Annual Report 2007-08

KFRI

Kerala Forest Research Insititute

ANNUAL REPORT

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Kerala Forest Research Institute

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

Peechi – 680 653, Thrissur Dt., Kerala

ANNUAL REPORT

Kerala Forest Research Institute

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DIRECTOR'S REPORT

The alarming rate of depletion of forest cover from the face of the earth has been a threat to the environmental stability particularly, in the context of increasing carbon levels in the atmosphere. It is the fact that plant cover is the only possible means for bringing down the atmospheric carbon through sequestration, speaks volumes on the value of vegetation cover to the existence of life on the planet. Thus it has become the duty of each inhabitant of the earth, state or country to look for ways to protect the planet from further deterioration, and at the same time, adopt suitable ameliorative measures. Needless to say, our forest cover needs to be enhanced and the message of forest conservation, to be propagated.

Kerala Forest Research Institute is an institution dedicated to tropical forestry. The mission of the Institute has been to cater to the requirements of the forestry in the State by undertaking time-bound research projects in various areas of forestry like plantation management, mensuration, wildlife, forest health, forestry database, wood and NWFP and so on. The research and extension projects undertaken by the Institute have not only been of local relevance, but also of global importance. The priority areas of research of KFRI are identified after examining their benefit to the society, State and also the global environment.

Over the years, our thrust of research and related activities has widened to address the diverse aspects of environment, biodiversity and societal development. One such important area identified is Biodiversity documentation and conservation. The Institute has already initiated a few projects on documentation of biodiversity. Similarly, for conservation of rare, endangered and threatened plant and animal species, research and action programmes have been initiated. The Institute has established arboreta of rare and endemic plants, live collections of medicinal plants, palms, orchids, bamboos and canes. A bioresources nature park has already been established at the Institute's Sub-centre at Nilambur.

KFRI has always endeavored to make the forestry research socially relevant. There have been a number of ongoing projects to take care of human dimensions of forestry. Besides these research activities, the Institute organizes training programmes for stakeholders and other specific groups. Demonstration of a model watershed and its maintenance, cluster development of bamboo artisans, offering training programmes suitable for village-level population, etc. are activities already undertaken. A number of training programmes are aimed at imparting guidance on employment opportunities in forestry sector such as nursery raising, supply of seedlings, composting, cultivation of medicinal plants, etc. which have livelihood potential. Raising of bioshields and coastal zone protection as a part of Tsunami Rehabilitation Programme of the Government and Establishment of a model watershed can be cited as examples of success achieved through people's participation.

During the reporting year the Institute received Rs. 671.00 lakhs as grant-in-aid from the Council (Govt. of Kerala) of which Rs. 286.00 lakhs was under Plan Grant and the rest under Non Plan. Financial support received from external agencies for specific projects was Rs. 242.56 lakhs. As regards the research projects undertaken, there were a total of 91 ongoing research projects including the recently initiated and the projects at the verge of completion. Final reports of 12 completed projects and three extension projects were brought out during the period.

Dr. R. Gnanaharan
Director

THE INSTITUTE

Kerala Forest Research Institute (KFRI) established in 1975 as an autonomous institute by the Government of Kerala under the Travancore-Cochin Literary, Scientific and Charitable Societies Act (1955) is an organization dedicated to research in tropical forestry and biodiversity. Presently, KFRI is one of the six R&D institutions of the Kerala State Council for Science, Technology and Environment (KSCSTE). During the past three decades of its existence, the Institute has made significant contributions to forestry research, which have made the Institute known worldwide.

The main campus of KFRI is located at Peechi in a picturesque, 28 ha reserve forest area, about 20 km North-east of Thrissur in Central Kerala. The Institute has a Sub-centre at Nilambur in Malappuram District and a Field Research Centre at Velupadam in Thrissur District. The total staff strength of the Institute is 133, which includes 57 scientific, 68 administrative and 8 technical personnel. In addition, there are over 15 members on contract appointment. About 70 project staff attached to various research projects provide the necessary research support.

