The actual export to foreign countries from Kerala was negligible. When the export demand for packing case timber is considered along with the industrial demand, around 74 per cent of the total demand was from the industries sector. Export of packing cases was of the order of 6,40,000 $m^3$ during 2010-11. Rubber wood alone contributed 5,29,000 $m^3$ in this export. Sawmills serving the household and institutions sectors processed 5,41,000 $m^3$; while packing case units, which are also sawmills, processed 6,40,000 $m^3$. Analysis of the timber supply situation in Kerala, revealed an export surplus of 3,17,000 $m^3$ during 2010-11. Contribution of forests was only 1.6 per cent and timber import represented 16.5 per cent of the total timber supply. Rubber estates in Kerala produced 46.6 per cent; home gardens and other estates, the remaining 35.3 per cent. Import from other States stood at 1,51,000 $m^3$, which included 83,000 $m^3$ of rubber wood. The actual import of timber from abroad was 2,16,000 $m^3$ during 2010-11. Timber imported from abroad was in the form of large dimension logs which have been severely depleted in the growing stock of timber in Kerala. Import of timber into Kerala has been growing and the trend is expected to continue in the future.The study reveals a comfortable situation in the matter of timber availability in Kerala, due to the large volume of rubberwood production which is used by the packing case, plywood and even furniture industries. With the abundance of timber in the Kerala timber market and the availability of modern machinery to process the timber, new units are bound to replace the outdated and inefficient ones. However, conservation of forests must be ensured by all means including restricting the location of sawmills near forest areas. The message in this study is to conserve the timber resources in the home gardens also besides forests to enable self sufficiency in large dimension timber, in the event of decline in availability of imported old growth timber from abroad in the future.

## Optimizing management of bamboo stands using growth simulation model. *KFRI Research Report No. 427* (K Jayaraman, RC Pandalai, MP Sujatha. 2012)

Bamboo (*Bamusa bambos*) is emerging as an important multiple-use plant both in forests and agricultural lands. However, no clear-cut guidelines have been found developed on optimal harvest levels based on quantitative methods. An attempt made in this direction is reported here based on a State level study initiated in the forests of Kerala. Maximum sustainable harvest was worked out using linear programming algorithm implemented on a transition matrix model that depicted the changes in culm numbers of different size classes over time. With the level of natural destruction found occurring on the shoots produced every year, sustainable harvest levels varied from 102 mature culms/ha annually to 832 mature culms/ha every ten years. Two cutting cycles of intervals three and five years, were evaluated through linear programming which maximized the land expectation value. With an annual discount rate of 9 per cent and average price of Rs 60 for a mature culm, five year cutting cycle was found better than three year cutting cycle especially when the management is poor. The optimal cutting intensity thus worked out to 50 per cent of the total number of culms in the stand every five years. At the current rates, the harvest value works out to Rs 27,832/ha every five years less costs of harvesting. This happens in the presence of natural destruction of the shoots amounting to 50 per cent every year. If we are able to reduce the extent of this damage, the harvests could be increased correspondingly. Study on the effect of soil properties on the growth of bamboo showed that increment in diameter of the clumps was not affected by many soil properties except for Aluminium and pH. However, the increment in height was found influenced by gravel and phosphorus content. Additionally, the effect of soil on ingrowth of culms and transformation from immature to mature stage of the culms was investigated. The production of new shoots is seen affected by soil reaction.

The transformation from immature to mature shoots reflective of the growth of the stand does not seem to be influenced by soil variables. With measurements coming from repeated measurements or larger number of plots, the results may get changed.

### Intensive cultivation for root production and technology for harvesting roots of five medicinal trees of Dasamoola. *KFRI Research Report No. 428* (N Sasidharan, KC Chacko. 2012)

The demand for herbal medicines, particularly in Ayurveda, the most prevalent herbal system in Kerala is increasing every year. The raw drugs for manufacturing Ayurvedic medicines are collected mostly from the wild. The continued exploitation of raw drugs from wild sources has resulted in their depletion. In order to meet the increasing demand, cultivation is inevitable. Traditional cultivation practices of tree species are not practical for extracting roots. The present study suggests a rapid root technology for Dasamoola which is very convenient for farmers. There is a notion that mature roots of older trees are superior and therefore preferred in the preparation of medicines. In order to assess the suitability of roots produced by rapid root production methods, comparative phytochemical analyses were carried out. The TLC profile obtained for phenolics, alkaloids and flavanoids show more or less similar pattern for the roots of young and mature *Brehetpanchamoola* trees. These findings indicate that roots of young trees are qualitatively as good as those from mature trees and can be used in the preparation of Ayurvedic medicines.

### Preparation of a detailed approach paper for adaptation are mitigation measures to deal with climate change in the forestry sector of Kerala state. *KFRI Research Report No. 429* (UM Chandrasekhara, Jose Kallarackal, Lakhwinder Singh. 2012)

In the present paper, the climate change impact factors such as precipitation, atmospheric temperature sea level changes and emission of greenhouse gases (GHGs) are discussed in the context of Kerala State. The high resolution daily gridded dataset for a period of 100 years (1901-2000) provided by the Climate Research Unit Time Series (CRU TS- version 2.10) was used to analyse the long-term trend of rainfall and temperature in Kerala. The mean annual rainfall and seasonal rainfall over the State showed an insignificant declining trend. However, throughout the State daily average, maximum and minimum temperatures increased irrespective of the season. The data available for a period of 68 years (1939-2007) showed that the sea level rose significantly at the rate of 1.49 mm/year. Among different landuse systems, forests are particularly sensitive to climate change. The possible impacts of climate change on forest species composition and diversity in Kerala are discussed. The forest cover in the State seems to be stabilised to around 17,382 $km^2$. However, information on the quality of existing forest cover and its current ability for buffering the impacts of climate change is lacking. Among several actions that can be taken in the forestry sector to promote mitigation include a) managing forests with high carbon uptake potential, b) expanding such forests through reforestation and afforestation, and c) reducing deforestation and reversing the loss of forest cover. By strengthening or continuing with programmes like social forestry projects and protection and conservation of forests, including sacred groves, already taken up by the Kerala Government, adverse effects of climate change can be mitigated. In the present paper, actions to maintain or enhance a) forest extent, b) biodiversity, c) forest health, d) productivity in forest ecosystems and e) forest soil and water, are identified as important adaptation strategies. A number of options are highlighted under each adaptation strategy.

## Strengthening and rehabilitating the bioresource nature park in the KFRI sub centre campus. *KFRI Research Report No. 430* (UM Chandrasekhara. 2012)

The Kerala Forest Research Institute, at its Sub Centre at Nilambur has developed about 12 ha of land into a Bioresources Nature Park. The Bioresources Nature Park has conservation themes for the lower groups of plants such as algae, bryophytes and pteridophytes, plants found in specialized ecological niche such as, xerophytes (cacti and succulents) and hydrophytes (aquatic plants), beneficial plants (eg. medicinal plants) and ornamental plants (eg. orchids), with special reference to endemic and rare, endangered and threatened (RET) species. During the project period, emphasis has also been given to collect plant propagules of ferns and angiosperms and assemble them in appropriate theme area in the Bioresources Nature Trail. Details of new species introduced and individuals of existing species that were replaced with healthy one are given in the report.

## Upgradation of small timber and Bamboo resources. *KFRI Research Report No. 432* (TK Dhamodaran, PK Thulasidas. 2012)

*Eucalyptus grandis* and *E. tereticornis* wood being non-durable, needs treatment with preservative chemicals. Vacuum-pressure impregnation.(VPI) treatment being more suitable for commercial scale applications in bulk quantity, an economical treatment schedule (15 minutes initial vacuum of 85 kPa followed by a pressure of 1300 kPa for 15 minutes and a final vacuum of 85 kPa for 5 minutes, denoted by 15'115'15') was developed for treating partially dry *E. grandis* wood with boron chemicals. m was achieved for wood in partially dried condition using a 6 boric acid equivalent (BAE) solution. Bamboo is found pressure treatable. An effective schedule capable for commercial scale pressure treatment of bamboo for industrial use was developed. some natural dyes yield colors by direct dyeing and do not require any mordanting whereas some other dyes impart a different color after mordanting.

## II. Ongoing Research Projects

### Ongoing Projects during the period 01-April-2011 to 31- March- 2012

| Project Number | Title | Principal Investigator | Funding Agency |
|---|---|---|---|
| RP 359/2000 | Taxonomy of palms (Component of an All India Coordinated Project coordinated by C Renuka) | Renuka C | MoEF |
| RP 399/2003 | Demonstrating the effect of controlling the teak defoliator on volume increment in teak in the permanent plots established at Nilambur | Sajeev TV | KFRI-PG |
| RP 401/2003 | Productivity and growth studies on sympodial bamboos and establishment of a monopodial Bambusetum | Pandalai RC | KFRI-PG |
| RP 403/2003 | Growth and yield studies in species trial plots establisahed by KFRI | Chandrashekara UM | KFRI-PG |
| RP 438/2004 | Improvement of Teak through genetic evaluation | Indira EP | KFRI-PG |
| RP 415/2003 | Maintenance of provenance trial plots of eucalypts and acacia and devlopment of new clones for establishment of Clonal Multiplication Area (CMA) | Maria Florence EJ | KFRI-PG |
| RP 440/2004 | Enriching of Live Collections of Wild Orchids and Ferns of Kerala and preparation of an illustrated manual | Sujanapal P | KFRI-PG |
| RP 441/2004 | Enrichment of insect culture collections at KFRI | Mathew G | KFRI-PG |
| RP 444/2004 | Strengthening and enriching the Palmetum | Renuka C | KFRI-PG |
| RP 445/2004 | Strengthening medicinal plants garden in the Peechi campus | Sasidharan N | KFRI-PG |
| RP 449/2004 | Participatory Forest Management and Ecodevelopment alternatives: Initiatives and challenges in Kerala | Mammen Chundamannil | KFRI-PG |
| RP 473/2005 | Recording of weather data at different centers of KFRI | Somen CK | KFRI-PG |
| RP 474/2005 | Establishment of a Clonal Multiplication Area for teak | Surendran T | KFRI-PG |
| RP 483/2005 | Enrichment of microbial culture collections at KFRI | Maria Florence EJ | KFRI-PG |

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| RP 490/2005 | Organising educational programmes at Teak Museaum KFRI Subcentre Nilambur | Sani Lookose | KFRI-PG |
| RP 499/2006 | Improving the yield and reducing the rotation age of teak plantations through superior clonal teak | Hrideek TK | KFRI-PG |
| RP 501/2006 | Strengthening and enriching Institute Central Nursery | Pandalai RC | KFRI-PG |
| RP 505/2006 | Strengthening and documentation of Wildlife Museum | Ramachandran KK | KFRI-PG |
| RP 506/2006 | Strengthening of floristic diversity in the KFRI Subcentre campus through planting and weed management | Chandrashekara UM | KFRI-PG |
| RP 512/2006 | Capability development in instrumental methods of analysis | Muralidharan EM | KFRI-PG |
| RP 516/2006 | Species recovery of *Dipterocarpus bourdillonii* and *Humboldtia bourdillonii* two critically endangered endemic trees of Western Ghats | Swarupanandan K | DBT |
| RP 525/2007 | Establishment of a soil museum at KFRI | Sujatha MP | KFRI-PG |
| RP 530/2007 | Digital Library in Forestry | Sarojam N | KFRI-PG |
| RP 531/2007 | Flowering Plants of Kerala- CD Version 2.0 | Sasidharan N | KFRI-PG |
| RP 533/2007 | Establishment of a Taxonomic Garden in the KFRI Sub Centre Campus | Chandrashekara UM | KFRI-PG |
| RP 536/2007 | Establishment of a Bamboo Technical Support Group for South Zone under National Bamboo Mission | Panadalai RC | NBM |
| RP 538/2007 | Carbon storage in different age teak plantations in Kerala | Thomas P Thomas | KFD |
| RP 547/2008 | Optimizing management of bamboo stands using growth simulation models | Jayaraman K | KFRI-PG |
| RP 548/2008 | Quality improvement of organic manures for reducing soil health hazards | Sujatha MP | KFRI-PG |
| RP 550/2008 | Vegetative propagation of selected medicinal plants for enrichment of resources - Phase II | Hrideek TK | KFRI-PG |
| RP 551/2008 | Ecophysiological responses of tree species to elevation gradient in the shola forests of Kerala | Chandrashekara UM | KFRI-PG |
| RP 552/2008 | Assessment of crop damage by wild animals in Trichur District Kerala | Jayson EA | KFRI-PG |
| RP 553/2008 | Phylogeny and generic classification of the woody bamboos (Poaceae: Bambu- | Muktheshkumar MS | NSF |

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| | soideae: Bambuseae) Collaborative project with Clark Lynn G IOWA State Univ USA | | |
| RP 559/2008 | Developing appropriate technology and establishing a plant for activated carbon production from coconut shells for community based organizations | Dhamodaran TK | ICAR |
| RP 561/2009 | Impact of Industrial activities on soil and water qualities in Koratty Panchayat area | Sandeep S | KSCSTE |
| RP 562/2009 | Bamboo resource development and utilisation in Karassery Panchayath | Raveendran VP | Karassery Panchayath |
| RP 564/2009 | Role of bamboo in sustainable rural livelihood in South India | Anitha V | NBM |
| RP 565/2009 | Structure and functioning of Bamboo Handicraft Industry in South India | Anitha V | NBM |
| RP 567/2009 | Species recovery of selected endangered rattan species of the Western Ghats | Indira EP | KFD |
| RP 568/2009 | Floristic studies in Aralam Wildlife Sanctuary | Sasidharan N | KFD |
| RP 569/2009 | Effect of crop rotation with short duration tree crops on the nutrient status of soil in clear felled teak plantation sites | Thomas P Thomas | KFD |
| RP 571/2009 | Kerala Forestry Statistical Database Data Mining and Information Dissemination | Sivaram M | KFRI-PG |
| RP 572/2009 | Technology for low-cost micro-propagation for *Bambusa balcooa* and *Thyrostachys oliverii* | Muralidharan EM | KFRI-PG |
| RP 573/2009 | Evaluation of *Ochlandra* germplasm mass propagation and field trials of elites | Thulasidas PK | KFRI-PG |
| RP 574/2009 | Computerisation of KFRI Herbarium | Sreekumar VB | KFRI-PG |
| RP 576/2009 | A Compendium of project profiles and a digital archive of project records in KFRI | Balagopalan M | KFRI-PG |
| RP 580/2009 | Development of a prophylactic control strategy for managing the mahagony shoot borer *Hypsyphyla robusta* in trial plantations | Mohanadas K<br>Sarojam N | KFRI-PG |
| RP 581/2009 | Indexing contents of the backvolume collections of KFRI Library | Sarojam N | KFRI-PG |
| RP 582/2009 | Digitization of Indian Forest Records Forest Bulletins and Forest Leaflets | Sajeev TV | KFRI-PG |
| RP 584/2009 | Establishment of tree health helpline for the State of Kerala | Sankar S | KSCSTE |
| RP 586/2009 | Ensuring sustainable livelihood of tribals through skill development and employ- | Jayaraman K | DST |

