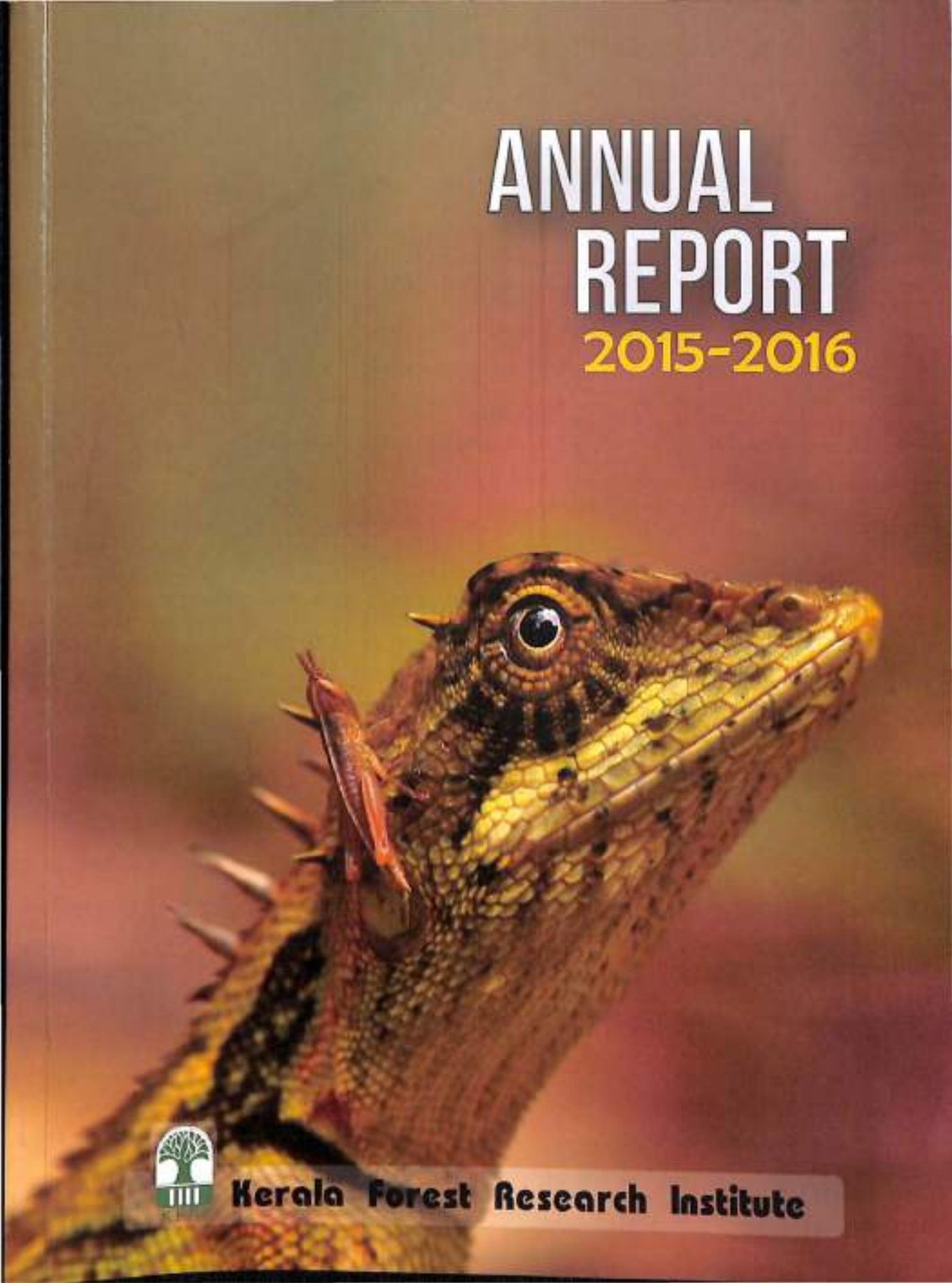
ANNUAL REPORT
2015-2016



Kerala Forest Research Institute

KFRI Annual Report 2015-16

KFRI

Kerala Forest Research Institute

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

Peechi - 680 653, Thrissur, Kerala

Cover Image :

Calotes elliotii (Elliot's Forest Lizard)

This is a Western Ghats endemic arboreal species of lizard found in Kerala. They are found inhabiting evergreen forests, moist deciduous, plantations and also in disturbed fragmented forest patches. Photographed from high elevation evergreen patches of Meghamalai
Photo credit: Mr. Sandeep Das, Forest Ecology Department

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The Director
Kerala Forest Research Institute
Peechi - 680 653, Thrissur, Kerala

www.kfri.res.in
director@kfri.org,director@kfri.res.in

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2015-16


KERALA FOREST RESEARCH INSTITUTE
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Director's Note

Soil, which is the foundation of food production and food security, has been taken for granted since time immemorial. It is often ignored that soil is non-renewable on the human time scale. The extent of fertile soil cover is very limited and often subjected to degradation due to poor management as well as land conversion activities which are occurring at an alarming rate. Healthy soils are capable of conserving biodiversity, providing a range of ecosystem services like food security, nutritional goal, along with climate change mitigation and adaptation which as a whole provide sustainable development. According to The United Nations Food and Agriculture Organization, about 33 per cent of global soils are already degraded.

Sustainably managed forest is essential for sustainable soil management as it helps in preventing soil erosion by restoring and enhancing the soil fertility. Both forest and forest soil play a pivotal role in maintaining healthy environment and providing food security. Under the situation of combating climate change, forests and forest soil play an important role in sequestering carbon, which is a major greenhouse gas. According to State of World's Forest report 2014, about one-third of the carbon produced is stored in the forest with the forest soil sequestering up to 45 per cent of global forest biomass. The FAO, Global Forest Resource Assessment, 2015 shows that the global forest area has been reduced due to deforestation and land conversion by 129 million hectares leaving about 4 billion hectares of forest. Increased awareness on life sustaining function of forest and forest soil is crucial for the reversal of catastrophic trends of land conversion and deforestation.

Declaration of 2015 as the International Year of Soils is with the aim of providing a platform for raising the awareness on the importance of soil in providing ecosystem functions along with better adaptation to climate change for present and future generations. In lieu with the International Year of Soils, KFRI also organized a National Seminar on "Issues, Challenges and Strategies in Sustaining Soil Health" with the purpose of widening the awareness of researchers and stakeholders on current issues in soil management and meeting the present and future challenges in sustainable soil management with special focus on innovative technologies and strategies to bring out policies which prioritize on soil issues. KFRI has contributed significantly and continues to generate information and knowledge through the research activities in various fields of forestry with special emphasis on conservation, sustainable utilization and scientific management of natural resources.

During 2015-16, the institute had 148 ongoing research/extension projects covering different aspects of forestry, local and global relevance. Financial support for these projects spans over KFRI Plan grants

and external agencies like, Food and Agricultural Organization, Ministry of Environment, Forests and climate change, Government of India, Department of Biotechnology, Department of Science and Technology, State Department of Planning and Economic Affairs, National and State Medicinal Plants Boards, Hindustan News Print Ltd and Kerala Forest Department. The Institute received Rs. 1941.64 Lakhs as grants from Kerala Sate Council for Science Technology and Environment, Government of Kerala, of which Rs. 746.64 lakhs is under plan grants and the rest under non-plan. Financial support received from external agencies for specific projects was Rs. 251.25 lakhs. Funds from plan grants were utilized for research and extension projects and for infrastructure development. I place on record the valuable guidance and unstinted support received from Research Council, Management Committee, Kerala State Council for Science Technology and Environment and the unrelenting co-operation and support from the Scientists, Staff and Students of KFRI.

Latha P G.

Dr. PG Latha

THE INSTITUTE

Government of Kerala established the Kerala Forest Research Institute (KFRI) in 1975 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 in 2003, the Institute was brought under the Council along with other Research and Development Institutions of the State. KFRI is in the area of forestry research over four decades now and is one of the leading institutes dedicated to tropical forestry research.

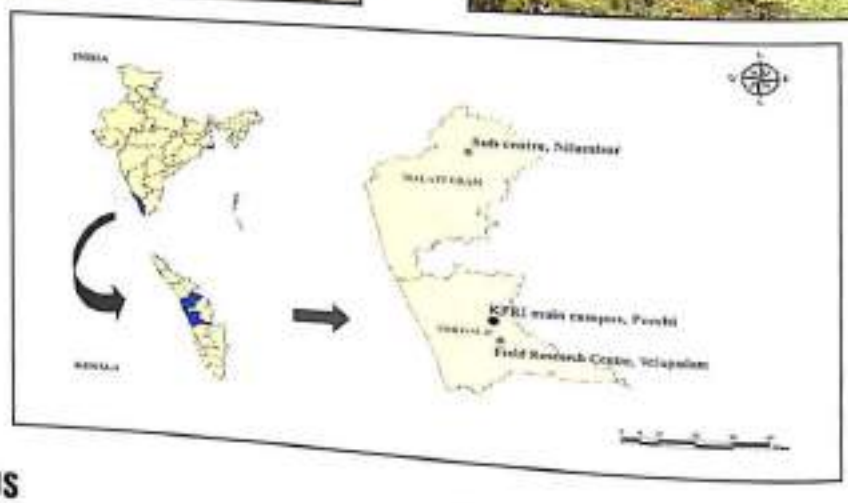
Vision

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

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

- Conduct inter/multidisciplinary research on priority areas of tropical forestry including wildlife management, socio-economics, indigenous knowledge, value addition of forest products, participatory forest management and livelihood improvement of forest dwellers/dependants by scientific management of forest resources,
- Provide technical advice and solutions to practical problems related to forest conservation and sustainable utilization of forest resources, and
- Disseminate knowledge and information on forest-related matters to end-users, farmers, general public and transfer of technology to stakeholders for social benefits.



THE CAMPUS

Main campus, Peechi

The main campus of KFRI is in a 28 hectares Reserve Forest area at Peechi, located 20 kms east of Thrissur city and adjacent to Peechi-Vazhani Wildlife Sanctuary. The Institute has a sub-centre at Nilambur in Malappuram District and a Field Research Centre at Velupadam in Thrissur District. The main campus is an assemblage of offices of many International and National Networks, highly sophisticated laboratory facilities, live collections and plant propagation facilities. Networks and Offices include Asia-Pacific Forest Invasive Species Network (APFISN), TeakNet, Bamboo Technical Support Group (BTSG) (south zone) of the National Bamboo Mission and the Tree Health Helpline. Laboratories include silviculture, soil science, physiology, tissue-culture, clonal multiplication, molecular biology, biochemistry, central instrumentation unit, wildlife biology, geographic Information System and remote sensing, wood science and technology, forest pathology and entomology. These research laboratories are designed to serve staff scientists and research scholars as well as researchers from universities, industries, foreign institutions, and other government laboratories. Collections include, arboretum, bambusetum, butterfly garden, herbarium, insect collections, medicinal plants garden, orchidarium, palmetum, soil museum, teak museum, wildlife museum and xylarium. For plant propagation there are nurseries, green house, mist chamber and the Kerala Forest Seed Centre. The monitoring facilities are the established permanent plots and weather stations. Library, Land Area Network (LAN), training facilities, stores, seminar and conference facilities, field work support (vehicles), staff accommodation, guest house and research scholars hostel are the centralized facilities of KFRI. A Seismic Observatory operated and maintained by the National Centre for Earth Sciences (NCESS) is housed in KFRI main campus.

Sub-Centre, Nilambur

The KFRI Sub-Centre campus at Nilambur has laboratory facilities, field trial plots of several tree species, a bambusetum with 21 species of bamboos, teak museum, a bioresources nature park, medicinal plant garden and a model butterfly garden. This campus is spread over an area of 43.36 hectares and is about 140 kms away from the main campus.

Field Research Centre, Velupadam

The Field Research Centre (FRC) at Velupadam in Thrissur District situated 36 kms away from Peechi main campus is spread over an area of 47.43 hectares. Mainly field trials are conducted at the FRC campus. The FRC has a nursery of forest plant species and also an arboretum with plant species from Western Ghats. A bambusetum, one of India's largest live collections of bamboos, is the main attraction of Velupadam campus. A bamboo processing center for the training of stakeholders is also located in the campus.

Organization

The research activities in KFRI is organized under nine programme divisions, which is a cluster of several departments for effective implementation of multidisciplinary research in forestry. Divisions are headed by Programme Coordinators and Departments by Heads. The Programme Divisions are: Sustainable Forest Management, Forest Genetics and Biotechnology, Forest Management Information System, Forest Ecology and Biodiversity Conservation, Wood Science and Technology, Forestry and Human Dimensions, Forest Health, Extension and Training and Library and Information. A Central Instrumentation Unit in the Institute functions as a common facility. A Research Monitoring and Evaluation (RME) Unit is also functioning to facilitate and monitor research activities in the Institute. The Research Council (RC) is the vital body responsible for overseeing and guiding the formulation and implementation of various research programmes in KFRI. The RC comprises of eminent scientists in the field of 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 Institute is an accredited Research Centre of the Forest Research Institute University Dehradun, Cochin University of Science and Technology, University of Calicut and Mahatma Gandhi University for enrolling students for research programmes leading to the award of doctoral degree. Secretariats of two International Networks funded by the Food and Agriculture Organization of United Nations, namely, Asia-Pacific Forest Invasive Species Network and International Teak Information Network are housed in KFRI.

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 routine administration of the Institute is looked after by the Director in accordance with the decisions of the MC. Administrative and Accounts Sections of the Institute, coordinated by the Registrar assists 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 total staff strength of the Institute is 103 which include 30 scientists, 63 administrative staff and 10 technical staff. In addition, more than 100 project personnels attached to various research projects provide the necessary research support.

PROGRAMME DIVISIONS

Sustainable Forest Management

The Division comprises of Tree Physiology, Silviculture and Soil Science Departments. The mandate is to derive modes and strategies for the sustainable management of forests. The key research areas of the Division are: improved nursery and silvicultural practices, seed technology, sustainable forest management and production of better clones and quality planting stock of plantation species. In addition, studies have also been undertaken on afforestation and eco-restoration 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. The Division is engaged in different social awareness programmes like medicinal plant conservation plans, soil erosion prevention programmes, weather parameters monitoring, among others.

Forest Genetics and Biotechnology

The Programme Division includes Forest Genetics and Tree Breeding and Biotechnology Departments. The major research activities of the Division include genetic improvement of teak, marker-assisted selection, DNA fingerprinting, population genetics and gene mapping. Tissue culture of important forestry species and medicinal plants and low cost micro-propagation technology are also carried out in the Division. The Division also undertakes evaluation of genetic diversity of forest species, selection of plus clones and genetic improvement, studies on breeding system and gene flow.

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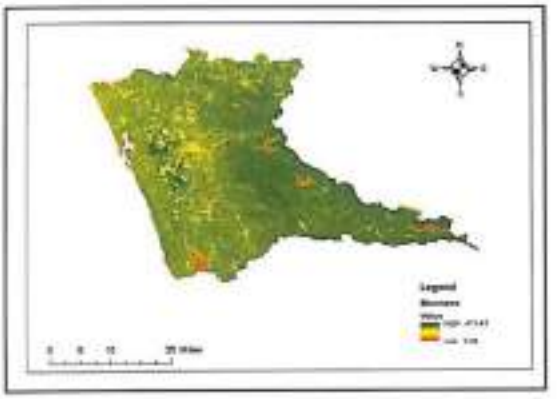


Forest Management Information System

The Programme Division fulfills the information needs of the stakeholders of forest sector using modern tools of statistics, GIS and remote sensing. Forest sector analysis and projections, creation of databases on biophysical and socioeconomic aspects pertaining to forests, mapping forest cover and biodiversity, modeling the growth dynamics of plantations and natural forests for effective management are the major activities of 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 using multilevel models were carried out by the Division. Stand modeling, biodiversity mapping, ecosystem analysis, GIS, forest resource mapping, population analysis and organization of a data bank of forestry in Kerala are the other programmes undertaken.

Forest Ecology and Biodiversity Conservation

The Programme Division has Forest Ecology, Botany, Wildlife and Non-Timber Forest Products (NTFP) Departments under its umbrella. Major research areas of the Division are biodiversity evaluation and conservation of fragile ecosystems, rehabilitation and restoration of degraded ecosystems, ecosystem and landscape analysis, population ecology, traditional knowledge system analysis and biodiversity-informatics. Documentation and inventorisation of biodiversity of diverse forest types and protected areas, evaluation of below-ground biodiversity, taxonomic studies and conservation of Red listed species of flora are some of the research areas of the Botany Department. Wildlife Department attempts various aspects on inventorisation of fauna, endangered animals, man-wildlife interaction and wildlife census. A wildlife museum with an exhaustive collection of species is attached to the Wildlife Department. The NTFP Department is involved in nursery and plantation technology of selected indigenous timber species, ethno-biological studies and cultivation of medicinal plants and other NTFPs, such as, bamboos and rattans, are other activities of the Division. The Department also works on isolation, characterization and bioactivity studies of molecules from medicinal plants of Western Ghats and environmental impact of pesticide application on the ecosystems.