Vision, mission and organization

The vision of KFRI is to become a centre of excellence in tropical forestry to provide scientific backbone for effective conservation of forest ecosystem and sustainable utilization of natural resources for the benefit of the society. The mission is to provide technical support to facilitate scientific management and utilization of forests for social benefits. Accordingly, the Institute envisages to: (i) conduct inter-/multi-disciplinary research on priority areas of tropical forestry including wildlife management, socio-economics, indigenous knowledge, value addition of forest products, participatory forest management and livelihood improvement of forest dwellers by scientific management of forest resources, (ii) provide technical advice and solutions to practical problems related to forest conservation and sustainable utilization of forest resources, and (iii) disseminate knowledge and information on forest-related matters to end-users, farmers, general public and transfer the technology to stakeholders.

The administration and management of KFRI are vested with the Management Committee (MC) chaired by the Institute's Director. The Committee approves and monitors research activities besides managing administrative and financial matters. Another vital body responsible for overseeing and guiding the formulation and implementation of various research programmes is the Research Council (RC) comprising eminent scientists of the

Country in forestry research. Research Council also monitors the quality and content of research undertaken and provides guidance for improvement.

The Director is the Head of the institution. The administration and financial matters of the Institute are handled by Administration and Accounts sections respectively, which function under the control of a Registrar. Both the sections have a Deputy Registrar each who is responsible to the Registrar. The financial and expenditure matters of the Institute are scrutinized by an Internal Auditor.

The scientific manpower of KFRI is organized into six Programme Divisions encompassing different Disciplines and three supporting Divisions for effective implementation of multidisciplinary research programmes in forestry and to disseminate the research findings. Each Programme Divisions is headed by a Programme Coordinator. The six Programme Divisions are: 1. Sustainable Natural and Plantation Forest Management, 2. Forest Ecology and Biodiversity Conservation, 3. Forest Protection, 4. Forest Utilization, 5. Forestry and Human Dimensions, and 6. Forest Information Management System. The supporting Divisions include: 1. Instrumentation, 2. Extension and Training, and 3. Library and Information. A Research Monitoring and Evaluation (RME) Unit is also functioning to facilitate and monitor research in various Disciplines.

Sustainable Natural and Plantation Forest Management (SNPFM)

The Division comprises Silviculture, Biotechnology, Genetics, Tree Physiology and Soil Science Disciplines. The thrust areas of research of the Division are: improved nursery and silvicultural practices, production of better clones and quality planting stock of plantation species, and sustainable forest management. Development of cost-effective micropropagation protocols as well as vegetative propagation of important forestry species, DNA fingerprinting, marker assisted selection, gene mapping and population genetics, assessment of genetic diversity of forest species, selection of plus clones and genetic improvement, studies on breeding system and gene flow have been some aspects of research in the Division. Besides, studies have also been undertaken on eco-restoration and afforestation of degraded sites, evaluation of factors affecting growth, enhancement of plantation productivity, soil nutrient management for different forestry species and environmental physiology, especially water use, photosynthesis and microclimate.

Forest Ecology and Biodiversity Conservation (FEBC)

Ecosystem and landscape analysis, rehabilitation and restoration, population ecology and dynamics, biodiversity evaluation and conservation of fragile ecosystems, traditional knowledge system analysis and biodiversity-informatics are the thrust areas of research of the Division. Inventorisation of biodiversity of different forest types and protected areas, evaluation of below-ground biodiversity, taxonomic studies and conservation of RET species of flora have been some areas of research in the Division. Besides, the Wildlife Biology Discipline deals with inventorisation of fauna, endangered animals, man-

wildlife interaction and wildlife census. Nursery and plantation technology of selected indigenous timber species and rattans and ethno-biological studies are other activities of the Division. A Herbarium representing the forest flora of the State, an Arboretum of rare and characteristic species of moist deciduous forests of Kerala, a Palmetum with about 80 species of palms, a Canetum with about 30 species of rattans, a bio-resource nature trail, etc. are the major facilities of the Division.