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| | ment generation: an action research programme in Wayanad Kerala | | |
| RP 591/2010 | Stock assessment and yield regulation for teak plantations in Kerala | Krishnankutty CN | KFD |
| RP 592/2011 | Growing stock of timber and industrial wood outside forests in Kerala | Chandrasekhara Pillai PK | KFD |
| RP 593/2010 | Storage practices in recalcitrant tropical forest seeds of Western Ghats | Sajeev TV | KFD |
| RP 598/2010 | Identification of phytochemical insect attractants in teak | Sajeev TV | KFRI-PG |
| RP 599/2010 | Spatial distribution and invasion dynamics of invasive alien weed *Mimosa diplotricha* in the Kerala part of Western Ghats | George KF | KFRI-PG |
| RP 600/2010 | Digital archival of rattan information | Renuka C | KFRI-PG |
| RP 601/2010 | Handbook on Indian palms | Renuka C | KFRI-PG |
| RP 602/2010 | Standardization for enhanced production of antagonistic principle by *Bacillus subtilis* and *Streptomycete* for the control of sapstain on rubber wood | Maria Florence EJ | KFRI-PG |
| RP 603/2010 | Use management and nuitritive value of edible non-crop plants in agroforestry and tribal landscapes of Kerala | Chandrashekara UM | KFRI-PG |
| RP 604/2010 | Testing of viability and germination percentage of stored seeds and assessment of planting stock quality | Pandalai RC | KFRI-PG |
| RP 605/2011 | Seed handling in selected forest tree species and medicinal herbs of Kerala | Pandalai RC | KFRI-PG |
| RP 606/2010 | Analysis of soil samples from kanor tree crops and agroforestry systems of Thrissur District Kerala | Sujatha MP | State Planning Board |
| RP 607/2010 | A decision support system for monitoring and forecasting timber prices of Kerala State | Sandeep S | KFRI-PG |
| RP 608/2010 | Impact of invasive weeds on the below ground communities in the forest landscapes of Kerala | Sudheendrakumar VV | KFRI-PG |
| RP 609/2010 | Conservation through restoration of two endemic endangered trees of Western Ghats of Kerala | Jose PA | KFRI-PG |
| RP 610/2011 | Preparation of a wetland atlas of Kerala | Vijayakumaran Nair P | KSBB |
| RP 611/2011 | Population evaluation and development of propagation protocol for three Rare | Somen CK | KFRI-PG |

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| | Endangered and Threatened (RET) trees fromm Kerala part of Western Ghats | | |
| RP 612/2011 | Detection and eradication of the giant African snail (*Achatina fulica*) in Kerala | Sajeev TV | KSCSTE |
| RP 613/2011 | Growth model for *Acacia auriculiformis* in relation to soil conditions in Kerala | Pandalai R C | KFRI-PG |
| RP 614/2011 | Genetic diversity and conservation of Teak phase II | Thulasidas P K | KFRI-PG |
| RP 615/2011 | Large scale propagation of *Embelia ribes* and *Embelia tsjeriam-cottam*-two important threatened medicinal plants through in vitro / in vivo techniques and repopulating the forests with participation of tribal groups | Raghu AV | KFRI-PG |
| RP 616/2011 | Tree flora of Kerala | Ssaidaran N | KFRI-PG |
| RP 617/2011 | Development of institutional capability for DNA barcoding of life forms | Muralidharan EM | KFRI-PG |
| RP 618/2011 | Pilot scale micro-propagation of important forestry species | Muralidharan EM | KFRI-PG |
| RP 619/2011 | Vetiver system technology for river bank stablilisation | Sandeep S | KFRI-PG |
| RP 620/2011 | Population ecology of the Lion tailed macaque in Silent Valley National Park its buffer zones and Muthikulam High Value Biodiversity Area | Sreekumar VB | KFRI-PG |
| RP 621/2011 | Appraisal of Forest Rights Act 2006-Implementation among the primitive tribal groups (PTGs) in Kerala | Anitha V | KFRI-PG |
| RP 622/2011 | Development experiences of selected groups of Scheduled Tribes in the Kerala part of Western Ghats | Amruth M | KFRI-PG |
| RP 623/2011 | Taxonomic manual on Indian Palms | Sreekumar VB | KFRI-PG |
| RP 624/2011 | Development of seed handling technologies for selected bamboo species | Pillai PKC | NBM |
| RP 625/2011 | Biosystematics and conservation biology of the genus *Cinnamomum* in the Western Ghats | Hrideek TK | MoEF |
| RP 626/2011 | Genetic status and livelihood trajectories of Cholanaickan Tribal Women with reference to Sickle Cell Anaemia | Suma TB | DST |
| RP 627/2011 | Long term studies on climate change | Sajeev TV | KFRI-PG |
| RP 271/2011 | Reinvestigating study plots established by KFRI during 1975-2010 to measure for- | Sreejith KA | KFRI-PG |

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| | est migration range shifts of species and compositional changes in the context of climate change | | |
| RP 627.2/2011 | Establishment of permanent plots in all forest types along the elevation gradient for continous monitoring of climate change induced variations | Sreekumar VB | KFRI-PG |
| RP 627.3/2011 | Seed ecological and regeneration studies on key stone species of the evergreen and moist decidous forest ecosystems | Chandrasekhara Pillai PK | KFRI-PG |
| RP 627.4/2011 | Preparation of protocols for availing carbon finances for forests of Kerala | Sajeev TV | KFRI-PG |
| RP 628/2011 | Population structure carbon sequestration litter dynamics propagation economics and livelihood potential of *Pseudoxyanthera ritcheyi* and *Ochlanra setigara*-Two rare bamboo species of Kerala | Kuruvilla Thomas (Coordiantorship changed to E M Muralidharan) | KFD |
| RP 635/2012 | Establishment of herbal gardens in selected 100 schools of Palakkad and Malappuram districts of Kerala | Sujanapal P | NMPB |
| RP 632/2012 | Environmental lmpact of Pesticide Application in Cardamom Hill Reserves (CHR) of Southern Western Ghats | Jayaraj R | KFRI-PG |
| RP 631/2012 | Soil and water quality status of Kadukutty region | Sandeep S | KFRI-PG |
| RP 636/2012 | Inventory of wetlands of kerala | Vijayakumaran Nair P | ESD-GOK |
| RP 637/2012 | Rehabilitation of two industrially important endangered species *Santalam album* (chandanam) and *Saraca asoca* (Asokam) in homesteads of Palakkad and Malappuram districts of Kerala | Sujanapal P | SMPB |
| RP 638/2012 | Handbook on mangroves and mangroves associates of Kerala | Sujanapal P | KSBB |
| RP 633/2012 | Soil organic carbon pool and its dynamics in the managed teak plantations of Kerala | Sandeep S | KFRI-PG |

## III. Highlights of Ongoing Research Projects

### All India coordinated project on the Taxonomy of Microlepidoptera

Intensive survey of Microheterocera was made from different parts of Southern Western Ghats. Sampling of insects was done by light trapping method. Altogether, 67 species of Microheterocera belonging to the families Psychidae, Tineidae (Tineoidae), Oecophoridae, Ethmiidae, Lecithoceridae, Gelechiidae, Blastobasidae, Cosmopterigidae (Gelechioidea), Plutellidae, Yponomeutidae, Lyonetiidae, Glyphipterigidae and Heliodinidae (Yponomeutoidea) were recorded. A major share of moths collected in the study belonged to Gelechiidae, Tineidae, Oecophoridae and Cosmopterigidae. The faunal elements contained several new records for the region - six species as new records for Kerala; 44 species as new records for Southern India and two species as new records for India. Studies on the morphology of various species with special reference to head appendages, wings and external genitalia 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. An identification key for various species using wing venational and external genitalial characters was prepared for easy segregation of species studied. In addition, an inventory of species recorded in this study along with details of collection localities, distribution and hosts is also given.

### Productivity and growth studies on sympodial bamboos and establishment of a monopodial Bambusetum

The sympodial bambusetum of the Institute located at the Field Research Centre campus, Velupadam holds more than 68 different species of bamboos. The growth monitored from the collection revealed that culm production increased from the second year of planting and came to a peak by the seventh year. Depending on the management practices, the productivity could be increased even after the initial six to seven years. Species like *Bambusa membranaceus, B. polymorpha* and *B. nutans* exhibited better growth and maximum culm productivity. Similarly *Dendrocalamus sikkimensis, D.brandisii* and *D. asper* performed best in the bambusetum. Five species of monopodial bamboos have been planted in the high range site at Devikulam, and their growth performance is being monitored.

### Establishment of an Arboretum of rare and characteristic species of moist deciduous forests of Kerala

Tropical forests are regarded as a storehouse of vast biological wealth. The species richness of tropical forests is tremendous as compared to subtropical and temperate forests. The Institute has made an attempt to assemble a live collection of several arborescent species in one place by establishing an Arboretum. The project initiated in 2003 contains, at present, more than 180 species of trees, herbs and shrubs of evergreen, moist deciduous, and swamp forests. As on date, 3,569 accessions of 170 species with more than 30 per cent endemics have been established and growth behavior is being studied.

### Improvement of teak through genetic evaluation

The objective of the project has been the genetic evaluation of the plus trees selected in Kerala. The

data collected on genetic variability and inheritance pattern of some economically important characters of teak were analyzed to facilitate selection of a few elite trees/ clones. The relationship between the plus tree clones was evaluated through microsatellite markers. Early evaluation of plus tree progenies showed that the geographical origin of the families had no influence on the growth performance. Earlier studies at KFRI also showed that teak exhibited high diversity within population. The phenotypic and genotypic coefficients of variation as well as family heritability were moderate for growth in general. DNA marker studies employing microsatellites revealed high genetic variability between plus tree clones and hence, the clones could be distinguished from each other even with very few microsatellite markers.

Teak plus tree at Kannavam

## Habitat enrichment in the butterfly garden at KFRI campus Peechi

Butterflies are fascinating organisms of nature exhibiting enormous diversity of form and function. They play a useful role in a forest ecosystem and serve as pollinating agents for several forest plants. With the denudation of forest cover several species of butterflies have diminished in their abundance. The situation demands appropriate conservation measures to support their population growth. The objective of this project was to maintain the butterfly garden at Peechi and to introduce themes to make it more attractive to visitors. The butterfly habitats were enriched through host plant introduction. Environmental education was provided to the visitors by explaining butterfly conservation activities. Over 35,000 persons visit the garden annually. Besides popularizing the concept of butterfly gardening, creation of conservation awareness among the public was also successful.

Butterfly garden

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

The project aimed at establishment of a germplasm collection of superior planting stock of five species of medicinal plants (viz., *Trichosanthes cucumerina, Merremia turpethum, Salacia oblonga, Saraca asoca* and *Ipomoea mauritiana*), standardisation of propagation and agrotechnology and distribution of superior planting material. The germplasm established from vegetatively propagated and field planted material of *Saraca asoca, Salacia oblonga* and *Merremia turpethum* was periodically monitored for growth and survival. As part of transferring the technology developed for mass multiplication of *Saraca asoca*, a one day workshop was conducted for the Range officers and Foresters of Kerala Forest Department.

## Genetic diversity and conservation of teak

A total of 97 samples of teak of various ages were sampled from plantations and natural teak growing areas in 23 localities of India, including the moist and dry deciduous forests of Madhya Pradesh, Maharashtra, Tamil Nadu, Karnataka, Andhra Pradesh, Kerala, Gujarat, Orissa, Chattisgarh and Rajasthan. The collected wood samples were grouped into Age Class I (up to 24 years); II (25-34 years); III (35-44 years); IV (45-54 years); V (>55 years) for studying the selected properties such as diameter at breast height, percentage of heartwood, average ring width, density and colour and anatomical properties. Tree diameter at breast height (DBH) of all the 23 provenances varied significantly between trees among all the provenances irrespective of age groups. DBH of the trees showed a positive correlation with age and heartwood percentage. Teak attained maximum diameter in the states of Kerala, Tamil Nadu, Karnataka, Maharashtra and Gujarat. Nilambur provenance differed significantly and stood superior to other provenances showing faster growth rate (wider rings) and attained maximum dbh of 72.5 cm in age class V (>55 yrs) with maximum heartwood proportion (94.8%). Ring width differed significantly between the 23 provenances and it varied within the age classes with maximum values recorded from Nilambur provenance (7.6 mm) followed by other provenances from Kerala, Tamil Nadu, Karnataka, Maharashtra and Gujarat. Wood basic density stabilized after attaining maturity in age class I and thereafter did not show any significant variation except the age-related structural changes. The densest (692 kg/m3) and lightest wood (473 kg/m3) was recorded from Banaswara (Rajastan) and Khariar (Orissa), respectively. Wood colour varied among the provenances from yellowish brown to light yellowish brown or dark yellowish brown and occasionally brown to dark brown.

Teak Seedling

## Establishment of a Clonal Multiplication Area for teak

Genetically superior planting stock has great importance in achieving higher productivity from teak plantations. The superior trees known as plus trees are selected as source material for raising the planting stock. For mass production of the superior stock from such trees, multiplication is done by clonal propagation. The Clonal Multiplication Area (CMA) of teak established in KFRI campus during 2008 with this objective contains, at present, 750 rooted cuttings planted in four separate blocks. They were maintained for further clonal propagation. These plants established were cut back at a height of 1 m to allow them to branch profusely and to form a hedge which would provide sufficient number of juvenile shoot material for large-scale propagation of superior teak clones. These are intended for establishing clonal plantations of teak with enhanced productivity.

Clonal multiplication area of teak

## Multilocational field trials of selected bamboo species in Kerala

Multilocational trials were conducted in Palakkad district of Kerala were to assess the performance of eight species of bamboos and evaluate the cultivation practices with respect to spacing, intercropping and clump management. The bamboo plantations were established both in farmers' fields and on government land. The results indicated that at the end of 4 years all the species raised through rooted cuttings (*B. balcooa, B. nutans, D. hamiltonii*) performed better compared to tissue culture and seedling propagules. The highest biomass per culm was observed in *B. balcooa*. Three-year observations on spacing trial of *O. travancoria,* indicated that the seedlings spaced at 9m x 4.5m x 4.5m and 5m x 5m produced the highest number of culms, and thereby, maximum yield. Intercropping with *B. bambos* was found to be promising in the initial years. However, definite conclusions could not be drawn as the plots caught fire during the summer season of 2008.

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

Clonal propagation of plus trees of teak was carried out in the mist chamber, applying the cloning technology. In order to raise trial clonal plantations about 6,000 clonal plants were produced during 2009-10 by macro- and micro-propagation methods. Trial clonal plantations were raised at three different locations of Kerala: South (Palode), Central (Vellikulangara) and North (Nilambur). The area of trial clonal plantations was 1 hectare each and 1,200 clonal teak plants were planted at a spacing of 3x3 m. Each plan-

Clonal plantation of teak

tation had 6-7 promising clones planted in a linear design so that growth monitoring and comparison of clones could be easy. The multilocational trials will give a clear picture of field performance of different clones of teak.