Wood Science and Technology

The Programme Division undertakes research and extension activities related to wood properties and utilization, wood structure, timber processing technology for increased durability, value addition, among others. Wood identification for commercial and judicial purposes are one of the major activities of the Division. Division has facilities for wood preservation, drying kiln and has instruments like Universal Testing Machine (UTM), image analyzer and NIR spectroscope. Many studies on wood structure, properties and preservative treatments for high value timber species like teak, eucalyptus and rubber wood were undertaken by the Division. In addition, anatomical studies, utilization modalities and value addition of products on bamboos, reeds and canes have been undertaken.

Forestry and Human Dimensions

The Departments of Forest Economics and Sociology constitute the Division. The Division focuses on human dimensions of forest management, economic valuation studies, sustainable utilization of forest resources - especially NTFPs, livelihood and recreation, environmental conservation, natural/forest resource management policy and strategic planning, participatory role of local communities in the conservation and sustainable management of forest ecosystem, forest history, oral history archive, and digital repository of forest and environmental writings. Economics and productivity of forest plantations, management of natural forests, demand and supply of wood in Kerala, trees outside forests, bamboo, price fixation of pulpwood, environmental impact assessments, role of bamboo in sustainable rural livelihood, adaption to mechanization in bamboo sector, development of primary & social linkages of marginalized communities are some of the achievements of the Division.

Forest Health

The Programme Division has Forest Entomology and Forest Pathology Departments. The major research areas are diverse aspects of insects and microbes and weeds in the forest ecosystem. The Division is engaged in the development of eco-friendly biological technologies for management of pests, diseases and weeds in forest plantations. In addition, management of nursery and plantation diseases, diversity of plant pathogenic fungi in different forest ecosystems, Vesicular-Arbuscular and ectomycorrhizal fungal diversity and biological control of Invasive alien species are the thrust areas of research in Pathology Department. The Entomology Department is involved in monitoring of forest insect diversity, control of termites in plantations, wood damaging insects and teak defoliator, and traditional methods of post-harvest protection of bamboo from insect borers. 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 is being provided to various agencies for the establishment of butterfly parks. Authentic collections of microbes and insects of Kerala forests and also of microbial pathogens of forest insects are maintained in the Division.

Extension and Training

The Programme Division functions as a link between expertise and technologies of KFRI and stakeholders. The Division communicates with various users /stakeholders, facilitates transfer of technology and conducts training programmes in different aspects of tropical forestry like forest management, medicinal plant cultivation, forest seed management, biodiversity monitoring and evaluation, root-trainer technology, environmental impact assessment, remote sensing and GIS, tree improvement, clonal propagation and statistical application in forestry. The Division has all the facilities for conducting training programmes including lecture halls and trainees' hostel. The Division also liaisons and coordinates technical support to the various stakeholders and departments, researchers, student community and general public.

Library and Information

KFRI Library with a core collection of books, journals and back volumes of journals on forestry caters to the information requirements of scientists and researchers in the field of forestry. A total number of 217 books have been added to its collection during this period. Online Public Access Catalogue (OPAC) of these books was made available for searching the collection in the library. Journals subscribed during this period include both online and printed journals. Out of 130 journals subscribed 40 journals are foreign and 90 Indian journals. Out of 40 foreign journals 32 are online, 4 print along with online and 4 printed journals. Out of 90 Indian Journals 55 are printed and 35 online. A total of 110 numbers of back volumes of journals have been added to the back volume collection. Contents of very important journals in the collection are made available for searching by author, title or subjects. Subscription to both the databases, EBSCO database on Environmental Science and CABI Abstracts on Agriculture and Forestry continued during this period.

The digital archive of KFRI Research Reports, Scientific Papers, theses and dissertations, KFRI Newsletter Evergreen, rare and important books in the field of Forestry and allied subjects built up was made available to search and retrieve. A digital library for teak is also developed during this period with the purpose of accumulating scattered resources of teak information under a single roof. A total number of 800 documents on teak have been collected which include books, seminar proceedings, reports and journal articles. Materials in printed form are organized at the teak museum library and the digital materials are made available to search and retrieve. As part of compiling information on the studies made in the Kerala part of the forests, a digital collection of published documents of 3220 documents have been built up. The digital collections of the library brought to an open source software Dspace, is made available for the online access from the researchers' desktop. The two websites, Indian Forestry Abstracts and Bamboo Information Centre – India (BIC – India) are maintained by the library. The current ongoing projects are: an information system for forests of Kerala. Compilation of Indian Forestry Abstracts - Phase II. BIC - India database generation and management, and developing a digital library for the teak museum. Scientists and researchers of KFRI can access the digital archives of the library round the clock. This facility is now extended to KFRI sub-centre, Nilambur also.

Support Sections

The Institute has Administration, Accounts and Engineering that support all the research and extension activities of the Institute. The day-to-day administrative activities of the Institute is looked after by the Administrative Section of the Institute. Administrative Section headed by Registrar, supports Director in the smooth management of the Institute. All administrative and financial sanctions related to project implementations are handled at Administrative Section. The financial and accounting management of the Institute including financial transactions related to projects implemented by the Institute are handled at the Accounts Section. The Accounts Section is responsible for all payments including payroll. It is also responsible for maintenance of relevant records and accounts and for ensuring effective financial management practice in place. The Engineering Section handles civil and electrical works separately. The civil section looks after the implementation of new constructions and maintenance of existing infrastructure. The electrical section is responsible for the installation and maintenance of electrical infrastructure and uninterrupted power supply.

INTERNATIONAL AND NATIONAL NETWORKS

Asia-Pacific Forest Invasive Species Network

The Asia-Pacific Forest Invasive Species Network (APFISN) was established in 2004 during the 20th Session of the Asia-Pacific Forestry Commission (APFC) held in Fiji as a response to the immense costs and dangers posed by invasive species to the substantial management of forest in the Asia-Pacific region. APFISN is a cooperative alliance of the 33 member countries in the Asia-Pacific Forestry Commission (APFC) a statutory body of the Food and Agricultural Organization of the United Nations (FAO). The Network focuses on inter country cooperation that helps to detect, prevent, monitor, eradicate and control forest invasive species in the Asia-Pacific region. The APFISN undertook the following activities during 2015-2016.

Informal Working Group meetings, at Kerala and Maldives (25 February and 28 April 2015); Technical back-stopping mission, undertaken by Dr. Shiroma Sathaypala, FAO (Rome) (24-26 April 2015) wherein evaluation of the field works at the model sites were conducted. Besides this, a National Training- (18-20 February 2015) on Quarantine Control and International Standards for Phytosanitary Measures by Expert Trainer- Ms.Gillian Allard, UK; Field Training Programmes at Maldives (24-26 February and 05 - 09 April 2015) on identifying, recording, monitoring and managing Forest Invasive Species (FIS); and training on rearing, multiplying and release of biocontrol agents against the coconut leaf beetle., led by Ms. Jawaidha Ahmed were conducted.

A final Workshop and Regional Forum (1-2 December 2015) on Control and Management of Destructive Forest Invasive Species in South Asian Natural and Plantation Forests was held at Kerala Forest Research Institute, Peechi. Result of field trials, achievements from the project and key protocols for managing invasive species in India and Maldives were presented. Discussions were also held on adoption of methods for managing FIS. Workshop on Transboundary Cases of Forest Invasive Species Management was held at Clark Free Port Zone –Philippines, Fontana (22-24 February 2016), focusing on facilitating capacity building implementation of inexpensive pest monitoring systems, enhancing collaboration among FIS researchers and practitioners from multiple countries by sharing information on ongoing and past efforts to manage FIS and identifying common transboundary issues.

TEAKNET (International Teak Information Network) FAO

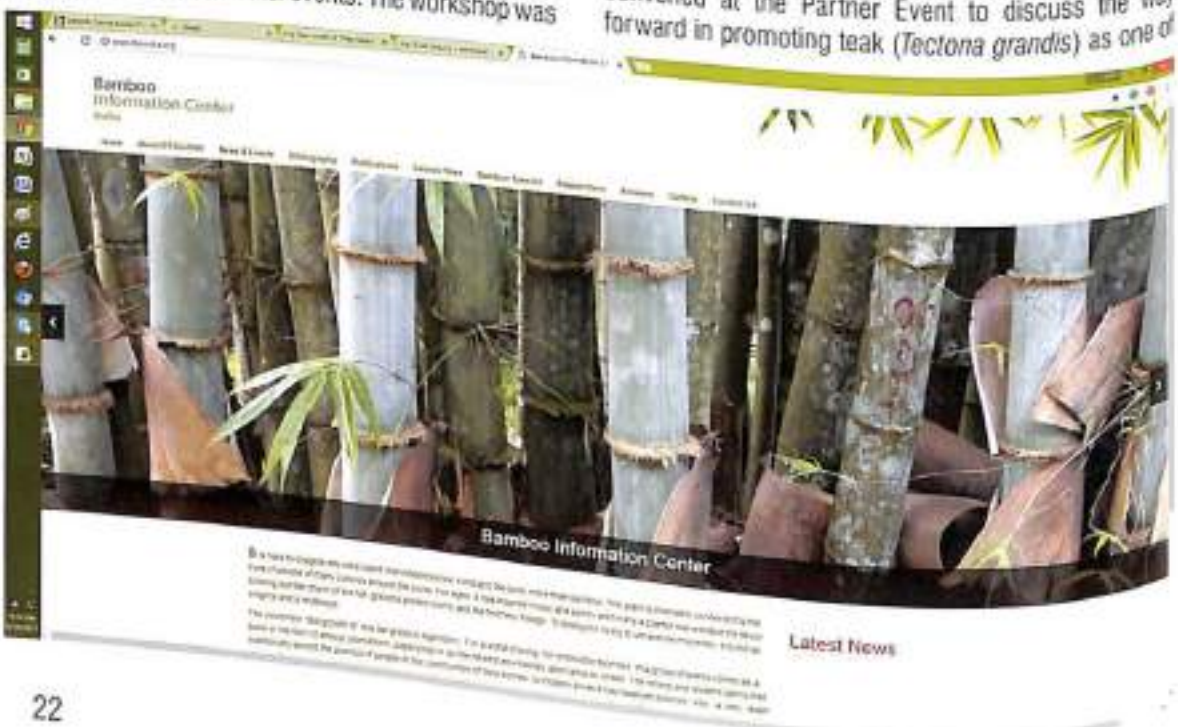
TEAKNET is an International Network of institutions and individuals interested in teak. The Network aims to transform the global teak sector from its current suboptimal state to that of a dynamic entity for the benefit of all stakeholders of the sector and also to address the issues of the global teak sector. TEAKNET is operated by an International Steering Committee and since 2008 it is functioning at KFRI as the host institution for its functioning. Continuance of regular TEAKENT activities includes website updation releases of quarterly TEAKENT Bulletin. Enrollment of new Teaknet Members and answering to the queries regarding various aspects of teak in aglobal level. The Network undertook the following activities during the period from April 2015 - March 2016.

Project Formulation Workshop, 10-11 May 2015, Guayaquil, Ecuador

TEAKNET in association with Special Programme for Development of Capacities of International Union of Forest Research Organization (IUFRO-SPDC), Austria and the Food and Agriculture Organization (FAO) of the United Nations, Rome organized a Project Formulation Workshop (10-11 May 2015) at Guayaquil, Ecuador with the objective to plan, organize and implement a program for the genetic conservation of teak resources on a global level in order to conserve the existing native and planted teak resources and widen the genetic resource base in view of new challenges from climate change and extreme weather events. The workshop was attended by 17 invited delegates from the selected 9 African and Latin American countries. 3rd World Teak Conference 5-Strengthe ning Global Teak Resources and Markets for Sustainable Development, 11-15 May 2015, Guayaquil, Ecuador.

TEAKNET successfully organized the 3rd World Teak Conference 2015-Strengthening Global Teak Resources and Markets for Sustainable Development during in association with Asociacion Ecuatoriana de productores de Teca Y Mederas Tropicales (ASOTECA), the FAO of the United Nations, Teakwood Working party of the IUFRO and the event organizer, Soluciones Ambientales Totales (SAMBITO). Around 341 registered delegates from 35 countries representing 5 continents attended the conference to share knowledge and experience and to exchange ideas on the multiple economic, social and environmental benefits that teak resources can prove. TEAKNET Partner Event - "Global Significance of Teak- Present and Future" In the Asia Pacific Forestry Week, 22-26 February 2016, Clark Freeport Zone, Pampanga, Philippines

Furthermore, TEAKNET participated in the Asia Pacific Forestry Week and conducted a Partner Event (24 February 2016) under Stream 1: Pathways to Prosperity: Future Trade and Markets at Philippines. Experts from the Asia Pacific region and from overseas convened at the Partner Event to discuss the way forward in promoting teak (*Tectona grandis*) as one of



the major high-value tropical timber species. Attended by over 25 participants the Partner Event was co-sponsored by Teakwood Working Party of the IUFRO, Vienna and FAO of the United Nations, Rome. TEAKNET also set up an Exhibition booth at the Venue in the Asia-Pacific Forestry Week 2016.

National Bamboo Mission - Bamboo Technical Support Group (BTSG- South zone)

Bamboo Technical Support Group (BTSG)-South Zone is hosted at KFRI and supported by the National Bamboo Mission (NBM), Ministry of Agriculture and Cooperation, Government of India. NBM has set up two groups in the country to support in its mission of bringing integrated development of the bamboo sector. BTSG – KFRI is one among such group that caters to the requirements of the six states in South of India viz., Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa and Maharashtra. The support group conducts various training programmes for stakeholders among these states. Field functionaries and farmers involved in cultivation and utilization of bamboo have been imparted training on diversity of bamboo species, their biology, and diverse range of uses it is put to, the methods of propagation, establishment and management of plantations, harvesting and utilization, economics, institutional arrangements and policy in bamboo sector. The faculty is drawn mostly from the scientists from various disciplines of KFRI that has been in the forefront of research in bamboo for the past three decades. Other activities have been to offer technical support on bamboo to the National Bamboo Mission and to farmers and artisans. KFRI has set up a bamboo nursery to provide quality planting material of the important commercial bamboo species to farmers. A Bamboo Information Centre supported by NBM functioning at the KFRI Library is a source of published literature on bamboo world over.

The Bamboo Processing Centre was established in the Field Research Centre of the KFRI at Velupadam, Thrissur, under the Bamboo Technical Support Group – KFRI with the support of the NBM. The Bamboo Processing Centre is established as a means of reviving traditional bamboo sector by demonstrating the benefits of mechanized processing of bamboo. The Bamboo Processing Centre is now extended to a new building in order to accommodate few more machines such as Bamboo Seasoning Plant, Matt Weaving Machine, Bamboo Incense Stick Making Machine, among others. Five training programmes of 21 days were conducted for about 71 different stakeholders including artisans, students, women groups and other interest groups in bamboo utilization. Training for producing various bamboo products such as bamboo star and Christmas crib, bamboo flower vase, bamboo waste paper basket, lampshades and bamboo blind weaving, among others were produced out of treated bamboo. The machines

and facilities of the Bamboo Processing Centre were demonstrated to NGOs, research students, entrepreneurs and artisans among others working on bamboo and allied fields. Demonstrations were made for 4 groups and 15 individual stakeholders, a total up to 75 individuals to date. Activities were initiated for the replacement of plastic office materials, viz. trays, wastepaper baskets, and penholders with bamboo material. Suitable designs and models were developed and produced. The Bamboo Processing Centre also serves as a Common Facility Centre in product designing, manufacturing, preservative treatment methods and marketing in the bamboo sector.

FACILITIES

Arboretum

Arboreta are special places for the cultivation and

display of a wide variety of evergreen and moist deciduous trees. It is a living laboratory, which functions as an outreach, teaching, and research facility dedicated to preserving the beauty and ecological functions of our biodiversity hotspot. KFRI Arboretum established in the Peechi campus in 2003 in an area of about 5 hectares currently has 3200 accessions belonging to 178 species under 50 families and 128 genera, with more than 50 taxa endemic to southern Peninsular India. Arboretum is maintained with grid maps with markings of the location details of each of the

live collection. It is also recognized internationally by Index Seminum with ID No. 1518 and is also enlisted in the National Network of Botanical Gardens in India. Among the 178 taxa in the arboretum, there are two gymnosperms and 176 angiosperms. Among the angiosperms, 162 taxa are 14 species of 3 genera and 2 families.