Forest Protection (FP)

The Division comprises Forest Entomology and Forest Pathology Disciplines that undertake research on various aspects of microbes and insects in the forest ecosystem. Further, eco-friendly technologies are being developed to manage the pests, diseases and weeds in forest plantations, mainly through biological means. The Division maintains authentic collections of microbes and insects of Kerala forests and also of microbial pathogens of forest insects. Management of nursery and plantation diseases, diversity of plant pathogenic fungi in different forest ecosystems, VA and ectomycorrhizal fungal diversity and biological control of weeds are the main areas of research in Pathology Discipline. In Entomology Discipline, the thrust areas include monitoring of forest insect diversity, control of termites in plantations, wood damaging insects and teak defoliator, traditional methods of post-harvest protection of bamboo from insect borers, etc. The mass production technology of the bio-pesticide Hyblaea puera Nucleo Polyhedrosis Virus (HpNPV) has been standardized, and the application technology has been transferred to stakeholders. The concept of butterfly garden has been popularized and technical advice provided to various agencies for the establishment of butterfly parks.

Forest Utilization (FU)

The major thrust of the Division is research and extension activities related to wood structure, properties and utilization, consumption and bio-prospecting of non-wood forest products with reference to medicinal plants, their quantitative inventory and sustainable extraction. The Division has facilities like wood preservation plant, drying kiln, xylarium, medicinal plants garden and instruments like Universal Testing Machine (UTM), image analyzer, NIR spectroscope, etc. The Division has undertaken extensive studies on wood structure, properties and preservative treatments for various timber species like teak, eucalypt and rubber wood. Also, anatomical and utilization studies of bamboos, reeds and canes have been undertaken. The Division has developed implements helpful for bamboo extraction.

Forestry and Human Dimensions (FHD)

The Division is comprised of Forest Economics, Agro-forestry, Sociology and Urban Forestry Disciplines which undertake research on human dimensions of forestry including livelihood and recreation, environmental conservation and linkages between social and

natural sciences. The major areas of research are natural/forest resource management, economic valuation, sustainable utilization of non-timber forest products, policy issues and strategic planning, sustainable forest management, participatory role of local communities in the conservation and sustainable management of forest ecosystem, resource use conflict and livelihood issues and agro-forestry systems. Assessment of supply-demand position of wood for the State, estimation of availability of bamboo in home gardens, evaluation of the livelihood conditions of bamboo workers in Kerala and establishment of a model watershed with people's participation are some of the recent achievements of the Division.

Forest Information Management System (FIMS)

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

Instrumentation

A central instrumentation facility caters to the material/chemical analysis needs of research, within and outside the Institute. The Division provides advanced instrument facilities for analysis and measurement to users from industries, R&D establishments and academic institutions, co-operates with professionals and academic staff and undertakes training and services for personnel from industries, R&D establishments and academic institutions. The Division is equipped with highly sophisticated laboratory facilities to carry out spectroscopic measurements, material/chemical characterization and structure analysis.

Extension and Training

The Division liaises with the users/stakeholders, facilitates transfer of technology to various stakeholders and conducts training programmes in different aspects of tropical forestry like forest management, forest seed management, medicinal plant cultivation, environmental impact assessment, biodiversity monitoring and evaluation, remote sensing and GIS, root-

trainer technology, clonal propagation, tree improvement and statistical application in forestry. Client-oriented training programmes and refresher courses are designed and conducted for managerial and field level personnel, teachers, artisans, entrepreneurs and representatives of local bodies.

Library and Information

KFRI library with a core collection of 16,000 books and 9,000 back volumes of journals on the subject caters to the information requirements of the scientists and research scholars of the Institute. The collection includes several valuable reference books, doctoral theses and back volumes of periodicals, databases in CD-ROMs, etc. Online Public Access Catalogue of books and back volumes is available. Subscription of more than 90 journals with more than 40 foreign journals in the subject was continued during 2007-08. As the Institute is a member of international bodies like APAFRI, IRGWP, IUCN and IUFRO, the library has in its collection the publications from these organizations. A CD-server is provided to access the CD-ROM collections of the library. Bibliographical databases developed on specialized topics such as bamboo and teak in the library are made available in CD-ROM. Annotated bibliographies on teak, bamboo and rattan, both in print and CDs are also available. The library provides literature search facilities to Scientists from within and outside the Institute, apart from art and photography and LAN facilities. Distribution of all KFRI publications is also carried out by the library. A Bamboo Information Centre - India, established in the library with the support of the International Development Research Centre (IDRC), Canada, provides information on various aspects of bamboo through its documents and databases developed for the purpose.