## Strengthening and enriching Institute Central Nursery

Central nursery facility was developed in the institute campus, where seedlings and propagates of around 80 different species of forest trees and medicinal plants were raised and distributed to the State Forest Departments, farmers and others interested in forest tree planting. The total revenue earned by the Institute through the sale of seedlings alone was to the tune of Rs.3 to 4 lakhs. Production of quality teak stumps for sale was one of the major sources of income to the nursery. About 20 teak nursery beds were prepared. Timely care was given to the seedlings of teak by application of fertilizer, fungicide and pesticide as and when necessary. About 20,000 teak stumps of good quality were produced and supplied to the public.

Nursery Beds

Sandal seedlings in vermiculate

## Management and monitoring of growth of coppice crop in the experimental plantations of *Eucalyptus tereticornis* (Kayampoovam and Punnala) and *E. grandis* (Sooryanelli and Vattavada)

The experimental sites were maintained by regular weeding and coppice reduction. The growth of coppice crop of *Eucalyptus tereticornis* and *E. grandis* was measured and the growth data analyzed to assess residual effect of silvicultural treatments carried out in the first rotation. The growth response to nitrogen input varied in both first rotation *E. tereticornis* and *E. grandis* plantations and the treatment effects were significant. However, in the second rotation, productivity of the plantations at the age of 48 months ranged from 8.2 to 10.8 and 15.2 to 20.2 $m^3\ ha^{-1}\ yr^{-1}$ for *E. tereticornis* and *E. grandis* respectively, indicating the absence of residual effect of nitrogen application in the second rotation. Weed management resulted in significant improvement in productivity of *E. tereticornis* plantation. However, the effect of weeding on growth was non-significant in *E. grandis* plantation probably because of the early canopy closure in these plantations which, due to its shade, suppressed the understorey weed growth. Growth of the second rotation coppice crop of *E. tereticornis* in the weed management plots showed significant residual effect till 18th month after harvest. However, the trend was non-significant thereafter. The productivity of the plantation at 48 months was $m^3\ ha^{-1}\ yr^{-1}$ in the totally weeded plots. The residual effect was non-significant in the second rotation coppice crop of E. grandis plantation throughout the study period. The productivity of second rotation E.

grandis plantation was 13 $m^3$ $ha^{-1}$ $yr^{-1}$ after 48 months.

## Species recovery of *Dipterocarpus bourdillonii* and *Humboldtia bourdillonii* - two critically endangered endemic trees of Western Ghats

One of the objectives of the study was to examine reproductive constraints in *Dipterocarpus bourdillonii* and *Humboldtia bourdillonii* which could be one of the factors for poor regeneration of the species. Hence, the reproductive biology of the two species was analysed in detail. Both the species were out crossed in nature and were cent per cent self incompatible. In *H. bourdillonii,* in both self and cross pollinated flowers, the pollen tubes reached the ovules but no fruit set was seen in selfing which indicates the presence of late-acting self-incompatibility (LSI) or ovarian self-incompatibility(OSI). Altogether 77 per cent of the fruits were found damaged by insects and animals. The percentage of germination was around 37 per cent. The seedlings, field planted in the KFRI campus, showed good growth. Though *D. bourdillonii* flowered profusely, very low percentage of viable seeds were seen. The rest were non-viable with crumbled and deformed embryos. A large chunk of flowers were found damaged by insects eating flowers, pollen and seeds. Most of the ovaries were found infested with insect larvae. Moreover, fungal attack led to browning and abscission of flowers and fruits.

*Dipterocarpus bourdillonii* planted seedlings at PTR (W)

Artificial pollination experiments showed that fruits developed both through apomixis and selfing, but the embryos turned deformed and aborted later indicating the late acting self incompatibility. Fifty per cent of the artificially cross pollinated flowers turned to fruits with viable embryos. Natural fruit setting also occurred, but with only 3 per cent germination. Role of insects as pollinators was also looked into.

## Processing, storage and supply of seeds of teak and miscellaneous forest tree species through KFSC

A total of 29,187 kg of teak seeds from the Seed Production Areas of all the six Research Ranges of KFD were brought and processed at Kerala Forest Seed Center (KFSC). The clean, graded seeds weighed 25,772 kg, out of which 25,719 kg seeds were distributed to Kerala Forest Department, Kerala Forest Development Corporation, farmers and other entrepreneurs. Similarly, seeds of miscellaneous forest tree species were also collected from different Forest Divisions for processing and distribution. Two training programmes, one on 'Collection, processing and storage of seeds of medicinal plants and management of seed centre under FRLHT Programme (8 -11 June 2009) and the second one 'Collection and processing of seeds and nursery techniques of selected forestry and

Seed germination

Teak seed - uncleaned & cleaned

medicinal plants' (30 March 2010) were conducted for the Forest Officials of five South Indian states and members of the Vana Samrakshana Samithi from Kerala. Brochures and leaflets were prepared in English for free distribution among the participants of different training programmes and to those interested in forest tree cultivation.

## Biodiversity of Iringole Sacred Grove

Iringole Sacred Grove (10°6'31"N 76°30'28"E) located in the Perumbavur Municipal Town is perhaps the largest and the best preserved among all the sacred groves in the State with an extent of about 10.53 hectare. Topographically, it is almost a plain land covered by semi-evergreen vegetation and surrounded by human habitations, roads, homesteads and cultivated areas. The Grove represents a traditional 'nature worship' in which natural ecosystems are devoted to ancestral spirits and deities, thereby providing protection and conservation in its most traditional form. KFRI conducted a multidisciplinary study of the flora and fauna of the grove. The most abundant species were *Artocarpus hirsutus, Hopea ponga, Strombosia ceylanica* and *Vateria indica.* The girth class distribution and IVI were analyzed for all the grids laid out. The flora showed a high degree of endemism; of the 210 species recorded from the grove, 39 species were endemic to India. Rare, endangered and threatened species were also recorded from the grove. Several species of lianas were also recorded. A total of 215 species of macrofungi falling in 95 genera and 28 families were encountered in the sacred grove. A total of 342 species of animals including invertebrates and vertebrates were recorded. Insects were the dominant group among the invertebrates. Eight species of amphibians, 15 species of reptiles, 65 species of birds and nine species of mammals were recorded.

## Linking conservation and forest management with sustainable livelihoods and resource use conflict in the Kerala part of Agasthyamala Biosphere Reserve

Agasthyamala Biosphere Reserve (ABR) has a resident population of indigenous communities who have established distinct systems of knowledge relating to the uses and management of biological diversity on these lands. The Kanis have been historically engaged in agriculture and dependent on the forest products for their livelihood needs, although the pattern of dependence and sustainability levels has changed. Land use changes in the Agasthyamalai Biosphere Reserve (ABR) have been highly complex due to human interactions over a period of time. Shifting paradigms in land use in ABR call for critical land use evaluation for stability and sustainability in the spheres of agricultural

production, environmental conservation, socioeconomic factors and societal welfare. There is a need to facilitate integrated interactive dialogue among various institutions especially the Government Departments such as Forest Department, Irrigation and Tourism. Neyyar, Thenmala, Peppara and Agasthyakoodam are fast emerging as a potential ecotourism and cultural tourism sites in ABR and can be considered a viable alternative to the conservation of forest and enhancing the standard of living of the depending communities. Strategies and Action Plan for sustainable recreation should essentially be in line with the 'Pro-Poor Tourism' focusing on economic, non-economic and policy reforms.

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

The project aimed at developing an improved and effective participatory management system of stakeholders and demonstrating its impacts on conservation and sustainable management of NTFPs in the study areas. The study conducted in Begur region of Wayanad district comprised a number of programmes and activities aiming to improve the livelihood of the selected communities. It included training on various income generating activities like bamboo handicraft, mushroom cultivation, among others. A number of meetings of the stakeholders were also conducted to develop effective participatory management in the study area. A resource management committee of the tribes was constituted to implement activities visualized in the project. During the early period of the project, unemployment was very acute. Thus it was felt that livelihood improvement programmes should be introduced to enhance the income. KFRI and URAVU jointly met the Forest Department to get funds for forestry operation. The Forest Department received fund from National Rural Employment Guarantee Programme (NREGP) which was used to generate employment in the forestry sector, consequent to this, the employment opportunities improved. The communities preferred other jobs which gave higher income as income received from NTFP collection was very low during this period. Since the income from non-forestry sources showed an increasing trend, income from the collection of NTFPs showed a decreasing trend, indicating that there was only less collection of NTFPs. Further, the tribes were advised to practice sustainable collection of NTFPs. As a result, density of NTFPs in the study area was found to be increasing over a period.

## DNA barcoding of satyrine butterflies of Peninsular India

Studies pertaining to morphology of the external genitalia were made on twenty-five species of satyrine butterflies collected from different locations in the Kerala part of Western Ghats. Based on an evaluation of resemblances of genitalial parts, these species were categorized under five separate groups. The first group contained *Melanitis leda, Melanitis phedima, Mycalesis anaxias, Mycalesis oculus, Lethe drypetis, Lethe rohria* and *Zipoetis saitis.* Of these, *Mycalesis anaxias, Mycalesis oculus* and *Lethe rohria* formed a subgroup distinct from the others. The second group contained *Mycalesis perseus* and *M. igilia.* These species shared

Nigger (*Orostriona medus mandata* Moore )

resemblance with *Lethe rohria, Mycalesis oculus, Mycalesis perseus, Mycalesis subdita, Mycalesis igilia* and *Mycalesis adolphei.* Each of the remaining species viz., *Mycalesis patina, Mycalesis subdita* and *Ypthima baldus* showed distinctness in their identity. Among these, *Ypthima baldus* stood out separately from all the rest in the structure of valvae, uncus and phallus.

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

A Bamboo Technical Support Group (BTSG) for South Zone was established at KFRI with financial support from National Bamboo Mission to popularize bamboo cultivation and to boost the income of farmers and artisans through bamboo cultivation and processing. The group organized 12 exposure visits and trained 361 farmers from Kerala, Tamil Nadu and Maharashtra. Six training programmes were organized on 'Priority species, resource estimation, plantation development, post-harvest technology and socio-economic and livelihood potential of bamboos' to field functionaries of the programme. A total of 119 participants from four states, Kerala, Karnataka, Maharashtra and Andhra Pradesh benefited by the training programmes. Necessary technical support was also provided to Kerala State Bamboo Steering Committee by providing required information. A brochure on training programmes and BTSG was printed and reading material was compiled for training of the field functionaries.

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

Establishment of a bioshield was taken up for protection of tsunami-affected coastal areas at Vadanappally, Kerala by strip planting of bamboos and other species along the coastline. Nurseries were established at Peringottukara, Kadappuram and Mathilakam for raising the planting stock. *Casuarina equisetifolia* and 14 other species suitable for coastal areas were raised in these nurseries. Adequate planting stock was produced for planting in bioshield in 10 Panchayaths starting from Kadappuram to Eriyad. The bioshield establishment was undertaken on a participatory mode. Stakeholder meetings were held at different Panchayaths and awareness campaigns about bioshield were held. Following planting, periodic observations were recorded on growth of mixed and single species bioshield. Soil analysis was done to decide on post-planting input required for boosting the growth. As an outcome of the project, bio-shield of 32 km was established in 10 Panchayaths in coastal areas.

Bioshield with *Casuarina*

## Carbon storage in differently aged teak plantations in Kerala

An attempt was made to evaluate the carbon sequestration potential of teak plantations. Plantations of teak at different thinning stages and at final felling were selected in Nilambur to study the carbon storage potential. Carbon content in different pools, viz., above-ground and below-ground parts of the teak tree, the undergrowth, litter as well as in the soil were estimated by destructive sampling of felled trees and by soil sampling and analysis.

## Symbiotic nitrogen bacteria-supported INM for rosewood plantations in degraded acid soils of Western Ghats

The objectives of the project were identification of suitable dosages and combinations of nitrogen fixing bacteria, compost and NPK through field trials and development of integrated nutrient management (INM) package for *Dalbergia latifolia* for plantation management. The experiment for developing INM package was conducted through both nursery and field trials. The nursery trials comprised five treatments laid out in completely randomized design. The results showed that biofertilizers along with low doses of chemical fertilizers gave growth improvement synergy. The biofertiliser-applied seedlings, in general, showed an increase in the uptake of N, P and K and as in other cases. Treatment with 50 per cent NP+bioinoculam resulted in significantly higher uptake of N and P over other treatments. Application of bioinoculant consortium significantly improved number of root nodules. As expected, enhanced rhizosphere population of Phosphate Solubilizing Bacteria (PSB) and higher VAM infection were observed in seedlings treated with bioinoculant consortium as compared to control and recommended practice of NPK. More number of PSB and VAM were observed in seedlings to which bioinoculant consortium was applied either alone rather than its combination with chemical fertilizers.

## A field study to evaluate the efficacy of lemon grass in controlling runoff and soil erosion

Impoverishment of fertile surface soil due to erosion is a major problem in both agricultural and forest ecosystems in high rainfall areas like Kerala. Establishment of a crop cover is an efficient way to minimize surface runoff and thereby control the loss of surface soil. Runoff studies carried out at the Field Research Centre of KFRI at Velupadam, with two species of lemongrass, namely, *Cymbopogon flexuosus* and *C. albescens* and Vetiver (*Vetiveria zizanoides*) revealed that all the three were efficient in reducing runoff and conserving soil. The efficacy of these decreased in the order *V. zizanoides*> *C. flexuosus*> *C. albescens.*

## Forestry sector analysis for the State of Kerala

The study to evaluate the supply-demand situation of teakwood in Kerala based on econometric modelling revealed that the demand of teakwood in Kerala is highly influenced by the current price of teak, lagged population and lagged per capita income of Karnataka. Similarly the supply of teakwood is found to be influenced by lagged values of consumption and price of teakwood. The future trends for price and demand worked out showed a generally increasing trend for both teak prices and demand beyond 2004-05 but for the yearly alternating fluctuations in both the cases. A study on the periodic behavior of production and price of teakwood indicated that production of teakwood from forest has no significant peaks and hence there is no cyclical pattern. On the whole, some market adjust mechanisms seems to be operating with a cycle of 3 to 5 years. Attempts were made to study the pulpwood requirement of the State using data obtained from Hindustan Newsprint Ltd. (HNL). There was a gradual increase in the consumption of pulpwood over the years which naturally reflect-

ed on the production of newsprint as well. HNL uses different types of raw material such as wood, bamboo, reed and waste paper. The wood consists mainly of eucalypts, acacia and mangium. Nearly 40 to 50 per cent of the total consumption consisted of wood. The next important material was reed but over the years, the percentage contribution has come down drastically and has been replaced by bamboo. The use of imported pulp although was prevailing in the earlier period, came down to almost nil by 2003. Since that period, waste paper is getting increasingly used reaching to almost 25 per cent of the total consumption by 2008. The projections made for the six years after 2008-09 showed further increase in total consumption of raw materials in HNL. The high production cost of HNL was preventing them from lowering the price of their products. With the result, the products were remaining in the factory lying unsold. In turn, the unit was unable to utilize the raw material that was piling up. Currently, an intervention from the government is called for.