Bambusetum

"Bambusetum" is a garden having a collection of bamboo plants. The basic purpose is for the ex situ conservation of different bamboo species and to assemble a collection of tropical bamboo taxa from all parts of the country at one selected site. The KFRI-Bambusetum was established during 1988-95 as part of the International Development Research Centre Bamboo project at Field Research Centre, Velupadam in Thrissur District, Kerala. It has been an attraction to researchers and visitors ever since. Presently, the collection includes 65 species under 14 genera viz., 26 species of *Bambusa*, *Davidsea attenuate*, 9 species of *Dendrocalamus*, 2 species of *Dinochola*, 7 species of *Gigantochola*, *Guadua angustifolia*, *Melocanna baccifera*, 7 species of *Ochlandra*, *Oxytenanthera abyssinica*, *Phyllostachys sulphurea*, 2 species of *Pseudoxytenthera*, 3 species of *Schizostachyum*, 2 species of *Sinarundinaria* and 2 species of *Thyrsostachys*. From time to time, the Bambusetum has been enriched with different bamboo species.

Three types of planting stock (offsets, rhizomes and seedlings) collected from Andhra Pradesh, Arunachal Pradesh, Assam, Himachal Pradesh, Karnataka, Kerala, Orissa, Tripura and West Bengal were used for planting. Valuable information on clump development, culm production and growth parameters like culm length, culm girth, among others, are being gathered computed and analyzed for productivity of these valuable Bamboos. Effect of management practices like weeding, soil working & selective cutting, on the production potential of each of these species is being closely monitored. The KFRI-Bambusetum aims to have an exhaustive collection of sympodial bamboos that can be grown in a typical agro-climatic zone and to gather invaluable scientific information on bamboo growth in state. The Bambusetum also serves as genetic resource for future crop improvement programmes and for forest managers and farmers.

Bioresources Nature Park

Bioresource Nature Park is located at KFRI Sub-centre Nilambur, and was established with the financial support from Department of Biotechnology, Ministry of Environment and Forests and climate change Government of India and Department of Planning and Economic Affairs, Government of Kerala. The Bioresources Nature Park has different conservation themes, four groups, viz.; algae, bryophytes, pteridophytes and plants found in specialized ecological niche, i.e. xerophytes (cacti and succulents) and hydrophytes (aquatic plants). Besides these beneficial plants (medicinal plants), ornamental and aesthetic plants (orchids), with special reference to endemic and rare, endangered and threatened (RET) species are also featured in the park. Propagules of over 1500 species of plants have been collected and introduced in the thematic areas of the nature trail. In the orchid house of the park, one can familiarise with some of the rare orchids, south Indian endemic species, medicinal orchids and commercially important orchids including some of the prettiest orchids in south India. The Fern House features around 80 species of ferns, including endemic, rare, endangered and ornamental ferns. The Aquatic plants include different forms, such as, floating hydrophytes, submerged and rooted hydrophytes, emergent rooted hydrophytes, and floating leaved and rooted hydrophytes. The Xerophyte and Succulent garden has both outdoor landscaped rock garden and a green house to display medicinal and ornamental species. A collection of bio-fence and bio-fuel species among other attractions too are displayed. Thallpohyte and Bryophyte specimens are displayed in a specially designed shade house with mist and drip irrigation facilities. In the Palm Garden, besides the 40 ornamental palm species many palms which have economic, ecological and cultural significance are grown. A Taxonomic Garden, where plants of over 100 angiosperm families are assembled as part of the Bioresources Park. The butterfly garden in the Park has been developed by planting larval and adult host plants and subtle modification of the habitat whereby one gets to see the entire life cycle of variety of butterflies. The Nature Park also has a model bamboo house established by the State Bamboo Mission.

Butterfly Garden

Butterfly gardens are considered as an important tool in the field of nature education. Butterflies are attracted into

semi-natural garden space where food plants of butterflies and their caterpillars are carefully selected and grown. KFRI developed this concept and created varieties of micro-habitats in the garden for attracting butterflies belonging to various groups. Large number of butterflies including the rare, endemic and endangered butterflies frequent the garden and captivates the eyes of the visitors in the background of which they receive elucidative lessons on life history of the butterflies besides their co-evolution, intricate ecological linkages, diversity, food requirements and other details. KFRI has two butterfly gardens, one in its main campus at Peechi and another in the Sub-centre at Nilambur. Some of the butterflies that can generally be seen in the garden include lemon butterfly (*Papilio demoleus*), southern birdwing (*Troides minos*), common rose (*Pachliopta aristolochiae*), light - blue tiger (*Tirumala limniace*), dark blue tiger (*Tirumala septentrionis*) and common crow (*Euploea core*). The regular monitoring of the butterflies reported the presence of 12011 individuals belonging to 61 species. The aggregation among tiger butterflies (Blue tiger, Dark Blue tiger, plain tiger, striped tiger and common crow) at alkaloid sources such as, *Crotalaria retusa* was observed in the garden. Total number of species recorded in 2015-16 is 4884 belonging to Papilionidae, Pieridae, Lycaenidae, Nymphalidae and Hesperiidae.

Central Instrumentation Unit

The Central Instrumentation Unit (CIU) a centralized facility established in 2006, is an assemblage of sophisticated analytical instruments used by scientists and researchers of different departments of the Institute. Since inception, various instruments have been added to the facility and now it caters to the demand of researchers within and outside the institute at a larger scale. The major instruments in the CIU are high performance liquid chromatography, gas chromatography, GC-mass spectrometer, CHNS elemental analyzer, autoanalyzer, real time PCR machine, spectrophotometer and soil CO_2 exchange system, among others. The CIU also has a sample preparation lab and other minor instruments like, muffle furnace, precision water bath, analytical balance, rotary shaker and ultrapure water system. The CIU also offers the facilities to researchers from other organizations on payment.

Central Nursery

The Central Nursery, situated at the KFRI main campus has a collection of about 120 species high in demand under timber yielding, fruit bearing and medicinal categories of plants. The nursery ensures the timely availability of planting material to the farmers, general public and other departments. Besides the above species and aspects, the nursery is engaged in handling a number of rare and threatened species from Western Ghats, related with various research programmes conducted by the Institute. Standardization of nursery techniques of various species in collaboration with KFRI

Seed Centre is the other major responsibility of the Central nursery. The data generated in the nursery is used in the ongoing research programs and is useful in future research programmes too.

Herbarium

The herbarium at KFRI, established in 1982, is recognized by the International Association of Plant Taxonomists, and is known by the acronym KFRI by Index Herbarium (Taxon 37: 503. 1988). The herbarium has over 11000 specimens demonstrating more than 2140 species from 203 families and is one of the major reference herbarium of forest plants. It has extensive specimen collection of flowering plants of Kerala, especially medicinal plants and a pan Indian collection of rattans, palms and bamboos of India including Anda man and Nicobar Islands. The species in the herbaria are indexed in alphabetical order with collection numbers under respective plant families and Bentham and Hooker's system of classification (1867-1883) has been followed for the systematic arrangements. The predominant plant families in the collection are Poaceae (171 spp.), Orchidaceae (151 spp.), Arecaceae (109 spp.), Fabaceae (81 spp.), Euphorbiaceae (96 spp.) and Rubiaceae (90 spp.). The herbarium is also represented with more than 90 species of pteridophytes. For instant access of specimens from any part of the world, all specimens are digitized and that can be accessed by botanists and other researchers free of charge through the data portal at http://kfriherbarium.org/. The website provides basic and advanced search capabilities. Default search can be conducted in all fields of the herbarium database while advanced search allows searches in specific fields.

Kerala Forest Seed Centre (KFSC)

KFRI together with Kerala Forest & Wildlife Department (KFD) established the Kerala Forest Seed Centre (KFSC) in 2003, as a joint venture. KFSC is administered by an Advisory Committee comprising of officials from both KFD and KFRI. KFSC is led by a Scientist of KFRI having professional training and experience in the field of Forestry/Silviculture. A Forest Range Officer and a Section Forest Officer on a working arrangement are deputed to KFSC from KFD. The Centre envisions gathering forest seeds of superior trees/stands, process, storing and distributing certified seeds to KFD and other Government Departments, NGOs and farmers in and out of the State. Directly after collection, seeds

are treated through appropriate methods for maintaining the quality. Quality of the seeds will be assessed through cutting/Tetrazolium /H_2O_2/germination test prescribed by the International Seed Testing Association (ISTA) and assessed for viability. Healthy, viable seeds are then stored at optimum storage condition (controlled temperature and relative humidity in plastic bins/gunny bags/plastic bags depending on their storage

physiology). Seeds stored at KFSC are being subjected to routine viability tests at regular intervals. About 800 kg certified seeds of 52 forest species were supplied to different stakeholders during 2015-2016. KFSC conducts regular trainings to forestry professionals, researchers, students and other stakeholders on seed technology and various aspects on seed handling.

Medicinal Plants Garden

The Medicinal plant garden at Peechi campus spread over 0.5 hectares, consists of 330 species of medicinal plants including of herbs, shrubs, climbers and trees. It is maintained as a reference collection of authentic medicinal plants of Kerala forests. The collection in the garden is enriched by bringing new plants collected from the wild or through exchange with other Botanic gardens. In 2015-16, 228 plant accessions were made through various plant collections of which 92 are new introductions to the garden. A few among the new introductions are *Rotula aquatic*, *Annona muricata*, *Chlorophytum laxum*, *Begonia albo-coccinea*, *Premna paucinervis*, among others. As part of labeling the plants, 355 metal boards were displayed for both field and potted plants. During this period, 22 groups

covering school/college students, researchers and general public visited the garden.

Orchidarium and Fernery

The Orchidarium and Fernery are meant to provide artificial conditions similar to their habitats and helps in the ex situ conservation and their multiplication, besides providing materials for study purposes. Orchidaceae, one of the largest families of flowering plants, consists of about 700 genera and 30,000 species and with untold number of hybrids. Though about 265 species have been recorded from Kerala, some species are known only by their type collections and few are presumed to be extinct. Among the orchids of Kerala, thirteen species are used medicinally. At present the Orchidarium/Fernery of KFRI have 240 species

including rare, threatened, terrestrial, epiphytic species of Orchids and Ferns, also maintaining some rare ornamental orchids and Ferns.

Palmetum

Palmetum is the live collection of indigenous and exotic palms. KFRI Palmetum was established in the year 2000. It serves as a facility for educating the public about the need for conservation of palms. We have a collection of 135 species of palms under 52 genera. Of these, 75 are indigenous palms and 60 are exotic species with 8 species critically endangered, 9 endangered, 8 vulnerable and 23 near threatened categories as per IUCN standards. The exotic species include those which are commonly found in Indian parks, gardens and along avenues. Rare species like *Bentinckia condapanna, Bentinckia nicobarica, Rhopaloblaste augusta, Calamus nagbettai,*

C.brandisii, C. vattayila, Wallichia disticha, W. nana, Korthalsia laciniosa, Korthalsia rogersii, Licuala spinosa and mangrove species like *Phoenix paludosa* and *Nypa fruticans* are also present in the collection.

Seismic Observatory

Broadband (BB) seismic observatory at Peechi, operated by NCESS in the campus of the Kerala Forest Research Institute (KFRI) is one of the 10 permanent stations set up by DST in 1999 for strengthening earthquake monitoring in the peninsular India and for improving the detection and location capabilities of earthquakes as well as azimuthal coverage in the shield region. The observatory is working well, generating high quality uninterrupted data that is being used for

monitoring worldwide earthquakes and studies of local and regional earthquakes. The data recorded here are systematically archived on hard disks / DVDs for future use. The observatory also provides data to government agencies as well as other research institutes, which is used in disaster management planning and various research works. The observatory acts as an educational facility by playing host to a large number of visitors, including students. The continuous and compiled data recorded here are being sent to IMD every six months, in SEED and SEISAN formats - latest being data till December 2015. The facility also supplies continuous seismic data to NGRI and INCOIS. Furthermore, data is shared with other institutes like KSEB, IISc, GSI and NIRM on their request.

A total of 1523 local, regional and global events were recorded during March 2015- February 2016. There were 30 tremors from Kerala, 6 events from nearby states, 15 events from other parts of India, 19 from Andaman-Nicobar region and 1453 global earthquakes recorded during the reporting period. The nearby state events were from Andhra Pradesh and Karnataka. Andhra tremors were mainly from Guntur, Adilabad and Nellore district. Karnataka tremors were from Kalburgi and Somwarpet. Other parts of India earthquakes were mainly from Gujarat, Chamoli, Maharashtra, Assam, Dharchula, Leh, off coast of Mumbai and Rajasthan. The 7.8 magnitude Nepal earthquake, 7.5 magnitude Hindukush, 8.3 magnitude earthquake of Chile and two 7.6 magnitude events near Peru were the other major teleseismic earthquakes recorded during the reporting period. The Seismic Observatory recorded 30 tremors from Kerala. These tremors mainly from Thrissur and Idukki district. In Thrissur district, tremors, were mainly from Peechi Dam area (Peechi forest region close to Peechi dam), Desamangalam, Ottappalam and Thalore-Mannav region. Magnitude range of these tremors was 0.7 to 3.4.

Soil museum

The KFRI Soil Museum established on 10th December 2015, showcases the diversity of forest soil and mineral resources in the State and provides critical inputs for forest management. The main attraction is a collection of 15 soil monoliths featuring the soils in different types of forests viz. shola, evergreen, semi-evergreen, moist and dry deciduous, bamboo, grasslands, teak

plantations, degraded forests and agroforestry systems in Kerala. A monolith is essentially a profile representing the soil typical of a region, with all the basic characteristics preserved intact. It displays vertical sections of the soil from the surface to the bedrock below displaying the various horizontal layers or genetic horizons. Each monolith was dug from the ground and processed for more than a month before being mounted for display. The forest soil museum is the first of its kind in India and provides valuable information on soil

genesis and transformation in the humid tropics. It provides signatures of the vegetation, climate, rainfall, topography, and rocks in a particular region. Any degradation of a forest ecosystem is reflected in the soil profile and can be a valuable tool in forest management and conservation.

Teak Museum

Teak museum, housed at the Nilambur Sub centre of KFRI is the first of its kind in the world dedicated to a single species-Teak (*Tectona grandis* L.f). The Museum

was established in collaboration with Kerala Forest Department and it was opened to the general public on 21st May 1995. India's first teak plantation was raised more than 150 years ago during 1842-44 at Nilambur located in Malappuram District of Kerala State.The museum offers information on several aspects of teak, such as, its history, cultivation management, utilization and socio-economics. The museum exhibits articles describing the historical, aesthetic and scientific aspects concerning teak tree. The ground floor houses the exhibits of historical and aesthetic value; the first floor is mostly devoted to exhibits and information of scientific nature. A Teak Information System (touch screen facility) in the museum helps the visitors to get

information on various aspects of teak tree, such as, habit & distribution, history, morphology, cultivation, harvesting, timber, and utilization. In addition, various educational, extension programmes like orientation programmes, workshops, nature study camps and summer training courses, teak study training programmes are also organized for various stakeholders. Furthermore; various contests, field trips /exhibitions, and Documentary fests for the students and the general public are conducted. The visitors include students, farmers and teak users. Approximately 2,29,135 people visited the Teak Museum in the year 2015-16. Apart from this, around 3000 participants including students, teachers, teacher trainees, teak users and farmers participated in the various extension programmes conducted in Teak Museum this year. In addition, approximately 400 Forest Officer trainees from forest academies of various states of India conducted field study trips to Teak Museum and Bioresource park. Regular visitor study survey is conducted in the museum to ascertain and analyse the visitors' flow, interests and suggestions as a necessary feed back.

Tree Health Helpline

The Tree Health Helpline at KFRI is an outreach initiative mechanism tapping the accumulated expertise of the scientific community in KFRI. Problems faced at single tree level to those at nurseries and plantations are attended through the helpline. Tree growers of both private and public sectors are expected to be the beneficiaries of this initiative. The helpline attends largely to the queries received from the State Forest Department on pests and diseases associated with teak and eucalypts. During 2015 – 16 a total of 156 queries belonging to various disciplines were attended by tree health helpline. The queries were mostly related to pest attack, fungal problems, species – site matching, species identification, species information, fertilizer application, harvesting time, planting techniques, wood quality, physiological problems, micronutrient deficiency, parasitic issues, suitable intercrops, seeds, seedling availability, etc. A brochure for tree health helpline was prepared and distributed to various schools and public programmes. A health card was prepared for assessing the health of avenue trees. The various social issues under taken involve assessment of

the various avenue trees under thrissur cooperation. One of the major breakthroughs was the resprouting of the *Ficus religiosa* tree near vadakkumnathan temple. The temple authorities had approached KFRI to examine the drying up of the ficus tree in the temple premises. As a result the site was examined by scientific team from KFRI and required treatment was recommended by the tree health helpline. The news of the resprouting was published by the Mathrubhumi Newspaper.