Activities

Besides research which forms the main activity, technical advice is provided to the Kerala Forest Department, other Governmental and non-governmental agencies and farmers on issues posed by them. The institute also undertakes identification of plants, fungi, timber and animals. Advice on wildlife management and resource estimation as well as expert opinions are provided. New technologies developed by the Institute are extended to the users. They include nursery and planting techniques, pest and disease control, site evaluation, choice of species for planting, utilization of timbers from non-conventional sources, etc. Consultancy services are offered on plantation establishment and management, greening of industrial areas, benchmark studies, environment impact assessment, etc. Supply of quality seeds and seedlings of various forestry species at reasonable cost is also undertaken by the Institute.

The Institute is also a recognized research centre of FRI University, Calicut University and Cochin University of Science and Technology. A number of research fellows pursue their doctoral study while working in the research projects of the Institute.

RESEARCH ACTIVITIES

The various intra- and inter-disciplinary projects undertaken in different Divisions, both completed and ongoing during 2007-08 are given below.

COMPLETED RESEARCH PROJECTS

Calibration of volume prediction equations for different clones of rubber based on random parameter models. *KFRI Research Report No. 294* (Meenattoor, J.R., Gireesh, T., Nair, R.B. and Jayaraman, K., 2007)

Attempts were made to develop volume prediction equations for 13 clones of rubber viz., GT 1, Java 1, PB 235, PB 260, PB 217, PB 28/59, PB 5/51, PR 107, RRII 105, RRII 118, RRIM 600, RRIM 628 and Tjir 1. The data were collected from plantations in different parts of Kerala and Tamil Nadu. The data consisted of girth at breast height of standing trees and the corresponding volume of trees as calculated from measurements on billets taken after felling the trees. For calculation of volume, two grades of rubber wood were identified viz., Grade A (wood >23" girth over bark) and Grade B (wood >27" girth over bark). Volume prediction equations were developed for each clone based on data

Rubber trees marked for measurement

CD for volume prediction for rubber wood

pooled over different locations. The predictivity of the models was, in general, only moderate due to variation in wood volume from tree to tree caused by variation in height, taper and branch wood for any given diameter at breast height. However, models with coefficient of determination higher than 0.7 are suggestible for field use.

Resemblance structure among the clones with respect to the intercept and slope coefficient of the volume equations was examined using corresponding parameter estimates obtained through least square analysis. Cluster analysis using average linkage method based on Euclidean distance indicated two broad groups of clones, one consisting of PB 217, PB 28/59 and RRIM 628 and the other group consisting of GT 1, PR 107, RRIM 600, Java 1, PB 235, PB 260, PB 5/51, RRII 105, RRII 118 and Tjir 1. The first group was characterized by high intercept and low slope coefficient probably indicating trees of higher density wood whereas the second group had a different combination of parameters considered.

Localizing functions for tree volume equations based on random parameter models were developed for GT 1, RRIM 600 and RRII 105. The analysis was done using *MLwiN* software. Other than tree diameter, age of the stand came out as predictor in the mean function. The intercept parameter showed significant variation at location level but slope coefficient showed very little variation over the locations. The variation in intercept parameter over locations indicated the need for localizing volume equations.

All the information required for applying the best linear unbiased predictor to generate local volume equations was worked out for the three clones. The predictivity of the localizing functions was evaluated using simulated calibration. The calibration was done by excluding one location each time from the estimation data set and generating predicted values for the excluded set and repeating the process for each location. A set of five randomly selected trees was used for localizing the function for any location. The whole exercise was repeated thirty times, each time using a fresh set of randomly selected trees for calibration. The average R^2 (prediction) was computed using the deviations of observed values from the predicted values. Except for a few cases, the value of R^2 (prediction) was above 0.8 for the cases considered.

Yield prediction models at stand level based on age were worked out for four clones viz., GT 1, PB 235, RRII 105 and RRIM 600. The data were obtained from temporary sample plots laid out in plantations in different locations. The data consisted of girth at breast height on trees in plots of size varying around 20mx20m. The plots were aligned on a transect running through the center of the plantations with a random start for the first plot in any transect. The functions contained volume per ha as the dependant variable and inverse of age as predictor. The R^2 values were reasonable and the functions are recommendable for predicting stand yield directly based on the predictor mentioned.

Other than illustrating the use of random parameter models for localizing volume prediction equations, the study has generated information useful for predicting commercial

volume of rubber wood both at tree and stand level and also volume and yield tables for many clones grown mainly in the state of Kerala. Both the methodology and the output are new for the species.