## Optimizing management of bamboo stands using growth simulation models

The study was taken up with the objectives of developing a growth simulation model for bamboo stands, to optimize the harvesting schedules and to study the influence of soil on growth of bamboo. 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. Observations on clump diameter, height and number of culms of different size classes in the selected clumps were recorded. Girth at breast-height and identity of the miscellaneous species in the plots were also recorded. Soil samples were collected from each sample plot for analysis. The mean clump diameter in the 22 plots ranged from 0.83m to 3.79 m. The number of clumps per hectare varied from 72 to 444, the number of immature culms per hectare varied from 573 to 1780 and the number of mature culms per hectare varied from 818 to 3239. The average height of the tallest culms varied from 10.1m to 22.5 m.

## Quality improvement of organic manures for reducing soil health hazards

Composts were made out of common weeds such as *Eupatorium, Macaranga* and a mixture of weeds at KFRI, Peechi through aerobic composting. Various types of inocula such as, cowdung, microbial consortium, Jeeevamrutham (combination of germinated green gram, coconut water, soil, cowdung, cow urine, and water) were tried to speed up the composting process. Data indicated that application of microbial consortium and jeevamrutham reduced the composting period from 110-120 days to 80-85 days, when cowdung alone was used. Results also pointed out that the practice of application of urea during composting can be eliminated by the use of above inocula. All the compost samples collected were analyzed for pH, organic carbon, N, P, K, Na, Ca, Mg, Fe, Cu, Zn Mn, among others. It was found that, as compared to most of the market samples, mixed weed composts were rich in nutrients. High values for N and P in some of the samples marketed by private companies are probably due to the artificial addition of those nutrients.

## Vegetative propagation of selected medicinal plants for enrichment of resources - Phase II

Vegetative propagation trials were carried out in mist propagation chamber to standardize the propagation methods for the selected medicinal plant species. The species studied were *Coscinium fenestratum, Embelia ribes, Clerodendrum serratum, Salacia fruticosa* and *Oroxylum indicum.* Stem cuttings of the plants were treated with rooting hormones and were planted in vermiculite-filled root trainers kept inside the mist propagation chamber. The rooting trials were carried out on a monthly interval, in order to study the seasonal effect on rooting of these plants. The trials showed that soft

wood cuttings with leaves were more suitable for propagation purpose.

*Coscinium fenestratum* propagation

## Ecophysiological responses of tree species to elevation gradient in the shola forests of Kerala

A study was undertaken to compare and contrast the ecophysiological features of different shola species along an elevation gradient and to analyze physiological response to elevation by some co-dominant shola tree species. The vegetation analysis was completed in three patches of shola forests along an elevation gradient in the Anaimudi National Park. A total of 12 shola tree species were selected for detailed ecophysiological studies. Propagules of these species were planted in plots established in the shola forest patches located along the elevation gradient for in-situ studies on ecophysiological properties of these species.

## Developing appropriate technology and establishing a plant for activated carbon production from coconut shells for community based organizations

The objective of the project was to develop appropriate technology and establish a community level activated shell carbon production plant. A work shed was constructed at the project site in Kasaragod to house the plant and machineries developed. A continuous carbonizing plant with an input capacity to process 6 tonnes of shells per day and with an output of around 2 tonnes charcoal per day was designed, fabricated and installed at the project site. Also a Rotary Fluidized Bed Reactor (RFBR) with an input capacity of 2 tonnes of charcoal and an output of 0.6 to 1.0 tonnes of activated charcoal per day, was developed and installed. Adequate quantity of raw material, namely coconut shells, were procured and stored for trial runs.

## Impact of Industrial activities on soil and water qualities in Koratty Panchayath area

The study was undertaken to analyze the problem of industrial pollution of soil and water in Koratty Panchayath. Sampling of soil and water from selected areas in Koratty was done twice in a year during pre- and post-monsoon periods to assess the quality in relation to land use, especially industrial activities. Soil samples were analyzed for physical and chemical properties including heavy metals. Water samples from wells, ponds and streams were monitored for physico-chemical parameters including the presence of heavy metals and pesticide residues. Other parameters such as dissolved oxygen and biochemical oxygen demand were also looked into.

## National Carbon Project: Spatial assessment of vegetation and soil carbon pool of Northern Kerala

The project was part of a larger National level initiative supported by ISRO. The major objectives

Carbonizing plant

of the vegetation carbon pool assessment were appraisal of terrestrial vegetation biomass in the country and generation of geospatial data of the terrestrial phytomass along with estimates of uncertainty. The soil carbon pool assessment sub project was aimed at determination of soil organic carbon in surface and sub-surface soils and inorganic carbon in arid regions, devising an integration methodology for spatial mapping of soil carbon pools and generating soil carbon spatial data sets along with estimation of uncertainty. Under this subproject, determination of soil organic carbon in surface and sub-surface soils of forests of Northern Kerala region was covered. Assessment of vegetation carbon pool was the major thrust area of the current project. Information on trees outside forests (TOF) was generated in three phases: land use classification and mapping; identification of tree-cover classes; and measurement of tree characteristics. Satellite images and aerial photos were suitable for the first two. High-resolution satellite images allowed identification of single trees (or crowns) which could be a data source for a large-area TOF inventory.

## Role of bamboo in sustainable rural livelihood in South India

The bamboo-based industry in Kerala is classified into the organized and unorganized sectors. In Kerala, the marginalized bamboo-dependent (MBDs) communities are socially and economically weaker sections and are involved in the unorganized bamboo-based productive activities. The market features of the bamboo products made by the MBDs are not so encouraging and this calls for strategic initiatives for their improvement. A market analysis of the bamboo products showed that the opportunity cost was greater than the earned benefit and the community was underpaid even during the peak period of sales. 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.

## Structure and functioning of bamboo handicraft industry in South India

A reconnaissance survey was conducted in the South Indian states (Kerala Tamil Nadu, Karnataka and Goa) to understand the problems faced by the industry. During the survey, 80 handicraft units were identified in Kerala which included both registered and unregistered units. Data were gathered from the 25 units in Kerala, 10 units in Karnataka and 15 units in Tamil Nadu. Preliminary observations showed that production of bamboo handicrafts, traditionally a hereditary occupation restrict-

ed to a particular caste, is now practised by anyone who has the aptitude and skill for the same. This is where the non-traditional sector comes into prominence. Although both the sectors used the same raw material, the inefficacies pertaining to production, marketing and technology were different. A majority of the non-traditional handicraft units were very small with low investment. Besides, cost escalation and low surplus generation in the past few years made investment in this sector less attractive. The value addition or surplus generation in manufacturing of bamboo handicrafts by the non-traditional sector was very low. Development of technology in this sector was also low since the activity was carried out by the socially and economically weaker sections in the society.

Handicraft making

## Species recovery of selected endangered rattan species of the Western Ghats

The study aimed at assessment of genetic structure of the populations using molecular markers and identification of molecular markers for sex determination. Four endangered rattan species, *Calamus brandisii, C. dransfieldii, C. travancoricus* and *C. vattayila* were selected for recovery. Seeds were collected from different populations from Kerala and Karnataka. Young leaves of the rattans were collected from the Kerala part of Western Ghats. Leaves from both sexes were collected separately. A protocol was standardized to extract the DNA. Modified CTAB method was adopted. Identification and selection of the primers were done. Eleven RAPD primers were procured and screened for polymorphism. One population each of *C. travancoricus* from Achenkovil and *C. vattayila* from Nelliampathy was analyzed for polymorphism and genetic diversity. Screening of RAPD primers for sex determination did not yield any encouraging result. Seedlings of *C. vattayila, C. travancoricus* and *C. brandisii* were raised, polypotted and maintained in the nursery to be transferred to the Forest Department, during the next rainy season.

## Floristic studies in Aralam Wildlife Sanctuary

A floristic study was conducted in the Aralam Wildlife Sanctuary to find out areas that were floristically rich and to elucidate the dominant plant groups, endemics, rare and threatened plants. The Sanctuary was dominated by semi-evergreen, moist deciduous and evergreen forests. Vegetation at Ambalappara (the highest peak) was similar to southern subtropical hill forests. During the collection trips about 400 species were collected. The collected specimens were processed and dried for preparing herbarium sheets. A preliminary analysis of species identified indicated that the sanctuary had several interesting, endemic and RET

category species. *Maytenus wallichii* and *Belolepis nervosa* collected from the sanctuary were new record of occurrence for Kerala.

*Calophyllum austro-indicum*

Rare plants like *Paracroton integrifolius, Didymoplexis pallens, Orophea sivarajanii, Ixora sivarajiana, Marsdenia raziana, Salacia beddomei, Eugenia argentea, Jerdonia indica, Goniothalamus cardiopetalus, Calophyllum austro-indicum, Strobilanthes sessilis, Swertia beddomei, Swertia lawii, Bidaria indica,* etc. were among the present collections. *Miliusa wayanadica,* a recently described new species was also collected from the sanctuary.

## Effect of crop rotation with short duration tree crops on the nutrient status of soil in clear felled teak plantation sites

Various methods are being looked into for enhancing the fertility of soils impoverished due to repeated teak planting. Crop rotation with leguminous tree crops is one such option being looked into. Kerala Forest Department has established research plots with *Acacia* species as short duration legume in clear felled teak areas in Nilambur and Thrissur. In the present study the litter dynamics and soil nutrient enrichment were investigated in the plots. It was found that *Acacia mangium* and *Acacia auriculiformis* could improve soil aggregation and nitrogen status of the soil. Litter fall was highest in *Acacia mangium* which was followed by *Acacia auriculiformis* and *Tectona grandis* but litter decomposition was faster in teak compared to acacias.

*Ochlandra travancorica*

## Evaluation of Ochlandra germplasm, mass propagation and field trials of elites

During an earlier study, reeds (*Ochlandra spp.*) having low lignin content were located from

some forest areas of Kerala. Such promising genotypes were vegetatively propagated and a germplasm was established at FRC, Velupadam. The work was continued in a second phase during which field visits were made to other forest areas such as Pooyamkutty for survey and collection of culm for lignin analysis and mass propagation. The newly emerged culms of the low lignin clump established earlier were collected at half yearly intervals. Rhizome samples from new collections were added to the germplasm established earlier. Protocol for mass multiplication of elites through macro and micropropagation methods is being developed.

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# AWARDS

## Dr. C. CHANDRASEKHARAN MEMORIAL AWARD 2011

The award was constituted in memory of Dr C. Chandrasekharan, an eminent researcher and former Director of KFRI, who retired from FAO after an illustrious career. He was involved in various programmes with organizations such as ITTO, Asian Development Bank, World Bank, Ford Foundation, CIFOR, WWF and IDRC. The family of Dr. C. Chandrasekharan constituted an award in his name to honour outstanding young researchers in field of forest management and conservation in Kerala.

The second Dr. C. Chandrasekharan Memorial Award was bagged by Dr. K.H. Amitha Bachan, an ecological enthusiast with a decade of experience in forest research, conservation and education. His PhD thesis was on the Riparian Flora and its ecological significance in the Chalakkudy River Basin, probably the first such study on the flora and community composition of riparian vegetation from India. Along with study he initiated a study on 'Participatory conservation and monitoring of Hornbills and their habitat in the Parambikulam - Vazhachal region' involving the primitive tribe, Kadar. This has been regarded one of the successful participatory species monitoring and conservation program from the Western Ghats. The State Govt. and Forest Department have recognized it through accepting it as a regular programme of the Forest department through tribal participation.

## Dr. KM BHAT MEMORIAL AWARD 2012

'The Dr. K. M. Bhat Endowment' award carrying a Gold Medal, Certificate of Merit and cash prize of Rs. 5,000/- was awarded to Dr. P. Mujeeb Rahman, Research Associate, Forest Entomolgy Division of KFRI, Peechi. Dr. Mujeeb Rahman was selected for the award for his doctoral work on "Below ground biodiversity of soil macrofauna in selected landuse systems, its spatial pattern and structural dynamics". The Endowment was instituted by the family of late Dr. K. M. Bhat for the best outstanding Research Scholar of KFRI. The award was presented to him on 2nd January 2012 in a function organised at KFRI in connection with 3rd death anniversary of Dr. K. M. Bhat. Dr. K. Sudhakara, Professor, College of Forestry, Kerala Agricultural University, Vellanikkara presented the award and delivered the Dr. KM Bhat Memorial lecture.

# EXTENSION AND TRAINING ACTIVITIES

## ORGANISATION AND PARTICIPATION IN SEMINARS/SYMPOSIA/WORKSHOPS/TRAININGS/ OUTREACH PROGRAMMES

### Amruth M

Moderator in workshop on Science and Traditional Practices series "on Understanding the Significance of Traditional Kalari Marma Therapeutic Practices and Problems in its Contemporary Transmission" organized by Advanced Centre of Environmental Studies and Sustainable Development (ACESSD) – An Inter University Centre at the Mahatma Gandhi University, Kottayam on 30 April -1st May, 2011.

Participated in the training programme on open source GIS (quantum GIS), from May 16- 20, 2011 organized by KFRI, conducted by kQube Consultancy Services.

Talk on "Representing Nature: Case of Travancore Museum", Discussion Forum Meeting, KFRI, Peechi, on 22 June 2011

Resource person for training of teachers as part of the National Green corps and eco-clubs of Kannur District, held at Extension training centre, Karimbam, Thalipparamba from July 21-28, 2011

Presentation on "Periyar Tiger Reserve: An introduction to the discussions on new approaches in participatory conservation", organized by School of Social Sciences and Periyar Foundation, on 11 September, 2011.

Seven week on-line training on "how to Build a policy Influence Plan : Sharing lessons learned in Latin America, Asia and Africa", organised by Centre for the Implementation of Public Policies Promoting Equity and Growth (CIPPEC), Argentina and Global Development Network, New Delhi. From August 29 - October 23, 2011

Talk on "Zotero": open source reference management software to manage bibliographic data and related research materials. Organized by KFRI Internet forum on 18 October 2011,

Organized a three-one day nature awareness camp for 45 primary school students as part of the Madayi Hill conservation awareness programme (KFRI EP-186/2010) in November, 2011.

Participated in four-day workshop cum training programme on 'Role of Scientists in Natural resource Management' organized by Indian Institute of Forest Management (IIFM), Bhopal from 2-9th December, 2011

Participated in three-day workshop on the 'science and the narratives of nature: East and West' jointly organized by the Manipal Centre for Philosophy and Humanities, Manipal and Social Sciences and Humanities Research Council of Canada at Manipal from 12-14 December, 2011.

Organized a three-day nature awareness camp for 30 School teachers who are in charge of the Green Corps in the schools as part of the Madayi Hill conservation awareness programme (KFRI EP-186/2010) from 30 December, 2011 - 1st January, 2012.

Invited talk on "A 'Sanctuary' on the Hills: History of 'Progress' and Emergence of Conservation ethos in Thiruvitamkur" in the UGC Sponsored National Seminar on "Faunal Diversity and Endemism of Southern Western Ghats" at NSS College, Pandalam on 17 January 2012.