Wildlife Museum

KFRI Wildlife museum houses an exhaustive collection of well preserved specimens belonging to various taxa from different landscapes of Western Ghats. The collection was developed from the specimen

assemblages of different studies carried out by Wildlife Department of KFRI since 1978. It contains a variety of preserved specimens including many invertebrates, fishes, amphibians, reptiles, birds and mammals. The collection is one of its kind with more than 1000 specimens and has 90 reptiles including rare coral snakes, kraits and many more reptiles, 76 amphibians including rare and endangered living fossil *Nasikabatrachus sahyadrensis*, 49 mammals including rare little Indian porpoise, flying squirrel, spiny dormouse and 8 aves. Other than vertebrates there are a number of invertebrate species including molluscus,

meretrix species and spiders from various regions of the State are also preserved. The specimens housed in KFRI serves unique role in information dissemination and they are used for graduate and undergraduate training, species identification workshops and educational programs by State and local agencies. The

goal of the museum is to support and promote morphology based taxonomy, research and education which will establish KFRI as a key reference facility in Kerala addressing environmental issues, such as, wildlife conservation, endangered species recovery, native fish decline, landscape ecology, systematics and biodiversity studies. KFRI Wildlife museum is dedicated to education, outreach, conservation and research in biodiversity.

Xylarium

Xylarium is well-curated authenticated wood specimen collections for the purpose of scientific research, teaching, environmental education and other programmes. KFRI Xylarium was established in the year 1979, and has a collection of 587 specimens, 133 samples representing 68 genera and 114 species from Kerala / India and the rest are from 13 foreign countries. The dimension of the KFRI xylarium sample is: 10 x 6 x 1 cm for small specimens and 16 x 10 x 2 cm for large specimens following international standard. The xylarium database has detailed records, such as, family name of the tree from which the wood was collected, species name, original wood specimen number, date of collection, collector(s) name, herbarium number of the voucher specimen, country, altitude, latitude, longitude, habit, habitat, note on collection or accession, among others. For each wood specimen, there will be a corresponding voucher herbarium specimen deposited in the KFRI Herbarium with the same accession number. Without proper cross-references, the wood collection is of no value. The xylarium of KFRI has been indexed in Kew Royal Botanic Garden, in its Index Xylarium - a directory of Institutional Wood Collections from around the world. To improve our collection of wood samples, KFRI encourages mutual exchange of xylarium samples of few Indian species.

RESEARCH AND EXTENSION ACTIVITIES

Completed Research Projects

KFRI Research Report No.500

Standardization for enhanced production of antagonistic principle by *Bacillus subtilis* and *Streptomyces* for the control of sapstain on rubber wood (Maria Florence EJ)

The standardization of chitinase and antibiotic production by the *Streptomyces* sp. SA18 and *B. subtilis* B2 respectively were conducted in the present study. The suitable medium and optimum conditions for the chitinase production by the *Streptomyces* sp. SA18 were standardized as chitin yeast extract salt medium at pH 8 and 35°C.

KFRI Research Report No.501

Genetic Diversity and Conservation of Teak - Phase II (Indira EP and Thulasidas PK)

The project evaluated the genetic diversity in twenty five ecotypes of teak (*Tectona grandis L.f.*) originated from

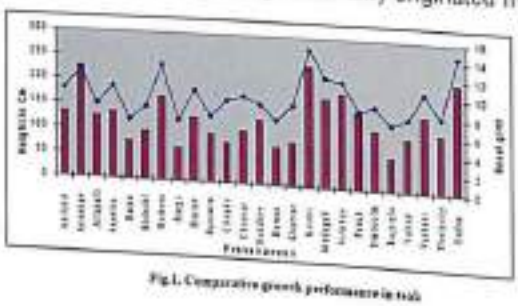


Fig.1. Comparative growth performance in teak

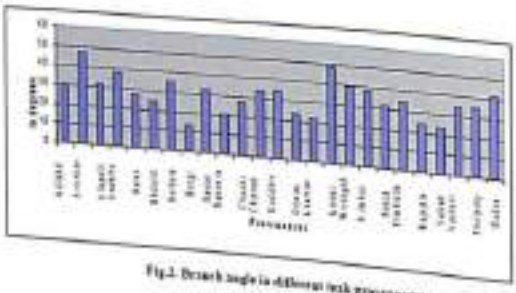
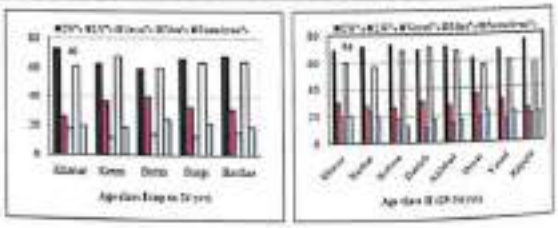
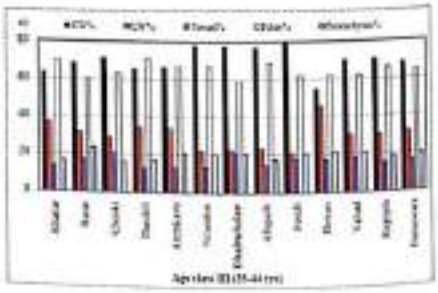


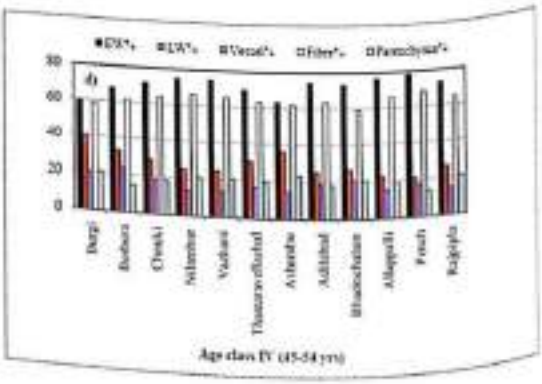
Fig.2. Branch angle in different teak provenances

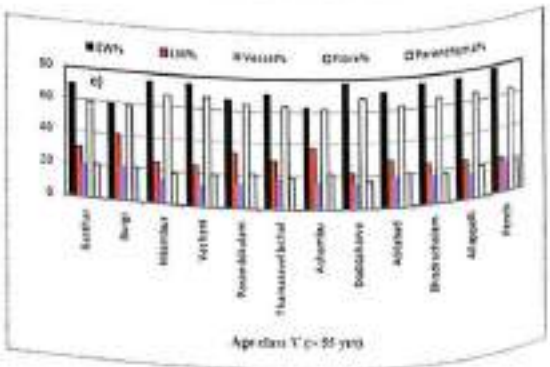
ten natural teak growing States in India (Kerala, Tamil Nadu, Karnataka, Andhra Pradesh, Maharashtra, Gujarat, Rajasthan, Madhya Pradesh, Chhattisgarh and Orissa) with respect to growth and branch characters. Variability of wood characteristics of 23 Indian teak provenances collected from these 10 States under varied ecological and climatic conditions were studied. All South Indian populations formed a single cluster





along with Basthar (Chhattisgarh) and North Indian populations formed a second cluster along with Chinnar (Kerala) and Badrachalam (Andhra Pradesh). The estimated genetic parameters showed high phenotypic and genotypic coefficients of variation and moderate heritability for height, basal girth, number of branches and branch angle. But branch girth has low heritability and genotypic coefficient of variation though it has high phenotypic coefficient of variation. Latitude has highly





significant negative correlation with height, basal girth, number of branches and branch angle while rainfall has highly significant positive correlation with these characters. On evaluation of the wood anatomical properties, significant variations were noted between provenances. Higher growth rate was noted in trees grown in southern States like Kerala, Tamil Nadu and Karnataka followed by Maharashtra, Gujarat and Andhra Pradesh.

KFRI Research Report No.502

Seed handling in selected forest tree species and medicinal herbs of Kerala (Pandalai RC)

The phenological observations on 14 forest tree species in different parts of Kerala revealed that in majority of them the seed maturity (both orthodox and recalcitrant) and the best seed collection period is from February to May. Flowering and fruiting in different species of selected tree species varied widely. In *Acacia concinna*, *Ailanthus triphysa*, *Delonix regia* and *Neolamarkia cadamba* had only a single flowering and fruiting episode in an year while two - peak periods of flowering and fruiting was common in *Cassia fistula* and *Dalbergia latifolia*. Though two peak periods of flowering was noted in *Acacia auriculiformis*, fruiting was observed only once in an year. In *Embelia ribes*, late flowering was observed during May while profuse fruiting was during the following August. *Azadirachta indica* started flowering in March and profuse fruit production is in May and June. In *Oroxylum indicum* flowering started in April and peak fruiting was in February. In *Acacia mangium*, *Eucalyptus grandis* and *Wrightia tinctoria* peak flowering period was once in a year. However, fruiting in all these species occurred twice in a year. Out of the 60 identified seed sources for tree species in Kerala, only 29 produced good quality seeds with above 50 per cent germination. The recalcitrant seeds *(Dysoxylum malabaricum, Syzigium cumini)* had maximum germination when processed within 3 days after collection. Seeds with pulpy seed coats *(Gmelina arborea, Melia dubia, Azadirachta indica)* are to be depulped by keeping them in cold water for 24-48 hours. However, *Magnolia champaca* seeds after soaking the seeds in cold water for 24 hours, were treated with 0.05 per cent gibberellic acid for 24 hours to enhance the germination up to 80 per cent. Majority of the orthodox seeds responds well to pre-sowing/ pre-soaking in cold water whereas *Acacia species* responded well to hot water treatments.

KFRI Research Report No.503

Strengthening and enriching the institute bambusetum (Pandalai RC)

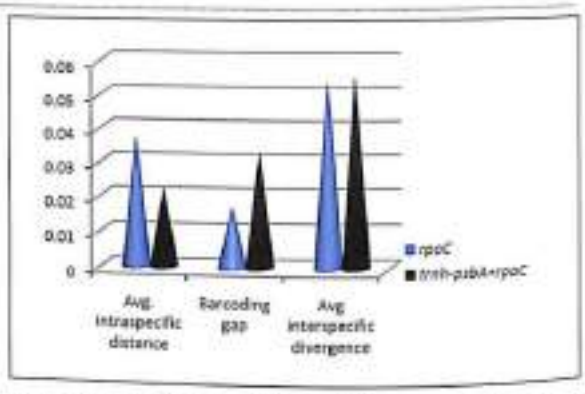
The Symbodial Bambusetum established at Velupadam extends over an area of 12 hectares, in the Field Research Center (FRC) campus of the Kerala Forest Research Institute. The Bambusetum is situated in an undulated terrain with gentle slopes with lateritic soil having a sandy loam texture. The temperature in the area varies between 28 to 40°C and the average rain fall is

approximately 3000 mm per year. A portion of the Bambusetum developed with a live hedge fencing using a shrubby species of *Bambusa striata* proved to be very successful, aesthetically appealing and is implementable in other places also. Soil mounding boosted bamboo growth and culm productivity increases multi-fold. The boundary lines and the inspection pathways were being cleared periodically so as to enhance the aesthetic beauty of the Bambusetum. This not only helped free movement of the visitors inside the Bambusetum but also served as fire lines during the summer months. In order to stabilize some of the steep slopes and to check the soil erosion, staggered trenches were provided in between the bamboo clumps. The soil beneath the clumps growing in sloppy areas were leveled and made into inwardly slopping platforms which helped to stabilize the soil/ clump and also to conserve the moisture along the lateritic tract of Bambusetum.

KFRI Research Report No.504

DNA Barcoding in the endemic bamboo genus Ochlandra of the Western Ghats (Suma T B and Sreekumar V B)

The genus *Ochlandra Thw* (Poaceae: Bambusoideae), commonly known as reed bamboos is a dominant



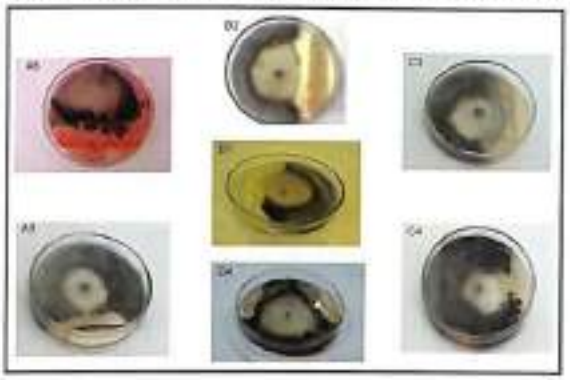
genus of the Western Ghats, India, comprising many taxonomically challenging species. The similarities between the species in the vegetative characteristics, phenotypic plasticity as well as relative rarity of flowering lead to identification issues in the genus. This study envisages demonstrating the usefulness of DNA barcoding technique to tackle the species identification problems in the endemic reed bamboo genus *Ochlandra* of the Western Ghats. Multiple accessions along with the type specimens of the reported ten *Ochlandra* species were collected from their natural distribution zones. PCR amplification and sequencing in all the species have been done using COBOL recommended four barcode regions (rbcL, matK, rpoC1, and trnH-psbA). The intra and interspecific divergence parameters were calculated using Kimura 2 parameter (K2P) in MEGA v.6.0. The results showed that trnH-psbA+rpoC combination can identify the species with 100 per cent species discrimination accuracy with a significant barcode gap. The results suggest

synonymisation of *O. spirostylis* and *O keralensis* under *O. travancorica* as the barcode derived phylogram clustered these three species together with high confidence level in addition to the existing morphological similarities. DNA barcoding has demonstrated as an efficient supplementary tool for the identification of taxonomically challenging species of the bamboo genus *Ochlandra*.

KFRI Research Report No.505

Mass production of *Bacillus subtilis* for biocontrol of sapstain on rubberwood (Maria Florence EJ, Sudheendrakumar VV and Suma TB)

Rubberwood, *Hevea brasiliensis* Muell. Arg. belonging to the family Euphorbiaceae, is one of the tropical softwood timber species mainly cultivated in the countries like Indonesia, Malaysia, Thailand, India and Sri Lanka. Sapstain fungi, the primary colonizers of the freshly felled rubberwood are a great concern and development of an appropriate control strategy has thus become the need of the hour. In India, biological control of sapstain fungi has not been experimented widely. The present study aims at large-scale production of bio control agent, *Bacillus subtilis* in a biore actor, production and qua ntification of the antifungal secondary metabolite, iturin A and field efficacy testing of the biocontrol agent. Six different media were experimented in the growth study of *B. subtilis B1*. Coconut water glucose peptone broth at 30°C and pH 7 was effective for the growth of *B. subtilis B1*. But due to the non-availability of the coconut water in all continents, molasses peptone broth was chosen for mass production of *B. subtilis B1* in the bioreactor. The sixth day culture (2.7 x 109 CFU/ ml) from the bioreactor was



tested in the laboratory under aseptic and non aseptic conditions on the treated and control rubberwood blocks inoculated with the sapstain fungus *L. theobromae*. Hundred per cent fungal inhibitions were observed in the aseptic treatment while significant difference in fungal inhibition was noted in the treatments in non-aseptic conditions. The biocontrol potential of mass produced *B. subtilis B1* was tested and effective in three different seasons (Northeast monsoon, summer season and Southwest monsoon) in the timber saw mill at Thrissur, Kerala, India.

KFRI Research Report No.506

Improvement of Taxonomic Botanic Garden at the KFRI Sub Centre, Nilambur, Kerala (Chandrashekara UM)

The Kerala Forest Research Institute established a taxonomic garden in the bioresources nature trail at Nilambur with an aim to assemble plants in family-wise in the garden and to conduct regular classes on taxonomy, ecology and biodiversity conservation for the school and college students and other benefici aries. The garden, covering about 2 hectares land is located adjoining to the teak museum and bioresources nature park complex. For each family, separate bed (family bed) was prepared and planted with one to five species. In front of each family bed, a signboard depicting details

such as characteristic features of the family, general floral formula, number of genera and species reported from Kerala, number of species belonging to different conservation status, and names of species planted in the family bed are provided. The taxonomic garden at Kerala Forest Research Institute Sub Centre, Nilambur is first of its kind in India, with a compact synopsis of angiosperm plants arranged in systematic sequence. The purpose of this taxonomic garden is mainly educational.

KFRI Research Report No.507

Establishment of a district medicinal plants demonstration garden at sub centre Nilambur, Malappuram District, Kerala (Chandrasekhara UM and Sujanapal P)

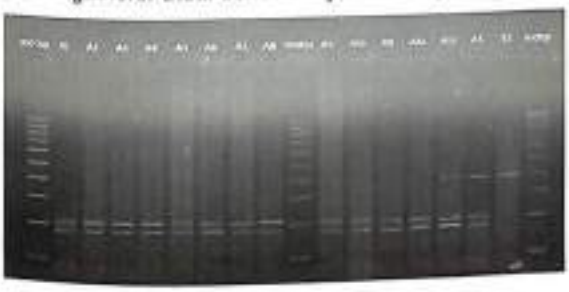
The Kerala State Medicinal Plant Board had initiated a programme to establish demonstration plots of medicinal plants at district level with aims to create

awareness among stakeholders on medicinal wealth of the State as well as conservation, multiplication and distribution of medicinal plants. As a part of this programme, the Kerala Forest Research Institute had established a district medicinal plants demonstration garden with an assemblage of 252 species of medicinal plants provides information of each species such as its Malayalam name, botanical name, plant part/s used and use of plant for treating different ailments. The garden is also functioning as an educational display and source of information to the visitors on conservation, management and utilization of medicinal plants. Further attempts need to be made to improve this garden to raise it as a state-level demonstration garden of medicinal plants.