Development of conservation strategies for selected endangered rattan species of the Western Ghats. *KFRI Research Report No. 295* (Renuka, C. and Rugmini, P., 2007)

Rattan resources in Kerala are getting reduced drastically and hence, there is an urgent need for evolving conservation and management strategies for this valuable resource. Knowledge of the performance of the existing population is essential for this. A demographic study of the population changes across the different life stages will help to understand exactly at what stage the population is affected adversely and the reason for the decreasing population.

Calamus brandisii, habit and fruits

Two endangered rattan species of the Western Ghats, *Calamus travancoricus* and *C. brandisii* were selected for the study. *C. travancoricus,* even though distributed throughout the Western Ghats at 200-500m above msl, populations of considerable size are seen towards the southern parts of the Western Ghats. *C. brandisii* is restricted to the southern part of the Western Ghats at 1000-1500m above msl. For both species the population size is very small ranging from 1 to 100 plants in a locality.

The finite rate of population increase l is an estimator of the population growth rate. When l equals 1, the population size is constant; when it is greater than 1, the population is increasing and when it is less than 1, the population is decreasing. The studies showed

that there was an annual decrease of 9 per cent in the population of *C. travancoricus* at Arienkavu and 61 per cent in the population of *C. brandisii* at Agasthyamala.

In *C. brandisii* the annual recruitment was found decreasing. At the same time there was not much decrease in the annual death rate. The number of flowering plants in the population was very low which affected the seed production. The adult survival rate also

Calamus travancoricus habit and fruits

was low. This, along with long adult stage duration, is detrimental to the population with low annual reproductive success. All these resulted in a decreasing population. Sensitivity and elasticity analyses revealed that juveniles and sub adults in *C. travancoricus* and sub adult stage in *C. brandisii* are very important from conservation point of view.

The calculated stable life stage distribution of the two species shows that in a climax population, a greater proportion will be constituted by the juveniles. But the observed life stage distribution does not match with this indicating that the population structure is changing rapidly and has not reached its climax stage. The finite rate of population increase (l) is 1.06 in the case of *C. travancoricus* in Achencoil, which shows that this population, as a whole, is in demographic equilibrium even though some stages of the life cycle are increasing and some decreasing.

The life stage duration of adults is longer in both cases. Hence, extraction of only the longest cane would minimize the effect of harvesting on population. In the juvenile stage, competition from other undergrowth species, herbivore and human interferences are probably the important causes of death. A reduction of these factors would also cause increased growth rate of juveniles.

In both species the number of fruits produced is lesser when compared to other species of the Western Ghats. In *C. brandisii* natural regeneration seems very poor and only 4.6 per cent of the population belongs to seedlings. Hence, mature fruits should be collected, germinated and transplanted in the forest areas.

Both species are good quality rattans and are extracted in large quantities for furniture and handicraft industries. In Kerala large populations of *C. brandisii* are seen only at Agasthyamalai region. This area is important from the ecotourism point of view, and hence, special care should be taken for the protection of this species. For this species, all the life stages of the population need protection during conservation efforts, while in the case of *C. travancoricus,* juveniles and sub adults need more protection.

The present study has clearly shown that population dynamics and population structure vary across the range of habitats available. This implies that the conservation strategy developed for one location need not be effective for another location. Hence, for problematic species, population modeling and appropriate conservation strategies for different locations would be needed.

Phytochemical characterization and evaluation of the medicinal plant moovila for resource enhancement. *KFRI Research Report No. 296* (Sasidharan, N., 2007)

Pseudarthria viscida is the preferred source of the raw drug, 'salaparni' in the Ayurvedic system of medicine. The plant is known as *Moovila* in Malayalam and is one among the 'Dasamoola' of Ayurveda. Due to scarcity, some other trifoliate leguminous plants, particularly the species of *Desmodium* and *Uraria* are used as substitutes. *P. viscida* and its widely substituted species viz., *Desmodium pulchellum* and *Uraria rufescens* were subjected to phytochemical as well as biological property analysis to find out their similarity. The