Organized a Two-day nature awareness camp for 50 Students of the National Green Corps in the NSS Higher Secondary School, Alakkode as part of the Madayi Hill conservation awareness programme (KFRI EP-186/2010) in January, 2012.

## Anitha V

Invited talk on '*macro scenario of the situation in Agasthyamala Biosphere Reserve*' in the one day Workshop – Man and Environment: Biosphere Reserve study, Anthropological Survey of India (ASI), at Jawaharlal Nehru Tropical Botanical Garden Research Institute, January19th 2012

Participation in the one day workshop -on the preparation of the Peechi Vazhani Chimmony management plan (2012-2022), February 18th 2012

Participation in the DST sponsored National Training (four-day workshop cum training programme) under the Management Development Programme on '*role of scientists in natural resources and environment management*' at Indian Institute of Forest Management, Bhopal, 4-10 2011.

Participation in the two day (09-10 Feb 2012) Workshop on "Environmental clearance to developmental Projects" at Mascot Hotel Thiruvanathapuram organised by the State Environmental Impact Assessment Authority.

Member in Organising Committee of International Training Programme in Innovations in the Management of Planted Teak Forests held at Kerala Forest Research Institute, Peechi, Thrissur, Kerala during 31 August -3 September 2011.

Resource Person - Training course on "Collection, Compilation, Validation and Dissemination of Forest Statistics" during March 14-16, 2011 for the Statistical Assistants of Kerala Forest Department (25 staff members) sponsored by the Kerala Forest Department on: *Data requirements, economic tools and techniques on quantification of recreational value of a natural ecosystem, Non timber forest products - data requirements, tools & techniques, data gaps* and *Raw Drug industry in Kerala.*

Resource Person - Training on Modern Trends in Forestry Research for Forest Officials in the Research wing of the Maharastra Forest Department 11 -13 August 2011 on: *Data requirements, economic tools and techniques on quantification of recreational value of a natural ecosystem* and Non *timber forest products - data requirements, tools & techniques, data gaps*

Resource Person - Specialized training for the 10 Scientists/Officers from the ICFRE on Effect of Invasive Species/Weeds on Productivity of Forest Plantations and Natural Forests and Different Cost Effective Methods for their Control during 13-17 December 2011 on '*Weed invasion in forests -economic dimensions & socioeconomic relevance*'.

Resource Person - Training courses on "Priority Species, Resource Estimation, Plantation Development, Post Harvest Technology and Socio-economic Livelihood Potential of Bamboos" during January 17-22, 2011; February 14-19 & 22-26, 2011; January 9-13, 2012; February 13-17, 2012 and March 12-16, 2012; supported by National Bamboo Mission (Bamboo Technical Support Group for South Zone) for the Field Functionaries.

Resource person for B. Sc. Forestry course in Kerala Agricultural University on : *Inter- linkages between environment and economics a theoretical and empirical approach* and *Economic aspects of NTFPs,* June 2011.

## Chandrashekara UM

Participated in the 19th Meeting of expert Group-A in the broad thematic area of Conservation and Sustainable Utilisation of Natural Resources Provided input to formulate a project proposal for an All India coordinated project on Sacred Grove Ecosystem Service Assessment 25th July 2011; MoEF, New Delhi

Resource Person - Training on Modern Trends in Forestry Research for Forest Officials in the Research

wing of the Maharastra Forest Department 11 -13 August 2011 on Phytosociological analysis for understanding the forest qualities.

Resource Person - Forest Guard Trainees of Kerala Forest School, Walayar on 'forest types of Kerala and forest ecology' 20 September 2011.

Organized an In-House Training at KFRI Sub Centre Nilambur during 19-31 May 2011 and 11-22 December 2011 for the Forest Guard Trainees of Kerala Forest School, Walayar

Participated in National Seminar on Agroforestry-an evergreen agriculture for food security and environmental resilience' 02-04 February 2012 ,Navasari Agricultural University, Navasari, Gujarat , Importance of Biodiversity in relation to Homegarden Agroforestry of Tropics

Resource Person- various aspects of forest conservation and management for Forest Department trainees (Forest Guards to IFS probationers' level).

## Chandrasekhara Pillai PK

Resource Person - Training course on "Collection, Compilation, Validation and Dissemination of Forest Statistics" during March 14-16, 2011 for the Statistical Assistants of Kerala Forest Department (25 staff members) sponsored by the Kerala Forest Department.

"Academic Writing" held at Kerala University Library Building, Thiruvananthpuram during 12-13 May 2011, organized by KSCSTE and Centre for Information Literary Studies, University of Kerala.

Training on "QGIS" at KFRI during 16-20 May 2011 by KCUBE Consultancy Services Pvt. Ltd., Chennai.

Member in Organising Committee of the International Training Programme on "Innovations in the Management of Planted Teak forests" held at KFRI, Peechi during 31st August – 3rd September 2011 organized by TEAKNET (International Teak Network), KFRI, FAO and KSCSTE.

Participate in Management Development Training on "Role of scientists in Natural Resources and Environment Management" held at IIFM, Bhopal during 5-9 December 2011 organized by DST, Govt. of India, New Delhi.

Resource Person - Lecture on 'Impact of weeds on productivity of *Eucalyptus* plantations in Kerala' in connection with the specialized training for the 10 Scientists/Officers from the ICFRE on "Effect of Invasive Species/Weeds on Productivity of Forest Plantations and Natural Forests and Different Cost Effective Methods for their Control" during 13-17 December 2011.

Site inspection was carried out on 12/1/2012 and report submitted to KFD on the Physical Status of Vegetation in the disputed area of 12 acres (Sy. No. 238/1, Kanjirathinal Village, Tondernad Taluk, Wynad District) Claimed by Sri. Kanjirathinal George as their land and KFD as Vested Forest.

Resource Person - Training courses on "Priority Species, Resource Estimation, Plantation Development, Post Harvest Technology and Socio-economic Livelihood Potential of Bamboos" during January 17-22, 2011; February 14-19 & 22-26, 2011; January 9-13, 2012; February 13-17, 2012 and March 12-16, 2012; supported by National Bamboo Mission (Bamboo Technical Support Group for South Zone) for the Field Functionaries.

Participated in a discussion on eco-restoration of Kulangattu Mala of Cheruvathur Grama Panchayat, Kasaragod District, in connection with 'Smruthi Vanam' project organized by the District collector, Kasaragod on 21 February 2012

Resource Person - Training course on seed collection, processing on March 17, 2012 for field staff of research wing of KFD.

Participated in National Seminar on 'Forest Health Management (FHM-2012)' held at IFGTB, Coimbatore, organized by Institute of Forest Genetics and Tree Breeding supported by the

Department of Biotechnology and Department of Science and Technology, Govt. of India, during 21-22 March, 2012.

## Dhamodharan TK

Handled three cases on testing and certification on preservative treatment of timber.

Reviewed the Ph. D. thesis 'Eco-Anatomical studies in certain hardwoods from southwest forest range of Karnataka' by Sujatha, M. FRI University, Dehra Dun.

Resource person and gave lectures on 'Preservative Treatment for Bamboo'at the training course on 'Priority species, resource estimation, plantation development, post-harvest technology and socio- economic livelihood potential of bamboos' organized by BTSG South Zone at KFRI, Peechi and the National Bamboo Mission (NBM).

## Jayaraj R

Invited talk on "Genomics and Drug Discovery" at Biotechnological Approaches and Translational Research for Human welfare - Current Trends in Animal Science Research, National seminar organised by Central University of Kerala, Kasaragod on 20th March 2012

## Jayson EA

Visited Kalady area to examine the suspected leopard attack as per the request of Kerala Forest Department.

Participated in Human–elephant conflict Conference at Palghat organized by the Kerala Forest Department and presented a paper on the subject on 27th July 2011

Visited Idukki as member of the EFL committee to evaluate the designated areas (15 - 16 September 2011).

Involved in the identification of one tortoise engaged in a case to Athirappally Range Office on 30 August 2011

Participated in International Ornithological Congress on Indian Ornithology at SACON Coimbatore on 20-22 November 2011

Inspected the EFL areas at Nemmara in Palghat District along with other committee members to evaluate the area on 24 November 2011

Participated in the Management Plan Workshop at Aralam Wildlife Sanctuary on 06-01-2012

Visited TBGRI, Palode to advice on the mitigation measures to stop elephant damage in their gardens on 13 January 2012

Participated in the Workshop on "Vegetation types of India" at IFGTB, Coimbatore on 02 Feb 2012

Participated in the two day workshop (09-10 Feb 2012) on "Environmental clearance to developmental Projects" at Mascot Hotel Thiruvanathapuram organised by the Stat Environmental Impact Assessment Authority.

Visited Gandhi Smirithi Vanam at Alleppy along with other scientists to evaluate the area and to prepare a programme for the area on 01 February 2012

Participated in the Management Plan workshop at Peechi-Vazhani Wildlife Sanctuary on 18 February 2012.

Received applications for Wildlife Census from volunteers and posted them into different Forest Divisions, which was required for the Wildlife Census 2011

Reviewed one project proposal entitled "Ecological investigation of woody vegetation and nest tree use by birds in the riverine Forest of Athilkkadavu Valley, River Bhavani, Western Ghats" for Ministry of Environment, Government of India.

## Jose PA

Attended 5 day open source Quantum GIS training programme at KFRI, Peechi from 16-20 May, 2011.

Participated and presented a paper titled 'Population structure and diversity analysis of *Hydnocarpus macrocarpa* (Bedd.) Warb. - An ecological approach for the conservation of endemic and RET trees of Western Ghats' under the Environmental Science& Forestry discipline at 24th Kerala Science Congress held at RRI India, Kottayam from 29-31 January, 2012,

## Mallikarjuna Swamy GE

Attended Workshop on "Academic Writing" organized jointly by KSCSTE and Centre for Information Literacy studies, university of Kerala on 12-13 May 2011 held at Department of Library and Information Science, University of Kerala, University Library Building, Thiruvananthapuram.

Attended Five day training programme on "Quantum Geographic Information System" during 16-20th May 2011 conducted by M/S Kcube Consultencies, Chennai held at Kerala Forest Research Institute, Peechi, Thrissur, Kerala.

## Maria Florence EJ

Member in the Organising Committee of International Training Programme in Innovations in the Management of Planted Teak Forests held at Kerala Forest Research Institute, Peechi, Thrissur, Kerala during 31 August -3 September 2011.

International Conference on Art and Joy of Wood during 19-21 October 2011 at IWST Bangalore and presented a paper

Indo–UK networking workshop on Providing Scientific Basis for fungal Conservation, 21-23 November 2011 at KFRI

Recommended control measures for the mortality of seedlings of Mahogany in Kallekkad in Pirayiri Panchayat reported by Kerala Forest Department.

Evaluated the cause of the poor performance of the Eucalypts clonal plantations raised in Trivandrum and Punalur Divisions from 2001 onwards by KFDC.

Evaluated the poor performance of KFDC sandal plantations and nursery seedlings at Vettiyil, Malampuzha, Palakkad, District raised by KFDC and suggested measures to improve the plants and nursery.

## Muralidharan EM

Contributed to the Chapter on Forestry (Chapter 2), "Current status and Options for Forest Biotechnologies in Developing Countries"

Contributed to the FAO Background Document (Chapter 10), "Agricultural Biotechnologies for food Security and Sustainable Development : Options for Developing countries and Priorities for Action for the international community") in Proceedings of the FAO International Technical Conference on " Agricultural Biotechnologies in Developing Countries: Options and Opportunities in crops, Forestry , Livestock, Fisheries and Agro-industry to face the Challenges of Food Security and Climate Change: ABDC -10

## Pandalai RC

Resource person in connection with the Environment Day Celebration at the Swaraj UPS, Kozhukkully organised by Prof. PC Thomas Education Sponsorship Programme, SUPS, Kozhukkully and

Rajagiri outreach on 04-06-2011, lecture delivered on "Forests and its benefit to human beings"

Delivered the Keynote address on the theme "Forests: nature at your service" in connection with the World Environment Day Celebration-2011 on Sunday, 5th June-2011 at the hall of the Association of Kerala Engineers, The Institution of Engineers (India) Trichur Local Centre.

Presented an overview paper on "Afforestation and Plantation Management" during the workshop organized by KSCSTE, KFD and KFRI on Strengthening the Science and Technology base of Forestry in Kerala during 13-14th of September, 2011 at KFRI, Peechi

Coordinated the field inspection to Mahatma Gandhi University, Kottayam on 11th October 2011 as per the request from the Vice-Chancellor and as instructed by the Director.

Induction training programme of the 86th and 87th batch Forest Guards trainees of the Forest School, Walayar while they were at KFRI Sub centre, Nilambur on 15th December, 2011. Took two lectures, one on "Forest Mensuration and Sampling techniques" and another on "Silviculture and management of Teak plantations in Kerala".

Functioned as Training Coordinator for the training course on Priority species, resource estimation, plantation development, post harvest technology and socio-economic livelihood potential of Bamboos, during 13-17 February 2012. The programme, supported by National Bamboo Mission under Bamboo Technical Support Group for South Zone for field functionaries. Delivered a lecture on Plantation and harvesting techniques for Bamboos on 13 Feb 2012.

Compiled information for the preparation of the Country Report on Forest Genetics Resources and attended the Workshop on Preparation of Country Report on Forest Genetics Resources (SOW-FGR,FAO) on 7th Feb 2012 at IFGTB, Coimbatore and took part in the deleberations.

Participated in a One day State Level Workshop as an invitee on" Bamboo Cultivation, Sustainable Harvesting and Utilization" organised by the National Bamboo Mission Society of Goa at the International Centre, Panaji, Goa on 21st of March 2012. A lecture on " Silviculture, Germplasm and Growth studies of Bamboo" was delivered during the programme

Prepared and despatched an extension report on Site selection for a model nursery for raising seedlings of medicinal plants and forestry species in connection with the MGNREGS of the Wadakkancherry block panchayat as per the request of the President, Wadakkancherry block panchayat on 28/08/11.

Inputs provided for the project formulation on Eco-restoration of Kulangattu Mala of Cheruvathur Grama Panchayat, Kasaragod District, in connection with 'Smruthi Vanam' project organized by the District collector, Kasaragod.

Field visit and submission of an extension report on Feasibility of planting teak in a sloppy terrain with bouldry outcrops at Manjapra, Angamali as per the request from Dr.Senny Thomas, Parckal House, Manjapra

Prepared and dispatched an extension report on A Proposal for the Green Belt Development at the Bharatheeya Vidya Nikethan, Kallekkad, Palakkad. 21st June, 2011

Submitted a report to the Divisional Forest Officer, Thenmala on the feasibility of supplying root trainer seedlings of a few pulpwood species produced at the central nursery at Kulathupuzha.

Submitted a report to the Deputy Conservator of Forests-Research South on the remedial measures to be followed for preventing the retarded growth of teak seedlings propagated at the Central Nursery at Kulathupuzha.

Served as an examiner for B.Sc Forestry course of Kerala Agricultural University.

Evaluated the project proposals on 'Study of physiological and biochemical characteristics of different seed sources of *Gmelina arborea*' and 'Standardization of seed handling techniques for fast growing native tree species' for IFGTB, Coimbatore.