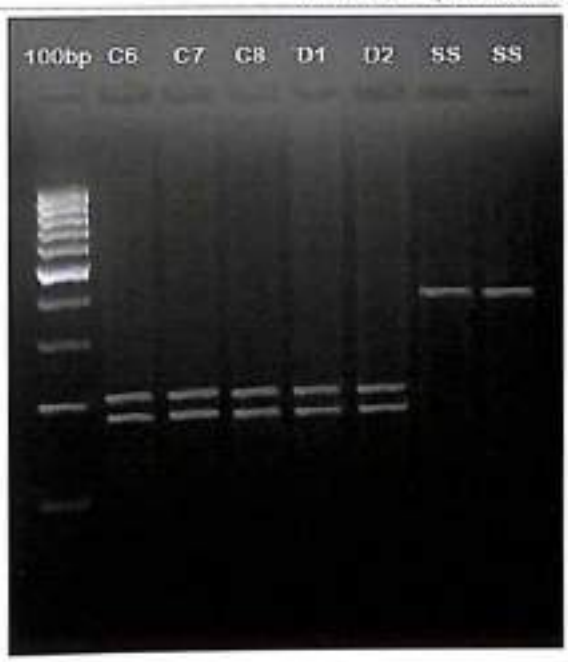
KFRI Research Report No.508

Molecular diagnosis of sickle cell anemia in Cholanaickan tribals (Suma TB, Anitha V and Feroze M)

Cholanaickans are numerically small, semi-nomadic hunter-gatherer tribal community inhabiting in the deep



forests of Nilambur valley, Malappuram Disrict of Kerala State. The present project envisages identifying the genetic status of sickle cell anemia (SCD) through restriction enzyme analysis of PCR amplified beta globin gene. Blood samples were collected from 33 individuals of the community as part of the All India Sickle Cell Anemia Screening Program by the medical team of Kozhikode Medical College. The PCR amplified beta globin fragment was subjected to Dde1 restriction enzyme digestion since the presence of sickle cell mutation eliminates the Dde1 restriction site. Among the analyzed 33 samples, one sample indicated the presence of one mutated allele leading to a heterozygous carrier state. The rest of the 32 samples were normal for the beta globin gene. None of the samples were detected positive for the SCD. Since the sickle cell carrier person detected in the community is of 70 years of age and unmarried, there is least chance for



the transfer of this mutant beta globin allele to the next generation. However, off late intermarriages between the Kattunaickans and Cholanaickans is a common practice, indicative of an increase in the incidence of SCD among the most vulnerable community in near future.

KFRI Research Report No.509

Development of INM Package for Commercially Important Plantation Crops (Balasundaran M, Sujatha MP and Maria Florence EJ)

The present study was carried out with the objective of finding out the influence of bio-inoculum in enhancing the growth of *Dalbergia latifolia* through nursery and field trials. Such a comprehensive study including the application of rhizobium, Phosphorus Solubilizing

Bacteria (PSB) and Vesicular Arbuscular Mycorrhizae (VAM) along with different doses of chemical fertilizers and organic manures has not been reported so far in *Dalbergia latifolia*. Two nursery trials and two field trials were conducted at Field Research Centre, Velupadam and one nursery trial and one field trial at Sub Centre, Nilambur. The results obtained in the nursery trials indicated that response to bio-fertilizer at nursery stage was significant and bio-fertilizers at low doses of chemical fertilizers [control + 50% NP + 100% K + BIC (Bio-inoculum)] gave growth improvement synergy. Application of higher dose of chemical fertilizers (100 %) resulted in lesser performance than seedlings with 50 per cent dose. Thus a 50 per cent reduction in the cost of chemical fertilizers can be achieved. In the field trials, no definite conclusion could be drawn even though a positive response to bio inoculum + chemical fertilizers was observed.

KFRI Research Report No.510

Development of institutional capability for DNA barcoding of life forms (Muralidharan EM, Suma TB and Sreekumar VB)

The present project could standardize protocols for DNA barcoding and sequence data analysis for deriving interpretations on the identity of the unknown specimens in the case of plants, insects and fungi. Case studies carried out could demonstrate the capability of DNA barcoding technique in solving taxonomic

complexities as well as in discriminating the original species from the substitute/ adulterant species. The project could develop species specific DNA barcodes for the original East Indian sandalwood and their market adulterants. Single nucleotide polymorphisms observed in the adulterants of original sandalwood clearly indicated the utility of DNA barcoding to keep track the wood adulterants in Indian sandalwood industry. The second case study was to prove the efficiency of DNA barcode sequences to discriminate morphologically similar species of the genus *Salacia* which is a source of many important pharmaceutical chemicals used in the Ayurvedic system of medicine in India. The study recommended DNA barcoding with ITS2 to confirm the taxonomic identity of the raw drugs in the market and to ensure safe supply of traditional medicines derived out of different species of the genus *Salacia*.

KFRI Research Report No.511

Development of equipment suitable for low-cost micropropagation (Muralidharan EM)

Different options for cost reduction in plant tissue culture were explored in the study. Modifications of some of the equipments and devices used routinely in

plant tissue culture and combinations of different cost reduction measures for micropropagation were tested. The use of inexpensive polypropylene (PP) containers

and PP sheets as culture vessels and closures was successfully demonstrated. The use of PP bags and standup pouches fabricated out of PP sheets with the use of a heat sealer was also found suitable as culture containers for bamboo and teak shoot cultures with advantages in terms of light availability as well as costs. A cooling water recirculation system for distillation units

was fabricated that results in considerable savings in the water used for cooling the units as well improved efficiency obtained through forced cooling of the heated water by coupling with a tissue culture hardening unit and use of sprayers. The use of LED lamps as alternative to conventional fluorescent lamps was also tested. A turn table culture rack system was fabricated aimed at reducing the number of lamps used for illumination of cultures arranged on a multi-tier on both sides of light source. The revolution of the rack at a slow speed was achieved through a gear system and timer.

KFRI Research Report No.512

Micropropagation of three selected species of bamboo (Muralidharan EM and Pandalai RC)

Micropropagation for three important bamboo species was attempted in this study using nodal explants

collected from mature clumps in the field. In *Bambusa tulda*, nodes with dormant buds were treated with an antimicrobial agent, Bavistin (1.5 % w/v) and antibiotics cefotaxim and tetracyclin (100 ppm each) for 45 min before surface sterilization with $HgCl_2$ (0.1 % w/v) for 10 minutes. Sprouting of axillary buds was obtained on MS medium supplemented with BAP 4.44 μM (1 mg/l),

NAA 0.53 μM (0.1 mg/l), sucrose 2 per cent (w/v) and Lactic acid (0.1%) with pH 3.0. Multiple shoots were induced on a multiplication medium consisting of MS salts and vitamins supplemented with BAP 7.77 μM (1.75 mg/l) and NAA 0.53 μM (0.1 mg/l) and sucrose 2 per cent. Rooting was obtained when clusters of 3-4 shoots were transferred to a rooting medium consisting of ½ MS supplemented with IBA (3 mg/l) and coumarin (10 mg/l). In *Dendrocalamus brandisii*, similarly, nodal explants were induced to sprout and multiple shoots were formed on a liquid MS medium supplemented with 8.88 μM BAP (2 mg/l), 4.65 μM Kinetin (1 mg/l), lactic acid (0.1%) and sucrose 2 per cent with pH 3.0 . Rooting was not successful in any of the treatments. Indirect somatic embryogenesis was induced in callus derived from nodes excised from in vitro shoot cultures and placed on MS with 13.32 μM BAP (3 mg/l), 2.06 μM 2,4-D (0.5 mg/l) and sucrose 3 per cent with pH 5.7 and solidified with Gelrite (0.2 %) and cultured in the dark. Conversion of somatic embryos were obtained by subculture of callus to ½ MS with 4.44 μM BAP (1 mg/l), sucrose (2 %) and agar (0.75 %). Hardening of the plantlets was done under mist on vermiculite and sand (1:1) for three weeks. Sprouting of axillary buds and multiple shoots were obtained from nodal explants of *Thrysostachys oliveri* cultured on a liquid medium consisting of MS supplemented with BAP (2 mg/l) (8.88 μM), Kinetin (0.1 mg/l) (0.46 μM) and Lactic acid

(0.1% v/v), sucrose (2%) with the pH adjusted to 3.0. A high rate of multiplication of upto 5 fold was achieved on a liquid medium supplemented with 11.1 μM (3 mg/l) of BAP and 0.53 μM (0.1 mg/l) of NAA. Rooting was not achieved in any of the in vitro rooting experiments.

KFRI Research Report No.513

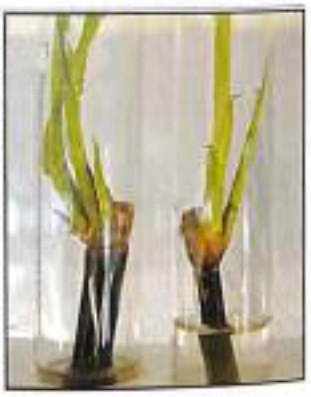
Micropropagation of selected teak clones for improvement of planting stock (Muralidharan EM)

This study envisaged the rapid micropropagation of selected clones of teak derived from plus trees of the plantations of the Kerala Forest Department. The project was discontinued when an externally funded research project was approved with the same objectives. The results of the studies carried out for a year on micropropagation of teak clones is summarised here. A basic protocol for micropropagation of teak from buds collected from adult trees of teak was standardized during the project period. Shoot cultures were established by using shoot tips of epicormic shoots that sprouted from branch cuttings of the selected trees maintained in the mist chamber in polybags. Excised shoot tips surface sterilized with $HgCl_2$ solution were inoculated on a modified MS medium with various levels of Benzyl aminopurine (BA) and Kinetin (Kn) in test tubes. Multiple shoot formation was obtained in third subculture onwards on the same medium. Thereafter subcultures were carried out at 4-6 week intervals by separating clusters of 2-5 shoots and transfer to fresh media in bottles or plastic containers. Rooting was achieved ex vitro by treatment of microshoots of at least 3 cm length with IBA and transfer to vermiculite and maintenance of high humidity either in individual plastic cups or in tray with a plastic cover. Hardening was obtained in two weeks and transfer of plantlets to soil was done after 4 weeks. High levels (> 95 %) of survival were obtained in most batches using this method.

KFRI Research Report No.514

Micropropagation of *Bambusa balcooa* and *Dendrocalamus giganteus* (Muralidharan EM and Seethalakshmi KK)

Micropropagation of *Bambusa balcooa* and *Dendrocalamus giganteus* was experimented using explants of adult field grown clumps of the two species viz. induction of multiple shoots in axillary buds followed by rooting of microshoots and plantlet regeneration through somatic embryogenesis. In *B. balcooa* a complete micropropagation protocol was developed using nodal explants collected from adult clumps growing in the field. Multiplication was achieved through multiple shoot formation in liquid media without shaking. Plantlets were regenerated through in vitro rooting at 94.4 per cent and 100 per cent survival. Regeneration of *B. balcooa* through somatic embryogenesis was also obtained during the study. Embryogenic calli was induced from nodes of in vitro shoots on auxin containing media and conversion to plantlets obtained on a hormone free medium. Most of the plantlets were found to be albinos. In *D. giganteus* successful induction of multiple shoot formation and embryogenic calli was possible but regeneration of plantlets was not feasible. Addition of lactic acid and reduced pH (3.0) in the initiation media reduced the fungal and bacterial contamination including endogenous contamination and also improved the sprouting of axillary buds in *B. balcooa*. Further work is required to develop regeneration of plantlets from the embryogenic callus of *D. giganteus*.



Ongoing Research Projects

1. Pilot scale micro-propagation of important forestry species (*Dr. Muralidharan EM)
2. Assessment of ecosystem services for conservation and management of sacred groves in Kerala part of Western Ghats (*Dr. Chandrashekara UM)
3. Evaluation of indigenous methods of nursery techniques for medicinal plants (*Dr. Pandalai RC)
4. Soil organic carbon pool and its dynamics in the managed teak plantations of Kerala Western Ghats (*Dr. Sandeep S)
5. Phenology and seed dispersal of trees in the wet evergreen forests of Silent Valley, Western Ghats (*Dr. Sreekumar VB)
6. Influence of fungal disease on phytochemical composition of selected medicinal plants with special reference to secondary metabolites (*Dr. Mallikarjuna Swamy GE)
7. Vegetative propagation of selected medicinal plants for enrichment of resources phase III (*Dr. Hrideek TK)
8. Developing strategies for bio-cultural restoration conservation and management of lateritic biotopes in north Kerala (*Dr Sreejith KA)
9. Assessment of human-wildlife conflict and mitigation measures in northern Kerala (*Dr. Jayson EA)
10. Structure, composition, dynamics and management of vayal ecosystem in Periyar Tiger Reserve (*Dr. Sreejith KA)
11. Regeneration dynamics, propagation and restoration of selected rare and threatened rattans in the Kerala parts of Western Ghats (*Dr Sreekumar VB)
12. Conservation through restoration of wild nutmeg tree populations of Western Ghats of Kerala (*Dr. Jose PA)
13. Assessment of medicinal plant resources of northern Kerala (*Dr. Sujanapal P)
14. An information system for forest of Kerala (*Smt. Sarojam N)
15. Genetic improvement of teak-Phase II Establishment of clonal hedge gardens and seed orchards (*Dr. Hrideek TK)

*Principal Investigator

16. Population analysis seed biology and restoration of *Hopea erosa* and *H. racophloea*, two critically endangered trees of Western Ghats (*Dr. Pillai PKC)
17. Forest programme for KFD in teak bamboo and other important forestry species (*Dr. Muralidharan EM)
18. Ex-situ conservation of wild orchids of Western Ghats India (*Dr. Sreekumar VB)
19. Development and management of Research and Office Information system- facility development (*Dr. Jayson EA)
20. Introducing biochar for enhancing the quality of degraded soils for plantation forestry sector in Kerala. (*Dr. Sujatha MP)
21. Popularization of weed composting technology for soil carbon sequestration and livelihood improvement of rural poor (*Dr. Sujatha MP)
22. Evaluation of *Ochlandra* germplasm, mass propagation and field trials of elites-phase 2 (*Dr. Thulasidas PK)
23. Digital archiving of PhD thesis and reprint collection of KFRI Library using an open source content management software (*Smt. Sarojam N)
24. Digitization of selected Books in KFRI Libraray-Phase2. (*Dr. George KF)
25. Information System on medicinal plant of Kerala (*Dr. George KF)
26. Compilation of Indian Forestry Abstracts Phase 2 (*Smt. Sarojam N)
27. Planning for conservation effectiveness in forest management ways to improve monitoring and community involvement (*Dr. Mammen C)
28. Systematics, phylogeny and biogeography of Dipterocarps in the Western Ghats (*Dr. Sreekumar VB)
29. Largescale restoration of *Dysoxylum malabaricum* Bedd ex Hiern and *Coscinium fenestratum colebr.* two endangered and important medicinal plants of Western Ghats (*Dr.Sujanapal P)
30. Genetic Improvement of Teak phase - I Locating plus trees and establishment of Clonal Hedge Garden and Clonal Seed orchards (*Dr. Hrideek TK)
31. Impact of climate change on growth dynamics of tropical tree species in the Western Ghat region as evidenced from dendroecological studies (*Dr. Thulasidas PK)
32. Development of a farming system based Cyber extension model for the state of Kerala (*Dr. Sujanapal P)
33. Control and management of destructive forest invasive species in South Asian natural and plantation forests (*Dr. Sajeev TV)
34. DNA barcoding as a valuable molecular tool for certification of bamboo plantation material (*Dr. Suma Arun Dev)
35. Kerala Forest And Environment Index (KF&E-Index) (*Dr. Amruth M)
36. Plant metabolic studies on the genus *Embelia* found in Kerala. (*Dr. Raghu AV)

*Principal Investigator

37. Ecology and restoration of *Cynometra beddomei* and *Kingiodendron pinnatum*, two endemic and endangered tree legumes of Western Ghats of Kerala. (*Dr. Jose PA)
38. Migration of KFRI Library Management System from Lib Soft to KOHA Phase II. (*Smt. Sarojam N)
39. Biospectrum analyses of *Coccinia grandis* DC from Southern Western Ghats. (*Dr. Jayaraj R)
40. Foraging ecology of selected birds in the Kole wetlands of Kerala, India. (*Dr. Jayson E A)
41. Network project on conservation of Lac insect genetic resources (*Dr. Sajeev TV)
42. Fire as a management tool: A case study from selected forest ecosystems in Kerala. (*Dr. Sreejith KA)
43. Floristic diversity structure, composition and regeneration in undisturbed and human impacted Shola-grassland ecosystems of GEF-Munnar landscape project-KFRI study 3/7 (*Dr. Sreekumar VB)
44. Studies on pattern of usage of pesticides and their impact on the ecosystem of cardamom hill reserves in GEF-Munnar landscape project area under different cropping systems (including residues effect on fauna and environment) (*Dr. Jayaraj R)
45. Review of ecological and development history of various sectors in GEF-Munnar landscapes project area (*Dr. Amruth M)
46. Study of tourism in GEF-Munnar landscape project area: patterns of development impacts, carrying capacity and mainstreaming biodiversity consideration and livelihoods in tourism strategy (*Dr. Anitha V)
47. Documentation and compilation of existing information on various taxa(flaura and fauna),and identification of critical gaps in the GEF-Munnar landscape project area (*Dr Sujanapal P)
48. Study on diversity and current status of fish and fisheries in GEF-Munnar landscape project area (*Dr. Jayson EA)
49. Study on the impact of invasive plant species on ecology of GEF-Munnar landscape project area (*Dr. Sajeev TV)
50. Development of biomarkers as a predictive tool for organophosphate toxicity in terrestrial ecosystem (*Dr. Jayaraj R)
51. Long-term monitoring of forest ecosystem dynamics: Phase I: Establishment of 10 ha. permanent plot in tropical wet evergreen forest of Kerala (*Dr. Sreejith KA)
52. Plant growth promoting Rhizosphere and Rhizoplane Fungi of grasses and their ability to control important fungal diseases of forest nurseries (*Dr Mallikarjuna Swamy GE)
53. Ecology and conservation genetics of *Aluna indica* and *Hydnocarpus longipedunculatus* –two rare and endemic trees in the Kerala part of the Western Ghats (*Dr. Jose PA)
54. Exploring the potential for hybridization in bamboo species in flower in KFRI Bambusetum (*Dr. Muralidharan EM)

*Principal Investigator

55. Study on reproductive constraints and seed characteristics of *Terminalia paniculata* (*Dr. Pillai PKC)
56. Developing a digital library for the Teak Museum (*Smt. Sarojam N)
57. Quantification of antibiotic gene expression levels in *Bacillus subtilis* during co-inhibition of rubber wood sapstain fungus using real-time PCR (*Dr. Suma Arun Dev)
58. Bioactivity guided fractionation and mechanistic elucidation of biomolecules from *Cocculus laurifolius* DC. of Southern Western Ghats (*Dr. Jayaraj R)
59. Genetic improvement of selected tree species- Phase I:Establishment of germplasm collection at KFRI (*Dr. Hrideek TK)
60. Establishment of Bamboo Technical Support group (BTSG) for South Zone under the National Bamboo Mission 2015-16 (*Dr. Muralidharan EM)
61. Plant growth promoting and bio control microbes for high quality bamboo planting stock production (*Dr. Mallikarjuna Swamy GE)
62. Factors affecting roosting ecology of birds in Kerala (*Dr. Jayson EA)
63. Pedogenic influences on vegetation dynamics in major forested wetlands of Kerala Western Ghats (*Dr. Sandeep S)
64. Exploration of medicinal plant resources of Lakshadweep island with special reference to indigenous knowledge (*Dr. Sujanapal P)
65 Wood balance study in Kerala 2015-16 (*Director, KFRI)
66 Documentation of population demography and genetic structure of teak for developing sustainable conservation strategies and resource management (*Dr. Suma Arun Dev)

*Principal Investigator

Ongoing Extension Projects

1. Strengthening the Ex-situ Conservatory at FRC Velupadam with RET tree species of Western Ghats (*Dr. Sujanapal P)
2. Management and monitoring of tree species trial plots in the KFRI sub centre (*Dr. Chandrasekhara UM)
3. Development of forest nursery at Kottapara and Devikulam (*Dr.Pillai P K C)
4. Strengthening and enriching the palmetum (*Dr. Sreekumar VB)
5. Production of teak clones and maintenance of clonal multiplication area established at KFRI (*Dr. Hrideek TK)
6. Organising educational programmes at teak museum, KFRI sub centre (*Smt.Sani Lookose)
7. Maintenance of *Dalbergia* plot established under DBT network project at Nilambur and Velupadam (*Dr. Sujatha MP)
8. Establishment of a field gene-bank for RET tree species in the KFRI sub centre campus, Nilambur (*Dr. Chandrashekara UM)
9. Strengthening and maintenance of institute bambuseturn (*Dr Sreekumar VB)
10. Strengthening and maintenance of Institute Arboretum (*Dr. Sreekumar VB)
11. Strengthening and enriching Institute central nursery (*Dr. Sujanapal P)
12. DNA barcoding of life forms (*Dr. Muralidharan EM)
13. Strengthening and enriching of KFRI Herbarium (*Dr. Sreekumar VB)
14. Maintenance of permanent plots establishment by KFRI in natural forest of Kerala -Phase I (*Dr. Sreejith KA)
15. Establishment of green groves in selected municipalities and panchayaths of Kerala (*Dr. Sujanapal P)
16. Enriching of live collections of Orchids and Ferns (*Dr. Sujanapal P)
17. Monitoring of teak experimental plots, clonal multiplication area (CMA) and production superior clonal plants (*Dr. Hrideek TK)
18. CAT(Conservation Awareness Team) at school for environment education and conservation (*Dr. Raghu AV)
19. CAT(Conservation Awareness Team) at school for environment education and conservation (*Dr Raghu AV)
20. Organising educational programs at Teak Museum, KFRI Subcentre (*Smt. Sani Lookose)
21. Maintenance of bioresources Nature Park in the KFRI Sub Centre, Nilambur (*Dr. Chandrasekhara UM)
22. Competence building on analytical instrumentation and maintenance of Central Instrumentation Unit (*Dr. Jayaraj R)
23. Enrichment of Microbial Culture collection at KFRI (*Dr. Mallikarjuna Swamy GE)
24. Maintenance, documentation and preparation of the Wildlife Museum of KFRI (*Dr. Jayson EA)
25. Habitat enrichment in the butterfly garden at KFRI campus, Peechi (*Dr. Sajeev TV)
26. Enrichment of the insect collection of KFRI (*Dr. Sajeev TV)

*Principal Investigator

27. Maintenance and enrichment of medicinal plants garden at Peechi campus- Phase II (*Dr. Jose PA)
28. Strengthening and enriching of KFRI Herbarium (*Dr. Sreekumar VB)
29. Establishment of nodal centre for coordinating giant African snail eradication programme in Kerala (*Dr Sajeev TV)
30. Issues, challenges and strategies for sustaining soil health in the humid tropics (*Dr. Sujatha MP)
31. Upgradation of soil museum at KFRI (*Dr. Sujatha MP)
32. Tree health helpline (*Dr. Sajeev TV)
33. Management and monitoring bambusetum at FRC, Velupadam (*Dr. Pillai PKC)
34. Maintenance and monitoring arboretum at FRC, Velupadam (*Dr. Pillai PKC)
35. Management of experimental plots at Devikulam (*Dr. Pillai PKC)
36. Bamboo innovations to enterprises: Maintaining and strengthening business model facilitating CFC activities (*Dr. Dhamodharan TK)
37. KFRI facility maintenance collection, Processing, quality assessment, storage and distribution of seeds of forestry species through KFSC (*Dr. Pillai PKC)
38. Production of planting stock in KFRI Bamboo Nurseries(*Dr. Muralidharan EM)
39. Analysis of soil samples from major tree crops and agro-forestry sysytems Kerala-Second phase (*Dr Sujatha MP)
40. Land management practice and rural livelihood: study of a Agroecosystem of selected tribal hamlets in Attapady (*Dr Sujatha MP)
41. Production and supply of quality seedlings of selected ten medicinal plants (*Dr. Sujanapal P)
42. Regional training on data analysis for the volume, biomass and carbon stock assessment (*Dr. Sandeep S)
43. Setting up of a small bamboo nursery and supply of bamboo planting material to the Kerala State Bamboo Mission (*Dr. Muralidharan EM)
44. Foraging ecology of birds in the Kole Wetlands of Kerala,India (*Dr. Jayson EA)
45. 11th Meeting of the Advisory Committee for ecosystem research Programme(ECRP) of MOEF & CC, Govt of India (*Dr. Chandrasekhara UM)
46. Orientation camps on identification, Management and ubilization of medicinal plants at KFRI subcentre Nilambur (*Dr. Chandrasekhara UM)
47. SAARC Expert Group Meeting on community based sustainable management of Non - wood Forest Products and Income generation for communities (*Dr. Anitha V)
48. Managing Green spaces for Urban Biodiversity and Ecosyalem services (*Dr Chandrasekhara UM)
49. Environmental sensitization to the Munsif- Magistrate Trainees (*Dr. Mohammad Kunji K V)
50. Avenue tree health assessment in Thiruvanthapuram corporation (*Dr. Sajeev TV)
51. National Workshop of CEOs of State Medicinal Plants Boards and other stakeholders of medicinal plants sector (*Dr. Sujanapal P)

*Principal Investigator

Publications

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Sivaram,M. and Sandeep,S. 2016. Error propagation in the estimation of greenhouse gas emissions due to Fforestry sector, IASRI, New Delhi.

Sureshkumar, P and Sandeep, S. 2016. Secondary nutrients in soils and their management, ISSS, New Delhi.

George, K.F 2015. Application of cloud computing in libraries. In: Francis A.T., Vishnu V. (Eds.) Technology Management in Libraries: 94-102. KFRI Scientific Paper 1604.

Popular Articles

Sajeev ,T.V. 2015 June 19. Media cell discussion of Encyclic paper by Pope Francis.

Awards

Dr.C.Chandrasekharan Memorial Award

Miss.Reshma. J and Mr. Divin Murukesh are the joint recipients of the Dr.C. Chandrasekharan Memorial Award 2015 for innovative research in conservation of forests. The award instituted by the family of Dr.Chandrasekharan in memory of KFRI's first Director, an expert in tropical forestry, carries a purse of Rs.20,000/- each, a gold medal and a certificate. Shri. S.P Ravi, Director, River Research Centre, Chalakkudy delivered the Dr.Chandrasekhara memorial lecture at KFRI on 25th September 2015 and Dr.P.G.Latha, Director, KFRI presented the award to the winners.

Awards

Dr. K.M.Bhat Memorial Award

The Dr. K. M. Bhat Memorial Award 2015 carrying a Gold Medal, Certificate of Merit and cash prize of Rs. 5,000/- was awarded to Dr. Revathy, V.S. Asst. Professor, Dept. of Zoology, KKTM Govt. College, Kodungalloor, Thrissur. The Endowment was instituted by the family of late Dr. K. M. Bhat for the best emerging Research Scholar of KFRI. Dr. Revathy has done her doctoral work on "Systematic of swallowtail butterflies (Lepidoptera: Papilionidae) of Kerala", a group of extremely colourful large butterflies having tremendous ecological and economic significance. Based on the quality of her doctoral work as evidenced by her thesis and publications, she was adjudged the best. Dr.Revathy did her doctoral programme with Dr. George Mathew, Entomologist and Emeritus Scientist with KSCSTE Fellowship during 2011-2005. The award was presented to her on 11th March 2016 at KFRI. Sri. T. M. Manoharan, IFS (Rtd), Former PCCF, and Chairman, Kerala State Electricity Regulatory Commission, Govt. of Kerala delivered the Memorial lecture.

Extension and Training Activities

TRAINING PROGRAMMES CONDUCTED

1. Two-day Orientation Programme on Birdwatching 'Pakshinireekshanathinu Sthreekootayma' (*Dr. Jayson E.A., Dr. Mohanadas K., Mr. Raveendran V.P., Dr. Raghu A.V. & Dr. Mohammed Kunhi K.V)
2. Two-day Environmental Awareness Programme for Students on Butterfly Conservation "CHITHRASHALABHANGALKKORU KOOTTU" (*Dr. Mohammed Kunhi K.V., Dr. Mohanadas K., Dr. Sajeev T.V., Mr. Raveendran V.P. & Dr. Raghu A.V.)
3. Industrial Training on "Arc GIS and ERDAS" to 3rd Semester M. Tech Students of Govt. Engineering College, Thrissur (*Dr. Mohanadas, K., Mr. Raveendran, V.P. & Mrs. Ricy Eliner Varkey)
4. Bamboo Cultivation – MGNREGES (*Dr. Muraleedharan, E.M. & Mr. Raveendran, V.P.)
5. One day orientation programme on Kandal Conservation "Kandal Nadeel Pariseelana Paripadi" Senet hall, Kannur University, Kannur (*Dr. Mohammed Kunhi K.V., Dr. Raghu A.V. & Dr. Mohanadas K.)
6. Bamboo Cultivation – MGNREGES (*Dr. Muraleedharan, E.M. & Mr. Raveendran, V.P.)
7. Cultivation and Management of Teak (*Dr. Mohanadas, K. & Mr. Raveendran, V.P.)
8. Two - Days Training Workshop on 'Personality Development, Stress Management, Communication Skill & Team Building' (*Dr. Mohanadas, K.,Ranjith Kumar M.G. & Mr. Raveendran, V.P.)
9. SAARC ' Expert Group Meeting on Community – based Sustainable Management of Non – Wood Forest Product (NWFP) and Income generates for communities (*Dr. Anitha, V. & Dr. Amruth, M.)
10. Tissue culture Techniques for MD students from Govt. Ayurveda College, Tripunithura (*Dr. Muraleedharan, E.M.)
11. Bamboo and Rattan Resource Management (*Dr. Muraleedharan, E.M. & Mr. Raveendran, V.P.)
12. Two day orientation Programme on Institute Environmental Sensitization Programme to the Munsif – Magistrate Trainees (*Dr. Mohanadas, K., Dr. Mohammed Kunhi K.V., Mr. Raveendran, V.P. & Dr. Raghu A.V.)
13. Bamboo Cultivation and Management (*Dr. Muraleedharan, E.M., Mr. Raveendran, V.P., Dr. Mohanadas, K. & Dr. Raghu, A.V.)
14. One day Orientation Forestry Training Programme for KFDC Managers (Dr. Mohanadas, K.). Managing Green Spaces for Urban Biodiversity and Ecosystem Services (*Chandrasekhara, U.M., Dr. Mohanadas, K., Mr. Raveendran, V.P., Dr. Sreejith, K.A. & Dr. Raghu, A.V.)

15. Skill Development Training in Bamboo Craft Design and Entrepreneurship Development Programme (EDP + MDP) for KFRI Bamboo Clusters (*Dr. Mohammed Kunhi K.V., Dr. Dhamodaran, T.K., Dr. Anitha,V., Dr. Muraleedharan, E.M.& Mr. Raveendran, V.P.)
16. One day Training Programme on "Control Measures to Mitigate Human – Wildlife Conflict in Kerala" (*Dr. Jayson, E.A. & Mr. Raveendran, V.P.)
17. National Seminar on "Issues Challenges and Strategies in Sustaining Soil Health" (*Dr. Latha, P.G., Dr. Sujatha, M.P., Dr. Sandeep, S., Dr. Mohanadas, K. & Mr. Raveendran, V.P.)
18. Prevention Control and Management of Forest Invasive Species – Strategies (*Dr. Sajeev, T.V., Dr. Mohanadas, K., Mr. Raveendran, V.P., Dr. Mohammed Kunhi K.V. & Dr. Raghu, A.V.)
19. Two day Nature Education Programme as a part of CAT@School (*Dr. Raghu, A.V., Dr. Mohanadas, K., Dr. Mohammed Kunhi K.V. & Mr. Raveendran, V.P.)
20. Evaluation of Eco system Service Values of Forest and Wetlands (*Dr. Jayson, E.A. & Mr. Raveendran, V.P.)
21. Modern trends in Tropical Nursery practices and composting technologies (*Mr. Raveendran, V.P)
22. Training cum Exposure Visit on Conservation, Cultivation, Utilization and Value addition of medicinal plants (*Mr. Raveendran, V.P. & Dr. Raghu, A.V.)
23. One day Training Programme on Weed Composting for Farmers (*Dr. Mohanadas, K., Dr. Sujatha, M.P.,Mr. Raveendran, V.P., Dr. Mohammed Kunhi K.V.& Dr. Raghu, A.V.)
24. Bamboo Cultivation and Nursery- Kerala (*Mr. Raveendran, V.P)
25. Bamboo Cultivation and Nursery- Karnataka (*Mr. Raveendran, V.P)
26. Bamboo Cultivation and Nursery- Kerala, Palappilly (*Mr. Raveendran, V.P)
27. Resource Enhancement of Utilization of Bamboos (*Mr. Raveendran, V.P)
28. Training Programme on Conservation and Evaluation of Bio diversity (*Dr. Sreejith, K.A., Dr. Sreekumar, V.B. & Dr. Raghu, A.V.)
29. Workshop for Postgraduate Students Specializing in Entomology (*Dr. Mohanadas., Dr. Sajeev, T.V & Dr. Raghu, A.V.)
30. Two day Orientation Workshop on Birds and Nature Resource Management "Kilikoodu" for Women Writers of Kerala (*Dr. Jayson, E.A.,Dr. Mohammed Kunhi K.V., Dr. Mohanadas, K., Dr. Raghu, A.V.& Mr. Raveendran, V.P)
31. Teak Nursery Management and Cultivation (KFRI) (*Dr. Raghu, A.V., Dr. Hrideek, T.K., Dr. Thulasidas, P.K. & Dr. Pillai, P.K.C.)