## Rugmini P

Memeber in teh Organising Committe of the International Training Programme in Innovations in the Management of Planted Teak Forests held at Kerala Forest Research Institute, Peechi, Thrissur, Kerala during 31 August -3 September 2011.

Functioned as Course Coordinator for the Training course on Statistical Techniques in Forestry Research for a Research Scholar from Andhra Pradesh Forest Department for 5 days (10- 14 October 2011).

## Sajeev TV

Talks on: "Biological invasions: Tales and science of a losing battle" for college teachers at Academic Staff College, University of Calicut on 8th March 2011

Research as a career for the students and faculty of MES College, Mampad on 8th March 2011

"Chemistry of Biological Invasions" to MSc Applied Zoology students of Kannur University at Mananthavady Campus on 11 March 2011

"Deforestation and its impact" at Apollo Tyres on 4 June 2011 as part of the Corporate Social Responsibility initiative.

"Legal dimensions of environmentalism' was given at Nilambur on 5 June 2011 organized by the Green Advocate Collective of Malappuram District.

"Nature – Forest at your service" at Centre for Water Resource Development and Management, Calicut on 6 June 2011

'Playing god? Designer Genes and the ethics in biotechnology' at UGC sponsored Natioanal Seminar at Morning star home science college, Angamaly on 12th August 2011.

'Impact of invasive alien species on biodiversity' during National Academy of Science conference at Thiruvananthapuram on 24 November 2011

"Biodiversity: why is it easy to misuse and abuse than to use or conserve" at a National Seminar at St. Joseph's college, Irinjalakuda on 2 March 2012

"Insect pests of bamboo and their management" at the KFRI extension centre on 13 march 2012 in the training programme on Priority species resource estimation, plantation development, post harvest technology and socio economic livelihood potentional of bamboo supported by national bamboo mission.

Participated in the Workshop on Forest Health Technology and Phytosanitary Standards. Biejing, china on 6, 8, 10 and 11th November 2011

## Sandeep S

Kerala Environment Congress: 25 – 27th Aug, 2011

International Training Programme in Innovations in the Management of Planted Teak Forests held at Kerala Forest Research Institute, Peechi, Thrissur, Kerala during 31 August -3 September 2011.

National seminar on Watershed management : 16 – 17th Feb, 2012

## Sasidharan N

Evaluated 10 Ecologically Fragile Land (EFL) notified properties in the Palakkad Forest Division on 19 August 2011 as a member of the evaluation committee.

National Seminar on Biodiversity Conservation and Climate change during 2-4 December 2011 at Institute of Minerals and Materials Technology, Bhubaneswar. Presented a plenary lecture *Flowering Plants of Kerala – A checklist ver. 2.0*

Prepared a report along with Dr . P Sujanapal on the Mangrove in Chettupuzha and adjacent areas of Chavakkad Taluk, Thrissur was submitted to Divisional Forest Officer, Thrissur as per his request in February 2012

National Seminar: New Vistas in Plant Sciences during 14-15 March 2012 at Goa University, Goa. Gave a lecture on Flowering Plants diversity of Kerala.

## Seethalakshmi KK

Participated in the mid-term evaluation of the technology development extension and training project "Wasteland Development with Sustainable Livelihoods based on Bamboo Plantation and Value Added Products for Housing, Food, Fodder and Bio-fuels funded by Department of Land Resources, Ministry of Rural Development, implemented by IIT Delhi in collaboration with Institute for Social Advancement, Kerala. April-May 2011

## Sreekumar VB

General introduction to rattans:- Training for forest officials. Aug 2011. KFRI

Introduction to the forest types in Kerala:- Awareness camp at Madai hills. October 21-22, 2011

XXI Annual Conference of IAAT and National Seminar on Biodiversity Conservation and Climate Change. (BCCC – 2011). December 2 - 4 CSIR-IMMT, Bhuvaneswar, Odisha, India. Presented a paper titled "Morphological, genetic and geospatial characterization of the genus Calamus L. (Arecaceae) in the Western Ghats"

National seminar on Geospatial solutions for Resource Conservation and management. 18-19 January 2012, IISC Bangalore. 49-50. Presented a paper titled "Geographical modeling for the conservation and management of rattan resources in Western Ghats".

## Sujanapal P

Talk on Biodiversity of Kerala, In-house vacation training for selected school children of Kerala organized by MSSRF-DST programme at Kalpetta. 10 May 2011

Field botany, Induction training of 84$^{th}$ batch Forest guard trainees from Forest school Walayar at KFRI subcentre, Nilambur. July 2011

Talk on Biodiversity of southern Western Ghats, Degree and PG students, Botany Department, Sir Syed College, Taliparamba. 18 August 2011

Talk on Biodiversity of Kerala, College students at Extension and Training centre, KFRI. 5 September 2011

Botany Association inauguration-2011 & Paper presentation, SNM College, Malliangara 30 September 2011

Talk on Biodiversity of Kerala, Induction training of 86$^{th}$ & 87$^{th}$ batch Forest guard trainees from Forest school Walayar at KFRI subcentre, Nilambur. December 2011

Workshop on Comprehensive farm development, District Agricultural farm, Chelakkara, Thrissur during 29-30 November 2011 and 23 January 2012

Prepared a report along with Dr . N Sasidharan on the Mangrove in Chettupuzha and adjacent areas of Chavakkad Taluk, Thrissur was submitted to Divisional Forest Officer, Thrissur as per his request in February 2012

Invited lecture in National Seminar on Mangrove Biodiversity and Conservation-MABICON-2012 conducted by Sree Narayana College, Alathur. 16 February 2012

## Sujatha MP

Carried out soil analysis and suggested fertilizer dosage for teak, eucalypt and acacia plantations in different forest ranges, KFDC and other individuals.

Analysed vermicompost and seed samples for various other agencies.

Evaluated a thesis titled "Suitability of azolla (*Azolla pinnata*) for biogas slurry enrichment submitted by Mr. Bishnu Prasad Paudel as part of the MSc (Ag) programme in the Dept. of Soil Science and Agrl. Chemistry, College of Horticulture, Vellanikkara, KAU.

## Suma TB

Participated in Kerala Environment Congress 25-27th August 2011 at RGCB, Trivandrum

Participated in the National Training course on 'Protection and Management of Intellectual Property Rights in Agriculture (September 20 -29th) organized by IPR cell KAU, Trichur.

Participated in the Mentorship Workshop organized by Department of Biotechnolgy (DBT), Govt. of India at National Center for Biological Sciences (NCBS), Bangalore on 22-23 November, 2011.

Participated in workshop on next generation sequencing bioinformatics at RGCB, Trivandrum on 18th December 2011.

Resoruce Person - 'Training on Modern Trends in Forestry Research for Forest Officials in the Research wing of the Maharastra Forest Department 11 -13 August 2011' on: 'Emerging trends in Forest Biotechnology'

Resoruce Person - At the Biotech Dept., Sahradaya College of Engineering & Technology on 4th October 2011 on 'DNA methylation and its significance in functional genomics' .

## Thulasidas PK

Timber testing (MC%, Density) and identification service (132 wood samples) was provided to 27 clients such as Customs Commissioner, Tuticorn, Powergrid Corp. of India Ltd, Karur, Hindustan Prefab Ltd, Kozhikode, Handicrafts Devpt Corp. TVM, Neyveli Lignite Corp. Neyveli, CPWD, FIT-Aluva, IIM-K Kozhikode, TELK, Angamaly, KSHB, Kollam, Judicial First Class Magistrate, Manathavady, Kerala Forest Dept, and many Private wood industries and individuals etc. and thereby generated income to KFRI in the form of wood testing charges.

Took part in the assessment of financial loss to Govt. of Kerala due to non-use of the specified Thambakam (*Hopea parviflora*) wood.

Participated in the International Conference on the "Art & Joy of Wood- Rediscovering Wood: The Key to a Sustainable Future" organised by FAO of the UN in the IWST, Bangalore during 19-22 October 2011.

## Training Programmes organised (April 2011– March 2012)

| Sl. No. | Year Month Date | Title | Sponsor | Course Coordinator |
|---|---|---|---|---|
| 1. | May 16 – 20 | Open Source GIS Training– Quantum GIS | | Dr. P. Vijayakumaran Nair |
| 2. | June 6 | Jaivajeevitham | KFRI | Dr. AV Raghu |
| 3. | June 16 | Familiarization of Ayurveda | KFRI Plan Grants | Dr. AV Raghu |
| 4. | July 5 – 7 | Training Workshop on Digital Library for Librarians and System Professionals of KSCSTE & R & D Centers | KSCSTE | Mrs. N Sarojam Mr. KH Hussain |
| 5. | July 18 | Refresher Course on Rules and Procedures | KFRI Plan Fund | Dr. RC Pandalai |
| 6. | July 19 | A Pestering Journey Documentary Film Show | KFRI Plan Grants | Dr. AV Raghu |
| 7. | August 11 - 13 | Modern Trends in Forestry Research | CAMPA (Western Region Maharashtra) | Dr. RC Pandalai |
| 8. | October 10 - 14 | Statistical Techniques in Forestry Research | Andhra Pradesh Forest Department | Dr. P Rugmini |
| 9. | October 17 - 21 | Collection, Compilation, Validation and Dissemination of Forestry Statistics | MoEF | Dr. M Sivaram |
| 10. | November 8 - 10 | Evaluation and Selection of Teak Plantations for Converting into TSPAs | KFD | Dr. RC Pandalai |
| 11. | November 21-23 | Providing the Scientific Basis for Fungal Conservation, India-UK Scientific Networking Workshop | Royal Society UK & DST | Dr. KV Sankaran |
| 12. | November 29 - 30 | Training Programme on Watershed Management for Kulakattukurishi Sub Watershed | NWDPRA - Kulakattukurishi Watershed & Soil Conservation Officer, Palakkad | Dr. S Sankar |

| | | | | |
|---|---|---|---|---|
| 13. | December 13-17 | Effect of Invasive species/Weeds on Productivity of Forest Plantations and Natural Forests and Different Cost Effective Methods for their Control" for the Scientists from Various ICFRE Institutions | ICFRE | Dr. KV Sankaran |
| 14. | December 21 - 23 | Academic Writing Skills | KFRI & KSCSTE | Dr. KP Vijayakumar |
| 15. | January 9 -13 | National Bamboo Mission | NBM | Dr. KK Seethalakshmi |
| 16. | February 6 - 10 | Conservation and Development of Medicinal Plants and Benefit Sharing with Local Communities | MoEF | Dr. N Sasidharan |
| 17. | February 13 - 17 | National Bamboo Mission | NBM | Dr. KK Seethalakshmi |
| 18. | March 12 -16 | National Bamboo Mission | NBM | Dr. KK Seethalakshmi |

## Exhibitions Conducted
## (April 2011 - March 2012)

| SI No | TITLE OF THE EXHIBITION | PERIOD | NAME OF THE ORGANIZATION | NAME OF RESOURCE PERSONS (At Site) |
|---|---|---|---|---|
| 1 | Thiruviliuamala Fest 2011 | 4- 8May | Thiruviliuamala Fest 2011 | Dr. K Mohanadas<br>Mr. CK Vincent<br>Miss. Sudha, Miss. Rani<br>Mrs. Vijitha |
| 2 | Karshakadinam | 17 August | Nilambur Municipality | Dr. AV Raghu<br>Mr. CK Vincent |
| 3 | Agri Rural Mela | 19 August | Cherppu Canara Bank | Mr. TM Vahab, Miss. Sudha |
| 4 | Haritholsavam 2011 | 3-7 September | Department of Agriculture Kerala & Ministry of Agri-culture Government of India | Dr. K. Mohanadas<br>Mr. Suresh |
| 5 | National Bamboo Fest | 8-11 December | Ernakulam | Dr. K Mohanadas<br>Mr. Vahab, Mr. Rajan |
| 6 | Siva Temple Festival | 15-20 December | Siva Temple Ernakulam | Dr. K Mohanadas<br>Mr. Vahab, Mr. Rajan |
| 7 | Kerala Science Congress | 28-31 January | Rubber Board Kottayam | Dr. K. Mohanadas<br>Dr. AV Raghu |
| 8 | Matha Amrutha Fest | 1- 3 February | Matha Amritanandamayi Math, Kollam | Dr. K. Mohanadas<br>Dr. AV Raghu, Mr.CJ Alex |

## Visitors to KFRI (April 2011 – March 2012)



KFRI had the privilege to cater number of visitors during the period, varied from young enthusiastic students from the local schools to Expert Scientists from different parts of the World. A total of 4003 persons visited KFRI from different slices of Society. KFRI Scientists were more than happy to share their knowledge and information with the visitors and such a sharing experience has a prominent role in the development and footing of any Institute of this kind.

# KFRI ACADEMIC ACTIVITIES

(April 2011-March 2012)

## Ph. D. Programme

| Forest Research Institute, Dehradun | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Name of the student** | **Supervising Guide** | **Title of the Thesis** | **Year** |
| **Ph. D. awarded** | | | | |
| 1. | TJ Roby | Dr. P Vijayakumaran Nair | Floristic structure and diversity of Myristica swamps at Kulathupuzha in a GIS perspective | April 2011 |
| 2. | Babu S. | Dr.EA Jayson | Ecology of Owls in the Southern Western Ghats, India | November 2011 |
| **Thesis Submitted** | | | | |
| | Bindhu TN | Dr. VV Sudheendrakumar | Dynamics of Baculovirus epizootics in teak defoliator (*Hyblaea puera*) populations | January 2012 |
| | Bindhu K Jose | Dr. VV Sudheendrakumar | Diet and dietary requirements of Teak Defoliators - *Hyblaea puera and Eutectona machaeralis* | February 2012 |

| Cochin University of Science and Technology, Ernakulam | | | | |
|---|---|---|---|---|
| **Sl. No.** | **Name of the student** | **Supervising Guide** | **Title of the Thesis** | **Year** |
| **Ph. D. awarded** | | | | |
| 1. | Mujeeb Rahman | Dr. RV Varma | Characterization of soil fauna in different land use systems in the Kerala part of Nilgiri biosphere reserve | April 2011 |
| 2. | Remya R | Dr. M Balasundaran | Physiological and genetic diversity studies on regeneration of *Santalum album* | 2011 |
| 3. | Beena VB | Dr. KK Seethalakshmi | Reproductive biology and biochemical changes associated with flowering of *Dendrocalamus stocksii and Ochlandra travancorica* | January 2012 |
| **Thesis submitted** | | | | |
| | Maghesh G | Dr. ARR Menon | Ecological studies of the Parambikulam Tiger Reserve in the Western Ghats of India, using remote sensing and GIS | February 2012 |
| | Sujesh SM | Dr. EP Indira | Breeding system of *Dipterocarpus bourdillonii and Humboldtia bourdillonii,* two endemic trees of Western Ghats | February 2012 |