Exhibitions and Visitors

A total of 4120 visitors from different Institutes, Departments of Non-Government Organizations and farmers group visited KFRI during 2015-2016. The contributions of KFRI were exhibited at the National Arogya Expo 2015, AYUSH, Poojappura Ground, Thiruvananthapuram; 'Vanamithra Day' 2015, St. Joseph's Church, Vilangannur; South Indian Agri Expo2015, Kannur; National Bamboo Day Bamboo Fest, Snehatheeram, Thalikkulam; "SwasrayaBharath 2015, Swadeshi Science Movement, Kozhikode; Kerala Bamboo Fest – 2015, KSBM, Marine Drive, Kochi; Flower show - 2016, Thrissur, Thekkinkad Maidanam; Exhibition, Govt.Brennen College, Thalassery, Kannur; Science Exhibition, Christ College, Irinjalakuda; Kerala Science Congress, Calicut University; Public Information Campaign 2016, APH Auditorium, Vengara, Malappuram; Kerala State Bio diversity Board, Nehru Stadium, Kottayam. Among these, KFRI won the first prize at the Kerala State Bio Diversity Board, Nehru Stadium, Kottayam and also got third prize at the "SwasrayaBharath 2015, Swadeshi Science Movement, Kozhikode.

KFRI Academic Programmes

KFRI academics activities include Post-Doctoral, Doctoral and MSc attachment programmes. KFRI is an approved Research Centre for Forest Research Institute University, Dehradun, Cochin University for Science and Technology and the Calicut University.

Doctoral Degree awarded

1. Smt. Revathy V.S - Systematics of swallow tail butterflies (Lepidoptera Papilionidae) of Kerala, India. Calicut University. 2015.
2. Mr. T.P. Narayanankutty - Ecology and population trends of the butterflies in the butterfly safari at Thenmala, Kerala, India. Forest Research Institute, Dehradun. 2015.
3. Mr. Suresh K. Govind - Studies on human-wildlife conflict in central Kerala, India. Forest Research Institute Dehradun. 2015.
4. Smt. Lakshmi C.J - Development of seed handling techniques for selected commercial bamboo species. Forest Research Institute, Dehradun. 2015.
5. Mr. Suresh T.A - Ecology and invasion dynamics of the Giant Sensitive weed complex in the western ghats. Forest Research Institute, Dehradun. 2015.
6. Kripa P.K - Bio Indicators for monitoring soil and water quality in Koratty Region, Kerala. Forest Research Institute, Dehradun. 2016.
7. Mr. Sreejesh K.K - Carbon Sequestration Potential of Teak Plantations of Kerala. Cochin University of Science and Technology. 2016.
8. Mr. Prasanth K.M - Soil and water quality as influenced by land use in Koratty, Kerala. Cochin University of Science and Technology. 2016.
9. Smt. Sajitha K.L - Identification and mass production of bacterial biocontrol against sapstain on rubberwood. Forest Research Institute, Dehradun. 2015.

Ongoing Programmes

Start-up research grant for young Scientists

1. Dr. Suganitha Sakthivel - Ecology and patch dynamics of the endangered grizzled giant squirrel, *Ratufa macroura dandolena* habitats in South India with special reference to its conservation (Department of Science and Technology- SERB)

Post Doctoral

1. Dr. Majesh Thomson - Evaluation of bioactive principles from entomofungi for insect pest management (Post KSCSTE Fellowship)
2. Dr. Presty John - Risk assessment and development of management protocols for alien invasive ants of Kerala (

Back to Lab Programme

1. Dr. Thulasi G Pillai - Isolation and characterization of fungal endophytes from certain medicinal plants and RET species in Western Ghats & their therapeutic potentials (KSCSTE Fellowship)

Best Paper Award in the 27th Kerala Science Congress KSCSTE Fellowship

1 Ms. Maneetha T.K - Developing a sampling methodology for the snail *Achatina fulica* and to estimate the population size in infested sites of Kerala

Doctoral Programmes

Forest Research Institute, Dehradun

1. Ms.Keerthy Vijayan - Tracking the invasion: Molecular phylogeography and phyloclimatic modelling of the Giant African Snail *Achatina fulica* (Bowdich, 1822) in South India.
2. Mr Kuruvila Thomas - Forest Management, Population structure, Carbon sequestration, Litter dynamics and propagation of selected rare Bamboos of Western Ghats.
3. Ms.Maneetha T K - Faunal responses to biological invasions: A case study of the Giant African Snail (*Achatina fulica* Bowdich) infestation in Kerala .
4. Ms Neethu R.S - Regional differences in phenotypic and phytochemical profiles of selected medicinal plants in Kerala
5. Ms.Sijimol. K - Molecular systematics and phylogeny of the genus *Ochlandra* Thw. (Poaceae) and related Genera in Western Ghats.
6. Ms.Soumya R - Ecology, Phenology and social contexts of invasion by selected alien plants in Kerala.

Cochin University of Science and Technology

1. Mr.Alex C J - Ecology of Kavvai River Basin: A fragmented Landscape in Kerala.
2. Ms.Anoja Kurian - Molecular Studies on Rattans of South India.
3. Ms Ashoedha K - Influence of biochar on soil carbon dynamics and growth of teak seedlings (*Tectona grandis*).
4. Ms.Divya Soman - Assessment of Ecosystem Services from Parambikulam Tiger Reserve (KSCSTE Fellowship programme).
5. Ms Greeshma P - Foraging Ecology of Birds in the Kole Wetlands of Thrissur, Kerala (KSCSTE Fellowship programme).
6. Ms.Kavitha C - GIS based soil fertility mapping in agro ecosystems of Thrissur District, Kerala.
7. Ms.Lathika C - Potential of urban waste compost for organic farming.
8. Ms.Renuka R - Chemistry of marshy grassland soils in Forest Ecosystems of Southern Western Ghats, India.

9. Ms.Vidhya R. Sankar - Study of the constraints in efficient micro propagation of Bamboo.

10. Ms.Vishnu P.S - Pedogenesis and geochemical transformations in Forest Ecosystems of Western Ghats, Kerala (KSCSTE Fellowship programme).

Calicut University

1. Mr.Bharath Nair - Biocontrol potential of Rhizosphere and Rhizoplane Fungi of Grasses against Certain Fungal diseases of Forest Nursery Seedlings.

2. Ms.Daisy M.J - Impact of Climate change on the Growth Patterns of Teak (*Tectona grandis* L.f.) in Western Ghats of Kerala as Evidenced from Dendroecological Studies

3. Mr.Dantas K.J - Flora of Aralam Wild Life Sanctuary

4. Mr.Dhaneesh Bhasker - Diversity of Beetles (Coleoptera: Insecta) and the Impact of prescribed fire practices in Eravikulam National Park and Parambikulam Tiger Reserve.

5. Mr.Mohamad Anaz K - Systematic studies, utilization and conservation of the genus *Salacia* (Celastraceae) in South India.

6. Mr Muraleekrishnan K - Studies on Variability, Phenology and Management Methods of the Alien Invasive Tree. *Senna spectabilis* (D.C.) Irwin & Barneby in Kerala, India

7 Mr Rajkumar K.P - Herpetofaunal Diversity in Swamp (Vayal) Ecosystems in Periyar Tiger Reserve, Western Ghats.

8. Mr.Riju P. - Assessment of Human-wildlife conflict and mitigation measures in Malappuram District, Kerala, India.

9. Ms Rini Vijayan - Micro propagation of selected species of *Embelia* Burm.f., characterization and *in vitro* production of secondary metabolites.

10. Mr.Sanal C. Viswam - Studies on plus tree selection, variability and seed biology of *Terminalia paniculata* Roth. (Combretaceae) in Kerala part of peninsular India

11 Mr. Sandeep Das - Ecology and Behaviour of amphibians of Eravikulam National Park, with special reference to Bush Frogs.

12 Mr Sanil M.S - Systematics and phylogeny of Dipterocarps in the Western Ghats, India.

Post Graduate Attachment

1. Ms.Saranya K - Fungal Diseases and their effect on Phytochemical Constituents of *Desmodium gangeticum* and *Strobilanthus ciliatus*: A less known medicinal plants.

2. Mr.Arjun B - Effect of Fire on Fungal Diversity of Parambikulam Tiger Reserve.

3. Mr.Krishna K Baby - Synthesis of Silver Nano-Particles and its Antibacterial Activity of *Hopea parviflora* and *Hopea racophloea*.

4 Ms.Aswani M - Comparitive phytochemical profiling of *Saraca asoka* and *Polyalthia longifolia*

5 Ms.Sandra K.J - Evolution of Heavy metals and their relations with organic fractions in the soils of various agro ecological zones of Thrissur district.

6. Mr.Akhilesh K B - Population structure and diversity analysis of *Kingiodendron pinnatum* (Roxb. ex DC) Harms - An endemic and endangered tree of Western Ghats of Kerala.

7. Ms.Roshni Mohan - Prediction of activity of heavy metals in contaminated soils of Lalur, Thrissur.

8. Ms.Sruthy Sebastain - Ecosystem Analysis with emphasis on population structure and diversity of *Humboldtia brunonis* var. *raktapushpa* - An endemic and rare taxon from the Western Ghats.

9. Ms.ShajaraMol K.R – Change detection of urban green spaces in Thrissur corporation, Kerala.

10. Ms.Asha Mariya Sunny - Nutrient mining in continuous leak rotation in the midland laterites of Kerala.

11. Ms.Lakshmi Mol - Environmental impact assessment of quarries in Thrissur district.

12 Ms.Thasneem N.A - Landuse and land cover change analysis of Kole wetland in Thrissur district

13. Ms.Athira Sivan - Efficency of chemical extraction is predicting bioavailability of heavy metals in soil

14. Ms.Deebika A. Danesan - Assessment of alien plant invasion along the Seaport-Airport Road, Cochin.

15. Ms.Aswathy O.S - Phenological observations of five indigenous tree species in relation to weather factors

16. Ms.Vineesha E – Phytosociology and soil analysis of the Thozhuvanoor sacred grove, Valanchery, Malappuram.

17. Ms.Nimmy Vincent - Genetic diversity of *Calamus nagbetta* through SSR Genotype.

18. Ms.Jeena George - Strategy for control of contamination in *in-vitro* culture of *Bambusa balcoa*.

19. Mr Sringa A.V – Authentication of *Saraca asoca* from its market adulterants using DNA barcoding.

20. Ms.Neethu Johny – Vegetation, structure and mapping of KFRI campus.

21 Ms.Viji P: Phytochemical analysis and evaluation of Pipperin content in different species in *Piper sarmi*.

22 Ms.Niviya K.P - Development of Vegetative propagation protocols for two endemic and threatened trees of the Western Ghats of Kerala.

23. Ms.Athira Vijayan - Numerical taxonomic studies of the tribe Caryoteae (Arecaceae).

24. Ms.Divya Ullas - Mapping the geographical distribution of *Syzygium travancoricum* Gamble (Myrtaceae) and *Teinostachyum wightii* (Munro) Bedd. (Poaceae), two endemic plants of Western Ghats using Ecological Niche Modelling.

25. Ms.Fiji Francis. P - Numerical taxonomic studies of the genus *Phoenix* L. (Arecaceae).

26. Ms.Swathy.V.R - Floral documentation of Kerala Forest Research Institute campus, Peechi, Thrissur District.

Kerala Forest Research Institute, Peechi

(An Institute of the Kerala State Council for Science Technology & Environment, Govt. of Kerala)

BALANCE SHEET AS ON 31st MARCH 2016

Liabilities	Sch No	As at 31.03.2016	As at 31.03.2015	Assets	Sch No	As at 31.03.2016	As at 31.03.2015
Reserves & Surplus	I	196,574,633	191,343,460	Fixed Assets	IV	163,008,173	155,495,516
Current Liablities & Provisions	II	103,394,964	76,891,853	Current Assets	V	192,414,471	148,002,462
Unspent balance	III	63,402,527	45,552,594	Loans & Advances	VI	7,849,480	10,289,929
Total		**363,372,124**	**313,787,907**	**Total**		**363,372,124**	**313,787,907**

Kerala Forest Research Institute, Peechi

(An Institute of the Kerala State Council for Science Technology & Environment, Govt. of Kerala)

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31st MARCH, 2016

Expenditure	Sch No	Year ended 31.03.2016	Year ended 31.03.2015	Income	Sch No	Year ended 31.03.2016	Year ended 31.03.2015
To Infrastucture Strengthening (Non plan)	X	15,019,663	14,248,416	By Grant from Govt. of Kerala	VII	185,810,879	131,114,676
To Salaries and Allowances (Non Plan)	XI	131,615,607	120,729,429	By Other Receipts	VIII	27,827,094	39,603,570
To Depreciation	IV	21,408,337	20,333,831	By Depreciation Written back	IV	21,408,337	20,333,831
To Other Project Expenses		57,777,200	29,876,568	By Income from Other Projects	IX	57,777,200	29,876,568
To Project Expenses under Plan scheme		67,002,703	35,740,401				
Total		292,823,510	220,928,645	**Total**		**292,823,510**	**220,928,645**

INSTITUTIONAL COMMITTEES

RESEARCH COUNCIL

The KFRI Research Council comprising of eminent Scientists of the country advise in matters concerning research policies and monitors the quality of research undertaken at the Institute.

Chairman
Dr.N.Krishnakumar, Director, Institute of Forest Genetics and Tree Breeding
(Indian Council of Forestry Research and Education), P.B.No.1061, R.S.Puram P.O., Coimbatore – 641 002.

Members
Dr.V.B Mathur, Director, Wildlife Institute of India.
P.O.Box.18,Chandrabani,
Dehradun-248 001, Uttaranchal.

Dr.R.V. Varma,
Former Chairman
Kerala State Biodiversity Board, Lakshmipuram, Royal avenue,
Thrissur-680 020

Dr.C.K. Sreedharan
Retd. PCCF, Tamil Nadu
Plot No. 06, Sarvaya, Third Main Road.
River view Colony,
Manapakkam, Chennai 600125.

Additional Principal Chief Conservator of forests (Development) Forest Head Quarters, Vazhuthacaud,
Thiruvananthapuram 695 014.

Dr.Madhu Verma
Professor-Environment and Developmental Economics
Coordinator-Centre for Ecological Services Management,
Indian Institute of Forest Management
PO Box 357 Nehru Nagar, Bhopal 462 003, Madhya Pradesh.

Member & Ex-Officio Convener
Director
Kerala Forest Research Institute
Peechi – 680 653.

MANAGEMENT COMMITTEE

The Management Committee looks after the administrative functions of the Institute. Under the Chairmanship of Director, the Committee takes care of the proper execution of administrative rules, smooth conduct of research activities and welfare of employees.

Director, Kerala Forest Research Institute	:	Chairman
Shri.K.B.Santhosh Kumar Addln. Secretary & Joint Chief Protocol Officer General Administration Department Thiruvananthapuram	:	Member
Member Secretary, Kerala State Council for Science Technology and Environment	:	Member
The Executive Director Centre for Water Resources Development and Management, Kunnamangalam (P.O) Kozhikode	:	Member
Dr.E.A.Jayson Scientist F, Kerala Forest Research Institute		Member
Registrar Kerala Forest Research Institute	:	Convener

Various programmes and activities in the Institute are implemented through the following Committees.