## M.Sc. Academic attachment programme

| Sl. No. | Name of the student | Year | Supervising guide | Name of College | Subject |
|---|---|---|---|---|---|
| 1 | Greeshma P | December 2011 | Dr. EA Jayson | CUSAT | Environmental Technology |
| 2 | Shinila K. | December 2011 | Dr. MP Sujatha | Kannur University, Kannur | Environmental Science |
| 3 | Deepthy Devanand | December 2011 | Dr.TB Suma | Rathnavel Subramaniam College, Trichy Road, Sulur | Biotechnology |
| 4 | Nidha K | December 2011 | Dr. MP Sujatha | Kannur University, Kannur | Environmental Science |
| 5 | Hridhya KP | March 2012 | Dr. TB Suma | St.Mary's College, Thrissur | Biotechnology |
| 6 | Soumya Sathyan | March 2012 | Dr. EM Muraleedharan | St.Joseph's College, Iringalakuda | Biotechnology |
| 7 | Anhjali SN | January 2012 | Dr. S Sankar | Mahatma Gandhi University, Kottayam | Environmental Science and Management |
| 8 | Neenu Mary Thomas | January 2012 | Dr. MP Sujatha | Sree Sankara College, Kalady | Environmental Science & Management) |
| 9 | Sreekala PP | January 2012 | Dr. S Sandeep | Sree Sankara College, Kalady | Environmental Science & Management |
| 10 | Geethu Ravindran | January 2012 | Dr. R Jayaraj | Sree Sankara College, Kalady | Environmental Science & Management |
| 11 | Stephy Thomas | March 2012 | Dr. EM Muraleedharan | St.Joseph's College, Iringalakuda | Biotechnology |

## Kerala Forest Research Institute, Peechi Thrissur

**(An Institution of Kerala State Council for Science, Technology and Environment, Govt. of Kerala)**

### BALANCE SHEET AS AT 31ST MARCH, 2012

| Liabilities | Sch No. | As At 31/03/2012 | As At 31/03/2012 | Assets | Sch No. | As At 31/03/2011 | As At 31/03/2012 |
|---|---|---|---|---|---|---|---|
| Reserves & Surplus | 4 | 15,10,32,417 | 14,78,79,523 | Fixed Assets | 1 | 11,71,76,068 | 11,40,23,174 |
| Current Liabilities | 5 | 81,53,268 | 1,20,96,126 | Current Assets | 2 | 5,89,83,416 | 5,77,47,776 |
| Unspent Balance | 6 | 1,90,07,243 | 1,32,66,256 | Loans & Advances | 3 | 20,33,444 | 14,70,955 |
| **Total** | | **17,81,92,928** | **17,32,41,905** | **Total** | | **17,81,92,928** | **17,32,41,905** |

### INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2012

| EXPENSES | Sch No. | Year ended 31/03/2012 | Year ended 31/03/2011 | INCOME | Sch No. | Year ended 31/03/2012 | Year ended 31/03/2011 |
|---|---|---|---|---|---|---|---|
| To Infrastructure Strengthening (Non-Plan) | 10 | 95,71,665 | 87,66,407 | By Grant from Government of Kerala | 7 | 9,78,98,503 | 10,15,30,534 |
| To Salaries and Allowances (Non-Plan) | 11 | 7,90,33,147 | 9,99,75,461 | By Other Receipts | 8 | 2,84,67,459 | 3,84,54,883 |
| To Depreciation | 1 | 1,39,46,579 | 1,36,29,014 | By Depreciation written back | 1 | 1,39,46,579 | 1,36,29,014 |
| To Other Project Expenses | | 72,88,832 | 1,42,34,018 | Income from Sponsored Project | 9 | 72,88,832 | 1,98,69,400 |
| To Project Expenses under Plan Scheme | | 3,77,61,151 | 3,68,78,932 | | | | |
| **TOTAL** | | **14,76,01,373** | **17,34,83,831** | **TOTAL** | | **14,76,01,373** | **17,34,83,831** |

# INTERNAL COMMITTEES

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

## Research Council (RC)

The Research Council (RC) comprising eminent scientists of the country advices in matters concerning research policies and monitors the quality of research undertaken at the Institute.

### Chairman

Prof. JS Singh
Professor Emeritus, Department of Botany.
Baranas Hindu University,
Varanasi, UTTAR PRADESH - 221 005
Ph: Res: 0452 2369093,
Mob: 9335178355
Email: singh.js1@gmail.com

### Members

Dr. K Gurumurthy
62-4, Block 2, II Floor, Leela Apartments,
Ponnaiyarajapuram, COIMBATORE 641 001
Ph: 080 64501102, Res: 0422-2479083,
Mob: 09363107627
Email: krishguru11@rediffmail.com

Dr. Gopal K Kadekodi
Honorary Professor Centre for
Multidisciplinary Development Research
Dr. BR Ambedkar Nagar, DHARWAD 580 004,
Karnataka. Ph: 0836-240453, 240472,
Res, 0836-2472827, Mob: 09845147633
Email: gkkadekodi@hotmail.com

Dr. Kailash Paliwal
Director, School of Biological Sciences &
Biotechnology Institute of Advance Research
Institutional Area, Koba, Gandhi
Nagar – 382007, Gujarat
Ph: 079-30514201/202,
Fax: 07930514110
Mob: 9426658440
Email: kpecol@yahoo.com

Dr. MP Nayar
Director (Rtd.), Botanical Survey of India,
'THE GREENS' 19/315, Vattavila,
Thirumala PO, Thiruvananthapuram –695 006
Ph: 0471- 2353185, Mob: 9447389332
Email: nayarmp@yahoo.com

Dr. VS Vijayan
Salim Ali Foundation, Aiswarya, TC31/1441,
Ayyappankavu Road, Kanimangalam PO,
Thrissur – 680 027. Ph: 0471- 2740240 (KSBB),
Mob: 9446372880, Email: vsvijayan@yahoo.com

Shri. KJ Varughese, IFS
Chief Conservator of Forests (ABP)
Forest Headquarters, Vazhuthacaud,
Thiruvananthapuram
Ph: 0471- 2321847, Mob: 9447979007
Email: ccf-abp@forest.kerala.gov.in

### Member & Ex-Officio Convener

Dr. KV Sankaran
Director, Kerala Forest Research Institute
Peechi – 680 653. Ph:0487- 2690110,
Mob: 9447625066, Email: sankaran@kfri.org

### Permanent Invitee

Dr. KK Ramachandran
Member Secretary
Kerala State Council for Science, Technology &
Environment, Sasthrbhavan, Pattom,
Thiruvananthapuram – 695 004
Ph: 0471- 2548220, Mob: 9447102199
Email: kkramans@gmail.com

## Management Committee (MC)

The Institute is managed by a Management Committee (MC) chaired by the Director. The present committee is

### Chairman

**Dr. KV Sankaran**
Director, KFRI

### Members

**Shri B Salim Kumar**
Joint Secretary
Government of Kerala, Thiruvananthapuram

**Dr. KK Ramachandran**
Member Secretary
KSCSTE, Thiruvananthapuram

**Executive Director**
CWRDM, Kozhikode

**Dr. KK Seethalakshmi**
Programme Coordinator
KFRI, Peechi

**Member-Convener**
Registrar,
KFRI

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

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

| | | | |
|---|---|---|---|
| 1 | The Principal Chief Conservator of Forests & Head of Forest Forces | … | Chairman |
| 2 | The Additional Principal Chief Conservator of Forests | … | Member |
| 3 | The Chief Conservator of Forests (Planning & Research) | … | Member |
| 4 | The Chief Conservator of Forests (Planning & Research) | … | Member |
| 5 | The Chief Conservator of Forests (Wildlife) | … | Member |
| 6 | The Chief Conservator of Forests (Tribal Welfare & Economic Development) | … | Member |
| 7. | The Chief Conservator of Forests (World Bank Projects) | … | Member |
| 8. | The Chief Conservator of Forests (Development) | … | Member |
| 9. | The Chief Conservator of Forests (Protection) | … | Member |
| 10. | The Chief Conservator of Forests (FMlS) | … | Member |
| 11. | The Chief Conservator of Forests (HRD) | … | Member |
| 12. | The Chief Conservator of Forests (Administration) | … | Member |
| 13. | The Chief Conservator of Forests (Vigilance) | … | Member |
| 14. | The Chief Conservator of Forests (Social Forestry) | … | Member |
| 15. | The Regional Chief Conservator of Forests (North) | … | Member |
| 16. | The Regional Chief Conservator of Forests (South) | … | Member |
| 17. | The Conservator of Forests (Biodiversity) | … | Member |
| 18. | The Deputy Conservator of Forests (Research) North | … | Member |
| 19. | The Deputy Conservator of Forests (Research) South | … | Member |
| 20. | The Managing Director, Kerala Forest Development Corporation | … | Member |
| 21. | The Associate Dean, Forestry Faculty, Kerala Agricultural niversity | … | Member |
| 22. | The Director, Tropical Botanic Garden & Research Institute, Palode | … | Member |
| 23. | The Director, Institute of Forest Genetics & Tree Breeding, Coimbatore | … | Member |
| 24. | The Managing Director, Oushadi, Thrissur | … | Member |
| 25. | The Director, Center for Earth Science Studies, Thiruvananthapuram | … | Member |
| 26. | The Director, Center for Water Resources Development and Management | … | Member |
| 27. | The Director, Rajiv Gandhi Center for Biotechnology, Trivandrum | … | Member |
| 28. | The Managing Director, Oushadhi, Thrissur | … | Member |
| 29. | The Director, Medicinal Plant Research Center, Arya Vaidya Sala, Kottakkal | … | Member |
| 30. | The Managing Director, Hindustan Newsprint Ltd., Kottayam | … | Member |
| 31. | The Managing Director, Kerala State Wood Industries Ltd., Nilambur | … | Member |
| 32. | The Managing Director, Kerala State Bamboo Corporation Ltd. | … | Member |
| 33. | The Director, Salim Ali Center for Ornithology and Natural History, Coimbatore | … | Member |
| 34. | Director, Kerala Forest Research Institute, Peechi | … | Member |
| 35. | Joint Director (Science & Technology Promotion), KSCSTE, Trivandrum | … | Member |
| 36. | Research Coordinator, KFRI, Peechi | … | Member |

37. All Scientists of KFRI … Invitees
38. Programme Co-coordinator, Training & Extension Division, KFRI … Convener

## 2.INTERNAL RESEARCH GROUP (IRG)

1. Director … Chairman
2. Dr. EA Jayson … Convener
3. Dr. TB Suma … Associate Convener
4. All Scientific staff … Members

## 3.PROJECT EVALUATION & MONITORING COMMITTEE

1. Dr. UN Nandakumar … Chairman
2. Dr. RC Pandalai … Member
3. Dr. Thomas P Thomas … Member
4. Dr. M Sivaram … Convener

## 4.Ph.D. & M. Sc. STUDENTS ATTACHMENT PROGRAMME ADVISORY COMMITTEE

(Vide 6. G.53/KFRI/79 dated 6 May 2006)

1. Dr. EA Jayson … Chairman
2. Dr. EJM Florence … Member
3. Dr. TV Sajeev … Member
4. Dr. MP Sujatha … Member
5. Respective Research Guide(s) … Invitees

## 5. EQUIPMENT/ INFRASTRUCTURE DEVELOPMENT COMMITTEE

1. Dr. EM Muralidharan … Chairman
2. Dr. S Sandeep … Member
3. Dr. R Jayaraj … Member
4. Smt. Mary Kuruvilla … Convener

## 6.PURCHASE COMMITTEE

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

1. One Scientist F or above : Dr. KK Seethalakshmi … Chairman
2. One Scientist nominated by the Director : Dr. M. Sivaram … Member
3. Registrar … Convener

## 7. INTELLECTUAL PROPERTY RIGHTS AND PATENT ADVISORY COMMITTEE

1. Dr. KK Seethalakshmi … Chairman
2. Dr. TK Hrideek … Member
3. Dr. PKC Pillai … Convener

## 8.PUBLIC RELATIONS COMMITTEE

1. Dr. TV Sajeev … Chairman

2. Dr. UN Nandakumar … Member
3. Dr. K Mohandas … Member
4. Mr. VP Raveendran … Member
5. Dr. AV Raghu … Member

## 9. LIBRARY & INFORMATION NETWORKING ADVISORY COMMITTEE

(Vide 6. G.53/KFRI/79 dated 19 July 2008)

1. Smt. N Sarojam … Chairman
2. Dr. N Sasidharan … Member
3. Mr. KF George … Member
4. Dr. S Sandeep … Member
5. Mr. KH Hussain … Member
6. Shri K Ravindran,(Retired Librarian, MG University) … Invitee

## 10.WEBSITE AND SOFTWARE COMMITTEE

(Vide 6. G.53/KFRI/79 dated 13 October 2008)

1. Dr. M Amruth … Chairman
2. Mr. KH Hussain … Member
3. Shri AR Rajan … Member
4. Dr. M Sivaram … Convener

## 11.OFFICE AUTOMATION COMMITTEE

(Vide Proceedings G.53/KFRI/79 dated 13 October 2008)

1. Mr.AR Rajan … Chairman
2. Mr. K Kamalakaran … Member
3. Smt. Ricy Eliner Varkey … Member
4. Smt. Anupa Vasu … Member
5. Smt. VK Leela … Convener

## 12.KERALA FOREST SEED CENTRE ADVISORY COMMITTEE

(Vide Proceedings G.53/KFRI/79 dated 11 February 2004 – Modified here)

1. Director … Chairman
2. Principal Chief Conservator of Forests (Working Plan & Research), KFD … Member
3. Conservator of Forests (Central Circle), KFD … Member
4. Research Coordinator, KFRI … Member
5. Silvicultural Research Officer (North), KFD … Member
6. Silvicultural Research Officer (South), KFD … Member
7. Silviculturist, KFRI … Member
8 Scientist-in-Charge, KFSC … Invite Convener

## 13.TEAK MUSEUM AND NATURE TRAIL ADVISORY COMMITTEE

1. Dr. UM Chandrasekhara … Chairman
2. Dr. RC Pandalai … Member
3. Dr. TK Dhamodaran … Member
4. Dr. P Sujanapal … Member
5. Smt. Sani Lookose, Teak Museum Curator … Convener

## 14.CAMPUS DEVELOPMENT COMMITTEE

1. Dr. EM Muralidharan … Chairman
2. Dr. RC Pandalai … Member
3. Dr. PA Jose … Member
4. Smt. MK Raji (Engineering) … Member
5. Dr. VB Sreekumar … Member
6 Dr. P Sujanapal … Convener

## 15. EDITORIAL COMMITTEE FOR THE JOURNAL OF BAMBOO AND RATTAN

(Vide 6. G.53/KFRI/79 dated 13 October 2008)

1. Dr. EM Muralidharan … Chief editor
2. Dr. KK Seethalakshmi … Associate Editor
3. Dr. PK Thulasidas … Associate Editor

## 16.ANNUAL REPORT COMMITTEE

1. Dr. KV Bhat … Chairman
2. Dr. V Anitha … Member
3. Dy. Registrar (Accounts, i/c … Convener
4. Dr. KK Ramachandran … Convener

## 17.NEWSLETTER COMMITTEE

1. Dr. R Jayaraj … Editor
2. Dr. TB Suma … Associate Editor
3. Dr. M Amruth … Associate Editor

## 18.STORES COMMITTEE

1. Dr. N Sasidharan … Chairman
2. Dr. PK Thulasidas … Member
3. Dr. GE Mallikarjuna Swamy … Member
4. Mr. KP Manoj … Convener

## 19.SPORTS COMMITTEE

1. Mr. VP Raveendran … Chairman
2. Dr. K Mohandas … Member
3. Mr. PI Shereef … Member

## 20.COMMITTEE FOR TRANSFORMATION OF OFFICIAL LANGUAGE TO MALAYALAM

(Vide KSCSTE letter no. 38/C6/09 dated 10 Feb. 2009)

1. Mr. KH Hussain … Chairman
2. Dr. KK Ramachandran … Member
3. Dr. TV Sajeev … Convener

## 21.EXHIBITION ADVISORY COMMITTEE

(Vide 6. G.53/KFRI/79 dated 13 October 2008)

1. Dr. K Mohandas … Chairman
2. Dr. UM Chandrasekhara … Member
3. Dr. CK Soman … Member
4. Dr. PA Jose … Member
5. Dr. AV Raghu … Member
6. Mr. VP Raveendran … Member
7. Dr. RC Pandalai … Convener

## 22. SEMINAR COMMITTEE

1. Dr. AV Raghu … Chairman
2. Dr. KA Sreejith … Member
3. Mr. KH Hussain … Convener

## 23.COMMITTEE TO PREVENT SEXUAL HARASSMENT ON WOMEN

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

1. Dr. P Rugmini … Chairman
2. Dr. Mammen Chundamannil … Member
3. Dr. MP Sujatha … Member
4. Smt. Seetha Sadanandan
   (C/o Kudumbasree State Poverty Eradication Mission, Ward 16, Cheenikkadavu, Kannara, Pananchery Panchayath, Trichur Dist.) … Member
5. Smt. Sherly Issac … Convener

## 24.HOSTEL ADVISORY COMMITTEE

1. Dr. K Mohanadas … Chairman
2. Registrar … Member
3. Mrs. Raji MK … Member
4. Dr. R Jayaraj … Convener

## 25.CAFETERIA COMMITTEE

1. Dr. KK Seethalakshmi … Chairman
2. Dr TK Damodaran … Member
3. Mrs VK Leela … Member
4. Mr. PI Shereef … Convener

## 26.BUILDING COMMITTEE

(Vide Note No. G 53/KFRI/Estt/79 dated 12 April 2010)

| | | |
|---|---|---|
| 1. Dr. UN Nandakumar | ... | Chairman |
| 2. Dr. EM Muralidharan | ... | Member |
| 3. Dr. PK Thulasidas | ... | Member |
| 4 Dr. VB Sreekumar | ... | Convener |

## 27.VEHICLE ADVISORY COMMITTEE

| | | |
|---|---|---|
| 1. Dr. RC Pandalai | … | Chairman |
| 2. Dr. KV Bhat | … | Member |
| 3. Mr. Krishnanunni | … | Member |

## 28.INFORMATION ARCHIVAL ADVISORY COMMITTEE

| | | |
|---|---|---|
| 1. Mr. KH Hussain | … | Chairman |
| 2. Dr. K Swarupanandan | … | Member |
| 3. Dr. M Amruth | … | Convener |

## 29. DIGITAL LIBRARY

| | | |
|---|---|---|
| Director | … | Chairman |
| 1. Shri. KH Hussain | … | Member |
| 2. Dr. P Vijayakumaran Nair | … | Member |
| 3. Dr. Mammen Chundamannil | … | Member |
| 4. Dr. K Swarupanandan | … | Member |
| 5. Dr. N Sasidharan | … | Member |
| 6. Dr. EM Muralidharan | … | Member |
| 7. Mrs. Ricy Eliner Varkey | … | Special Invitee |
| 8. Mrs. N Sarojam | … | Convener |

# LIST OF STAFF

## Scientific Staff

| Sl. No. | Name | Designation | Date of joining |
|---|---|---|---|
| 1 | Dr. KV Sankaran, Director | Scientist-G | 21.05.1982 |
| Research Monitoring and Evaluation Unit | | | |
| 2 | Dr. K Swarupanandan, Research Coordinator | Scientist-F | 20.07.1979 |
| 3 | Dr. KV Bhat | Scientist-F | 31.05.1982 |
| Sustainable Forest Management | | | |
| 4 | Dr. KK Seethalakshmi, Programme Coordinator | Scientist- F | 13.09.1979 |
| 5 | Dr. M Balagopalan | Scientist-F | 14.03.1978 |
| 6 | Dr. Thomas P Thomas, Head, Soil Science Dept. | Scientist- F | 31.12.1979 |
| 7 | Dr. RC Pandalai | Scientist- F | 14.03.1983 |
| 8 | Dr. UN Nandakumar | Scientist- F | 23.03.1983 |
| 9 | Dr. MP Sujatha | Scientist-EII | 11.12.1987 |
| 10 | Dr. CK Somen | Scientist-EI | 06.12.1978 |
| 11 | Shri. P.K. Chandrasekhara Pillai | Scientist-C | 18.10.1983 |
| 12 | Shri. VP Raveendran | Scientist-C | 25.02.1993 |
| 13 | Dr. P Sujanapal | Scientist-B | 09.12.2010 |
| 14 | Dr. S Sandeep | Scientist-B | 09.03.2011 |
| Forest Genetics and Biotechnology | | | |
| 15 | Dr. EP Indira, Programme Coordinator | Scientist-F | 28.02.1979 |
| 16 | Dr. EM Muralidharan (Scientist-in-Charge, CIU) | Scientist-EII | 27.05.1991 |
| 17 | Dr. TB Suma | Scientist-B | 08.12.2010 |
| 18 | Dr. TK Hrideek | Scientist-B | 08.12.2010 |
| Forest Ecology and Biodiversity Conservation | | | |
| 19 | Dr. N Sasidharan, Programme Coordinator | Scientist-G | 25.02.1977 |
| 20 | Dr. KK Ramachandran, Head, Wildlife Dept. | Scientist-F | 17.08.1978 |
| 21 | Dr. EA Jayson | Scientist-F | 16.12.1981 |
| 22 | Dr. PS Easa | Scientist-EII | 16.08.1978 |
| 23 | Dr. UM Chandrashekara, Scientist-in-Charge, KFRI Sub Centre, Nilambur | Scientist-EII | 15.07.1992 |
| 24 | Dr. KV Mohammed Kunhi (On deputation) | Scientist-EI | 24.10.1994 |
| 25 | Dr.PA Jose | Scientist-C | on deputation from TBGRI |
| 26 | Dr. VB Sreekumar | Scientist-B | 01.03.2011 |
| 27 | Dr. KA Sreejith, KFRI Sub Centre, Nilambur | Scientist-B | 01.03.2011 |
| 28 | Dr. R Jayaraj | Scientist-B | 28.03.2011 |

| | | | |
|---|---|---|---|
| Forest Health | | | |
| 29 | Dr. TV Sajeev | Scientist-EI | 06.02.1997 |
| 30 | Dr.GE Mallikarjuna Swamy | Scientist-B | 20.12.2010 |
| Wood Science and Technology | | | |
| 31 | Dr. TK Dhamodaran, Head, Wood Science and Technology Dept. | Scientist-F | 02.08.1982 |
| 32 | Dr. PK Thulasidas | Scientist-C | 28.06.1984 |
| Forestry and Human Dimensions | | | |
| 33 | Dr. S Sankar, Programme Coordinator | Scientist-G | 19.09.1981 |
| 34 | Dr. Mammen Chundamannil, Head Forest Economics Dept. | Scientist-F | 29.05.1982 |
| 35 | Dr. V Anitha | Scientist-EI | 07.09.1998 |
| 36 | Dr. M Amruth | Scientist-B | 01.03.2011 |
| Forest Management Information System | | | |
| 37 | Dr. K Jayaraman, Programme Coordinator | Scientist-F | 02.05.1984 |
| 38 | Dr. P Vijayakumaran Nair, Head, GIS and Remote Sensing Department | Scientist-F | 01.11.1980 |
| 39 | Dr. P Rugmini, Head, Forest Statistics Department | Scientist-F | 17.11.1978 |
| 40 | Dr. CN Krishnankutty | Scientist-F | 24.09.1981 |
| 41 | Dr. M Sivaram | Scientist-EI | 04.12.1998 |
| Extension and Training | | | |
| 42 | Dr. EJ Maria Florence, Programme Coordinator | Scientist-F | 22.09.1980 |
| 43 | Dr. K Mohanadas, Head, Extension Department | Scientist-F | 01.06.1982 |
| 44 | Smt. Sani Lookose, Curator, Teak Museum, KFRI Sub Centre, Nilambur | Scientist-C | 07.08.2002 |
| 45 | Dr. AV Raghu | Scientist-B | 07.12.2010 |
| Library and Information | | | |
| 46 | Shri. AR Rajan | Scientist-EII | 01.12.1978 |
| 47 | Smt. N Sarojam, Librarian & Programme Coordinator (i/c) | Scientist-C | 06.07.1981 |
| 48 | Shri. KH Hussain | Scientist-C | 28.12.1981 |
| 49 | Shri. KF George | Scientist-B | 23.12.1994 |

## Technical Staff

| | | | |
|---|---|---|---|
| 1 | Shri. PP Sunny | Engineer-in-Charge & Sr. Spl. Grade Technical Officer | 23.04.1979 |
| 2 | Shri. UY John | Sr. Spl. Grade Technical Officer | 09.01.1981 |
| 3 | Shri. Shereef PI | Technical Officer | 10.08.2010 |
| 4 | Smt. Raji MK | Technical Officer | 18.08.2010 |
| 5 | Shri. D Skariah | Sr. Spl. Grade Technical Asst. | 01.09.1983 |

| | | | |
|---|---|---|---|
| 6 | Shri. KC Subramanian | Sr. Spl. Grade Technical Asst. | 22.07.1985 |
| 7 | Shri. PB Sajeev Rao | Spl. Grade Technical Assistant | 30.01.1989 |
| 8 | Shri. MR Anilkumar | Spl. Grade Technical Assistant | 30.01.1989 |
| 9 | Shri. OP Ranjith | Binder | 03.10.2011 |

## Administrative Staff

| | | | |
|---|---|---|---|
| 1 | Dr. VV Sudheendrakumar | Registrar-in-charge (Scientist, F) | 19.02.1979 |
| 2 | Shri. K Thulaseedharan Nair | Registrar (on deputation) | 15.03.2002 |
| 3 | Shri. K Venugopal | Deputy Registrar (on deputation) | 27.05.2008 |
| 4 | Shri T.K.Antony | Deputy Registrar Admin. (Deputation) | |
| 5 | Smt. VK Leela | Assistant Registrar | 02.07.1979 |
| 6 | Smt. Mary Kuruvilla | Section Officer | 07.07.1980 |
| 7 | Smt. Sabitha Balakrishnan | Section Officer | 03.09.1999 |
| 8 | Smt. Shirly Issac | Section Officer | 16.09.2003 |
| 9 | Smt. K Annapoorni | PA to Registrar | 12.07.1982 |
| 10 | Smt. Grace Andrews | PA to Director | 27.01.1987 |
| 11 | Shri. K Kamalakaran | Office Assistant | 10.12.2009 |
| 12 | Smt. V Raseena | Office Assistant | 20.08.2010 |
| 13 | Smt. R Tintu | Office Assistant | 18.08.2010 |
| 14 | Shri. VS Krishnanunni | Office Assistant | 28.08.2010 |
| 15 | Ms. CK Sindhumol | Office Assistant | 19.08.2010 |
| 16 | Smt. VV Rajina | Office Assistant | 17.08.2010 |
| 17 | Smt. Anupa Vasu | Office Assistant | 01.10.2011 |
| 18 | Smt. Anuja Prasannan | Office Assistant | 17.10.2011 |
| 19 | Kum. K Keerthy | Office Assistant | 06.01.2012 |
| 20 | Shri. PM Venugopalan | Spl. Grade Typist | 22.05.1978 |
| 21 | Shri. KP Manoj | Spl. Grade Typist | 28.08.1992 |
| 22 | Shri. TM Abdul Vahab | Sr. Word Processing Assistant | 27.01.1989 |
| 23 | Shri. TC Paul | Sr. Driver | 01.07.1994 |
| 24 | Shri. VC Chandran | Sr. Driver | 01.07.1994 |
| 25 | Shri. PK Rajendran | Driver | 07.01.2012 |
| 26 | Shri. EO Mathai | Driver | 07.01.2012 |
| 27 | Shri. CH Herald Wilson | Driver | 24.02.2012 |
| 28 | Shri. MC Mohandas | Sr. Attendant | 24.10.1977 |
| 29 | Shri. PA Sankarankutty | Sr. Attendant | 30.01.1978 |
| 30 | Smt. N Baby | Attendant | 24.11.1995 |
| 31 | Smt. Ricy Eliner Varkey | Computer (LAN) Assistant | 02.03.2006 |
| 32 | Smt. KK Vanaja | Helper | 26.08.2003 |

| | | | |
|---|---|---|---|
| 33 | Ms. K Aparna | Helper | 23.08.2004 |
| 34 | Shri. P Rajeesh | Helper | 14.06.2000 |
| 35 | Shri. TP Padmanabhan | Attendant | 17.12.1991 |
| 36 | Smt. AM Lalitha | Sr. Helper | 01.08.1986 |
| 37 | Smt. TG Chandrika | Sr. Helper | 01.03.1988 |
| 38 | Shri. VK Mohandas | Sr. Helper | 01.01.1992 |
| 39 | Shri. NI Thankappan | Sr. Helper | 01.01.1992 |
| 40 | Shri. EP Ulahannan | Sr. Helper | 01.01.1992 |
| 41 | Smt. AK Ammini | Helper | 29.04.1993 |
| 42 | Smt. EV Thanka | Helper | 01.07.1994 |
| 43 | Shri. CP Shoukathali | Helper Grade III | 01.03.1988 |
| 44 | Shri. K Mohammed | Helper Grade III | 01.01.1992 |
| 45 | Shri. KK Mohammed | Helper Grade III | 05.07.1994 |
| 46 | Smt. P Deepa | Helper | 06.08.2009 |
| 47 | Shri. IO Thomas | Helper | 11.06.2010 |
| 48 | Shri TP Valsan | Helper | 11.06.2010 |
| 49 | Shri. E Hamsa | Helper | 19.08.2010 |
| 50 | Shri. S Ashamole | Helper | 19.08.2010 |
| 51 | Smt. C Sujatha | Helper | 21.08.2010 |
| 52 | Smt. S Sheeja | Helper | 17.08.2010 |
| 53 | Shri. K Abdul Jaleel | Helper | 16.08.2010 |
| 54 | Shri. AV Chamy | Helper | 27.10.2010 |
| 55 | Shri. NK Rajan | Nursery man | 31.07.2007 |
| 56 | Smt. S Padmavathy | Nursery man | 27.09.2008 |
| 57 | Shri. K Rajan | Nursery man | 29.09.2008 |