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 PCCF (D&P) & Disciplinary Authority	...Member
3	The Additional PCCF (FM/S)	.. Member
4.	The Additional PCCF (Development)	...Member
5	The Additional PCCF (WP&R)	...Member
6.	The Additional PCCF (E&TW)	
	The Additional PCCF (Administration)	.. Member
7.	The Additional PCCF(Southern Region)	...Member
8.	The Additional PCCF (Protection)	...Member
9.	The Additional PCCF (Vigilance)	...Member
10	The Additional PCCF (Northern Region)	...Member
11.	The Additional PCCF (BDC)	...Member
12.	The Additional PCCF (IHRD)	. .Member
13.	The Additional PCCF (SA&NO)	...Member
14.	The Principal Chief Conservator of Forests Wildlife & Chief Wildlife Warden	...Member
15.	The Principal Chief Conservator of Forests (Social Forestry)	...Member
16.	The Principal Chief Conservator of Forests (Vigilance)	...Member
17.	The Principal Chief Conservator of Forests (Dev & PFM)	...Member
18.	The Chief Conservator of Forests (Protection)	...Member
19.	The Chief Conservator of Forests (FM/S)	..Member
20.	The Chief Conservator of Forests (HRD)	.. Member
21.	The Chief Conservator of Forests (Administration)	...Member
22.	The Chief Conservator of Forests (Vigilance)	...Member
23.	The Chief Conservator of Forests (Social Forestry)	...Member
24.	The Regional Chief Conservator of Forests (North)	...Member
25.	The Regional Chief Conservator of Forests (South)	...Member
26.	The Conservator of Forests (Biodiversity)	...Member
27	The Deputy Conservator of Forests (Research) North	...Member
28.	The Deputy Conservator of Forests (Research) South	..Member
29.	The Managing Director, Kerala Forest Development Corporation	...Member
30.	The Associate Dean, Forestry Faculty, Kerala Agricultural University	.. Member
31	The Director, Tropical Botanic Garden & Research Institute, Palode	...Member
32.	The Director, Institute of Forest Genetics & Tree Breeding, Coimbatore	..Member
33.	The Managing Director, Oushadi, Thrissur	. .Member

34. The Director, Center for Earth Science Studies, Thiruvananthapuram ...Member
35. The Director, Center for Water Resources Development and Management ...Member
36. The Director, Rajiv Gandhi Center for Biotechnology, Trivandrum ...Member
37. The Managing Director, Oushadhi, Thrissur ...Member
38. The Director, Medicinal Plant Research Center, Arya Vaidya Sala, Kottakkal ...Member
39. The Managing Director, Hindustan Newsprint Ltd., Kottayam ...Member
40. The Managing Director, Kerala State Wood Industries Ltd., Nilambur ...Member
41. The Managing Director, Kerala State Bamboo Corporation Ltd. ...Member
42. The Director, Salim Ali Center for Ornithology and Natural History, Coimbatore ...Member
43. Director, Kerala Forest Research Institute, Peechi ...Member
44. Joint Director (Science & Technology Promotion), KSCSTE, Trivandrum ...Member
45. Research Coordinator, KFRI, Peechi ...Member
46. All Scientists of KFRI ...Invitees
47. Programme Coordinator, Training & Extension Division, KFRI ...Convener

2. INTERNAL RESEARCH GROUP (IRG)
(Vide Proceedings G.53/KFRI/79 dated 13 January 2009 – Modified here).

1. Director ...Chairman
2. Dr. K. Mohanadas ...Convener
3. Dr. V. Anitha ...Associate Convener
4. All scientific staff ...Members

3. Ph. D. & M. Sc. STUDENTS ATTACHMENT PROGRAMME ADVISORY COMMITTEE
(Vide G.53/KFRI/79 dated 6 May 2006)

1. Dr. T.K. Dhamodaran ...Chairman
2. Dr. M.P. Sujatha ...Member
3. Dr. Mallikarjuna Swamy ...Member
4. Respective Research Guide(s) ...Invitees

4. EQUIPMENT/ INFRASTRUCTURE DEVELOPMENT COMMITTEE

1. Dr. S. Sandeep ...Chairman
2. Dr. E.M. Muralidharan ...Member
3. Dr. P.K. Thulasidas ...Member
4. Smt. Ricy Eliner Varkey ...Member
5. Mr. V.C. Jinesh ...Member
6. Purchase-in-charge ...Member
...Convener

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

1. Dr. T.K. Dhamodaran ...Chairman
2. Dr. R. Jayaraj ...Member
3. Registrar ...Convener

6. LIBRARY & INFORMATION NETWORKING ADVISORY COMMITTEE
(Vide G. G.53/KFRI/79 dated 19 July 2006)

1. Librarian ...Chairman

2. Mr. K.F. George ..Convener
3. Dr. Mammen Chundamannil ...Member
4. Dr. T.B. Suma ...Member
5. Dr. M. Amruth ...Member
6. Dr. Mallikarjuna Swamy ...Invitee

7. WEBSITE AND SOFTWARE / HARDWARE COMMITTEE
(Vide 6. G.53/KFRI/79 dated 13 October 2006)

1 Dr. T.K. Hrideek ...Chairman
2. Dr. M. Amruth . .Member
3. Smt. N. Sarojam ...Member
4. Smt. Ricy Eliner Varkey ...Member

8. 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 ...Convener

9. TEAK MUSEUM AND NATURE TRAIL ADVISORY COMMITTEE

1. Dr. U.M. Chandrasekhara ...Chairman
2. Dr. E.A. Jayson ...Member
3 Dr. P. Sujanapal ...Member
4 Smt Sani Lookose, .. Convener

10. CAMPUS DEVELOPMENT COMMITTEE

1 Dr. P.A. Jose ...Chairman
2 Dr. E.M. Muralidharan . .Member
3. Smt. M.K. Raji (Engineering) ...Member
4. Dr P. Sujanapal ...Convener

11. EDITORIAL COMMITTEE FOR THE JOURNAL OF BAMBOO AND RATTAN
(Vide 6. G.53/KFRI/79 dated 13 October 2006)

1. Dr E.M. Muralidharan ...Chief editor
2. Dr U.M. Chandrashekaa ...Associate Editor
3. Dr P.K. Thulasidas ..Associate Editor
4. Dr V Anitha ..Associate Editor

12. ANNUAL REPORT COMMITTEE

1. Dr V. Anitha .Chairman
2. Dy.Registrar (Accounts i/c) ...Member

3 Mr. K. Kamalakaran ...Member
4. Dr.R.Jayaraj ...Member
5. Dr. T.K. Hrideek ...Convener

13. NEWSLETTER COMMITTEE
1. Dr. M.P Sujatha ...Editor
2. Dr. M. Amruth ...Associate Editor
3 Dr T.B. Suma ...Associate Editor

14. COMMITTEE FOR TRANSFORMATION OF OFFICIAL LANGUAGE TO MALAYALAM
(Vide KSCSTE letter no. 36/C6/09 dated 10 Feb. 2009)
1. Registrar ...Chairman
2. Dr. U.N. Nandakumar ...Member
3. Dr. T.V. Sajeev ...Member
4. Smt. V.K. Leela ...Convener

15. EXHIBITION ADVISORY COMMITTEE
(Vide 6. G.53/KFRI/79 dated 13 October 2008)
1. Dr. K. Mohandas ...Chairman
2. Dr. A.V. Raghu ...Member
3. Dr. P. Sujanapal ...Member
4. Dr. T.V. Sajeev ...Member
5. Mr. V.P. Raveendran ...Convener

16. SEMINAR COMMITTEE
1. Dr. R. Jayaraj ...Chairman
2. Dr. S. Sandeep ...Member
3. Dr. V.B. Sreekumar ...Convener

17. COMMITTEE TO PREVENT SEXUAL HARASSMENT ON WOMEN
(Vide No.1763/B6/03/KSCSTE dated 5-12-2003)
1. Dr. M.P. Sujatha ...Chairman
2 Dr. S. Sandeep ...Member
3 Smt. Seetha Sadanandan (C/o Kudumbasree State Poverty Eradication Mission, Ward 16, Cheenikkadavu, Kannara, Pananchery Panchayath, Trichur Dist.) ...Member
4. Smt. Shirly Isaac ...Convener

18. HOSTEL ADVISORY COMMITTEE

1. Dr. K. Mohanadas ...Chairman
2. Smt. Sabitha Balakrishnan ...Member
3. Smt. M.K Raji ...Member
4. Mr. V.P. Raveendran ...Convener

19. CAFETERIA COMMITTEE

1. Dr. Mammen Chundamannil ...Chairman
2. Smt. Anupa Vasu ...Member
3. Dr.K.A. Sreejith ...Member
4. Mr. PI Shereef ...Convener

20. BUILDING COMMITTEE

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

1. Dr. P.K. Thulasidas ...Chairman
2. Dr. R. Jayaraj ...Member
3. Dr. M.P. Sujatha ...Member
4. Dr. A.V. Raghu ...Convener

21. VEHICLE ADVISORY COMMITTEE

1. Dr. E.A. Jayson ...Chairman
2. Dr. S. Sandeep ...Member
3. Mr. V.C. Jinesh ...Member

22. DR. K.M. BHAT MEMORIAL ENDOWMENT COMMITTEE

1. Director ...Chairman
2. Dr. Mammen Chundamannil ...Member
3. Dr. E.A. Jayson ...Member
4. Dr. E.M. Muralidharan ...Member
5. Dr R. Jayaraj ...Member
6. Dr. P.K. Thulasidas ...Member - Convener

23. DR C. CHANDRASEKHARAN MEMORIAL ENDOWMENT COMMITTEE

1. Director ...Chairman
2. Dr. Mammen Chundamannil ...Member
3. Dr. K. Mohanadas ...Member
4. Dr V Anitha ...Member
5. Dr. M. Amruth ...Member
6. Dr P Sujanapal ...Member Convener

STAFF LIST

Sl.No	Name	Designation	DOJ
1	Dr. P.G.Latha	Director (i/c)	
		Research Monitoring & Evaluation Unit	
2	Dr. E.A.Jayson	Scientist-F16-12-1981	
		Sustainable Forest Management	
3	Dr. U.N.Nandakumar	Scientist F	23-03-1983
4	Dr. M.P.Sujatha	Scientist-EII	11-12-1987
5	Dr.P.Sujanapal	Scientist-B	09-12-2010
6	Dr.S.Sandeep	Scientist-B	09-03-2011
		Seed Centre	
7	Dr.P.K.Chandrasekhara Pillai	Scientist-C	18-10-1983
		Forest Genetics & Biotechnology	
8	Dr.E.M.Muraleedharan	Scientist-EII	27-05-1991
9	Dr.T.B.Suma	Scientist-B	08-12-2010
10	Dr. T.K. Hrideek	Scientist-B	08-12-2010
		Forest Ecology and Biodiversity Conservation	
11	Dr.U.M.Chandrashekara,	Scientist-EII, Scientist i/c, KFRI Sub Centre, Nilambur	15-07-1992
12	Dr. P.A.Jose	Scientist E I	18.10.2014
13	Dr. V.B.Sreekumar	Scientist-B	01-03-2011
14	Dr. K.A .Sreejith	Scientist-B	01-03-2011
15	Dr. R.Jayaraj	Scientist-B	28-03-2011
		Forest Health	
16	Dr.T.V. Sajeev.	Scientist-EI	06-02-1997
17	Dr.Shambu Kumar	Scientist-EI	29.02.2016
18	Dr.G.E.Mallikarjunana Swamy	Scientist-B	20-12-2010

Wood Science & Technology			
19	Dr.T.K.Dhamodaran	Scientist-F	02-08-1982
20	Dr.P.K.Thulasidas	Scientist-C	28-06-1984
Forestry and Human Dimensions			
21	Dr.Mammen Chundamannil	Scientist-F	29-05-1982
22	Dr. V.Anitha	Scientist-EI	07-09-1998
23	Dr. M.Amruth	Scientist-B	01-03-2011
Forest management Information System			
24	Dr. Shijo Joseph	Scientist-EI	26.02.2016
	Extension & Training		
25	Dr.K.Mohanadas	Scientist-F	01-06-1982
26	Shri.V.P.Raveendran	Scientist-C	25-02-1993
27	Dr.K.V.Muhammed Kunhi	Scientist-EI	24-10-1994
28	Dr.Raghu A V	Scientist-B	07-12-2010
Museum Curator			
29	Smt. Sani Lookose	Scientist C-Teak	07-08-2002
Library & Information			
30	Smt.N.Sarojam	Scientist-C- Librarian i/c	06-07-1981
31	Dr.K.F.George	Scientist-C	23-12-1994
Administrative Staff			
1	Shri. K.Satheesakumar	Dy.Registrar Accounts & Registrar i/c	20-12-2013
2	Shri.K.Venugopal	Dy.Registrar Admin.	27-05-2008
3	Shri.Ranjithkumar M.G	Dy. Registrar Admin.	04-06-2014
4	Smt.V.K.Leela	Asst. Registrar	02.07.1979
5	Smt.Sabitha Balakrishnan	Section Officer	03-09-1999
6	Shri.T.D.Tomy	Dy.Registrar Admin. on Deputation from secretariate	

7	Smt.Shirly Issac	Section Officer	16-09-2003
8	Shri.K.Kamalakaran	Section Officer	10-12-2009
9	Smt.K.Annapoorni	P A to Registrar	12-07-1982
10	Smt.Grace Andrews	PA to Director	27-01-1987
11	Shri.V. S.Krishnanunni	Assistant	28-08-2010
12	Smt.V.V.Rajina	Assistant	17-08-2010
13	Smt.P.Anupa Vasu	Assistant	01-10-2011
14	Smt.Anuja Prasannan	Assistant	17-10-2011
15	Smt.K.Keerthy	Assistant	06-01-2012
16	Smt. Maymol Joseph	Assistant	16-08-2011
17	Shri.P.M.Venugopalan	Sr.Spl.Gr.Typist	22-05-1978
18	Shri.K.P.Manoj	Spl.Gr.Typist	28-08-1992
19	Shri.T.M.Abdul Vahab	Spl.Gr.Word Processing Assistant	27-01-1989
20	Shri.P.Rajeesh	Typist	14-06-2000
21	Shri.T.C.Paul	Spl.Gr.Driver	01-07-1994
22	Shri.P.K.Rajendran	Driver	09-01-2009
23	Shri.E.O.Mathai	Driver	09-01-2009
24	Shri.C.H. Herald Wilson	Driver	24-02-2012
25	Shri.M.C.Mohandas	Senior Attendant	24-10-1977
27	Smt.N.Baby	Attendant	24-11-1995
28	Smt.K.K.Vanaja	Office Attendant	26-08-2003
29	Smt.K.Aparna	Office Attendant	23-08-2004
30	Smt.A.M.Lalitha	Office Attendant	01-08-1986
31	Smt.T.G.Chandrika	Office Attendant	01-03-1988
32	Shri.V.K.Mohandas	Office Attendant	01-01-1992
33	Shri.N.I.Thankappan	Office Attendant	01-01-1992

34	Shri.E.P.Ulahannan	Office Attendant	01-01-1992
35	Shri.C.P.Shoukathali	Helper Gr.III	01-03-1988
36	Shri.K.Mohammed	Helper Gr.III	01-01-1992
37	Shri.K.K.Mohammed	Helper Gr.III	05-07-1994
38	Smt.P. Deepa	Office Attendant	06-08-2009
39	Shri.I.O.Thomas	Helper	01-12-2009
40	Shri.T.P.Valsan	Helper	11-06-2010
41	Smt.S.Ashamol	Office Attendant	19-08-2010
42	Shri.E.Hamsa	Office Attendant	19-08-2010
43	Shri.K.Abdul Jaleel	Office Attendant	16-08-2010
44	Smt.C.Sujatha	Office Attendant	21-08-2010
45	Smt.S.Sheeja	Helper	17-08-2010
46	Shri.A.V.Chamy	Helper	27-10-2010
47	Smt.C.Rugmini	Helper	29-05-2012
48	Shri.P. V. Santhosh Kumar	Helper	29-05-2012
49	Shri.T. S. Prakash	Helper	29-05-2012
50	Shri.M.S.Santhosh Kumar	Helper	29-05-2012
51	Shri.K.Krishnadasan	Helper	29-05-2012
52	Shri.N.Rajan	Helper	29-05-2012
53	Shri.T.O.Simon	Helper	29-05-2012
54	Shri.C.P.Ummer	Helper	29-05-2012
55	Smt.P. S. Kadeeja	Helper	29-05-2012
56	Smt.V.L.Alphonsa	Helper	29-05-2012
57	Shri.M.K.Suresh	Helper	29-05-2012
58	Shri.K.A.Thankachan	Helper	29-05-2012
59	Shri.C.B.Sajy	Helper	29-05-2012
60	Shri.T. P. John	Helper	29-05-2012

61	Shri.N.K.Rajan	Nuresry Man	31-07-2007
62	Smt.S.Padmavathy	Nuresry Man	27-09-2008
63	Shri.K.Rajan	Nursery Man	29-09-2008
Technical Staff			
1	Shri.U.Y.John	Sr. Special Grade Technical Officer	09-01-1981
2	Shri.D.Skariah	Sr.Special Grade Technical Assistant	01-09-1983
3	Shri.K.C.Subramanian	Sr.Special Grade Technical Assistant	22-07-1985
4	Shri.M.R.Anilkumar	Sr.Special Grade Technical Assistant	30-01-1989
5	Shri.P. B.Sajeeva Rao	Sr.Special Grade Technical Assistant	30-01-1989
6	Shri.P. I. Shereef	Technical Officer (Electrical)	10-08-2010
7	Smt.M.K.Raji	Technical Officer (Civil)	18-08-2010
8	Shri.V.C.Jinesh	Technical Officer	04-07-2014
9	Shri.O.P. Ranjith	Technical Assistant (Binder)	03-10-2011
10	Smt.Ricy Eliner Varkey	Computer Lan Assistant	01-03-2006