P. viscida habit (L) and the plant in flower (R)

polyphenolic, flavonoid, terpenoid and alkaloid compounds isolated from these plants were separated on TLC with various solvent systems. Profiles obtained for polyphenolic compounds showed more or less similar patterns in all the samples used. For flavonoids and terpenoids similar patterns were observed in the samples of *P. viscida* and *U. rufescens*. But different profiles were obtained for *D. pulchellum*. Among the plants studied, only the root of *D. pulchellum* showed the presence of alkaloid. For the biological property analysis the antioxidant hydroxyl, nitric oxide, superoxide and lipid peroxide radical *in vitro* assay systems were performed. Among the plants used, *P. viscida* alone showed significant anti-oxidant properties. Fifty per cent inhibition of hydroxyl radical was found at the concentration of 5.75 and 7.61 μg/ml with methanol and acetone fractions respectively. Nitric oxide generated from sodium nitroprusside was found inhibited by *P. viscida* extracts. Concentrations needed for 50% inhibition of nitric oxide were 33.34 and 3.48 μg/ml for methanol and acetone fractions respectively. The extracts were also found to inhibit lipid peroxides generated by induction of Fe^{2+}/ascorbate and Fe^{3+}/ADD/ascorbate in rat liver homogenate. Fifty per cent inhibition of lipid peroxidation was observed with 35 and 8.19 μg/ml of methanol and acetone fractions respectively. The results of above assay systems show significant free radical scavenging property of *P. viscida*. Mice treated with acetone extract of *P. viscida* showed significant protection against ethanol induced gastric damage. The acetone extract was found cytotoxic to various transformed cells in *in vitro* assay systems. Among the various concentrations used, 50% cell death was obtained in the concentration of 40 μg/ml. The extract was also found to reduce the tumour volume in solid tumour bearing animals in dose-dependent manner. Thus, the study reveals that *P. viscida* extracts show only significant free radical scavenging and other biological activities.

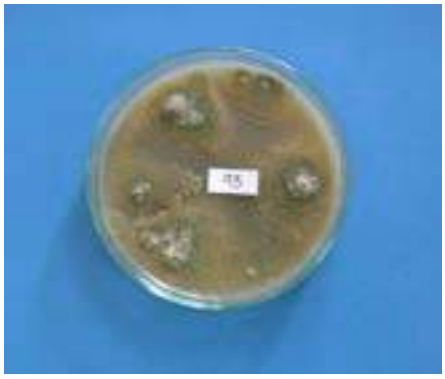
Microbial pathogens associated with forest insects in the Kerala part of Western Ghats with respect to host-parasite relationship and *ex-situ* conservation. *KFRI Research Report No. 297* (Varma, R.V., Sudheendrakumar, V.V. and Sankaran, K.V., 2007)

The objectives of the project were to generate basic data on the microbes associated with forest insects in the Kerala part of the Western Ghats and to test the potential of some of these microbes as biocontrol agents. The study also envisaged *ex-situ* conservation of the microbes and to share them with other scientific institutions for further studies and practical use.

During the survey in the moist deciduous forests and teak plantations in the Western Ghats over a period of 3 years, 750 dead insect specimens infected with microbes were collected. Of the microbes, over 70 per cent belonged to fungi, indicating the dominance of the group. Out of these, over 30 species were identified and for the rest, identification up to species level is pending. The available data indicate presence of new species of fungi under the genera, *Akanthomyces* and *Paraisaria*. Some fungi are apparently new records for the Country.

In general, death of insects due to microbial infection was more during the wet period of the year. Death of insects due to microbial pathogens was more in the moist deciduous forests as compared to teak plantations . Insect death due to bacterial infection was considerably low and epizootics due to bacteria were not observed during the study period. Insect death due to nucleopolyhedrovirus infection (HpNPV) was observed in teak plantations on *Hyblea puera* and epizootics of HpNPV were observed mostly during the peak outbreak period in many teak plantations from South to North.

Beauveria bassiana



Aspergillus parasiticus

The laboratory evaluation of the some selected fungal pathogens like *Beauveria brongniartti*, *Paecilomyces fumosoroseus*, and *Meatrhizium anisopliae* against the teak defoliator, *Hyblea puera* revealed their potential as biocontrol agents.

The study has generated valuable information on the microbes surviving on insects in a variety of habitats in the forests. The microbial pathogens collected are stored and periodically subcultured and conserved under *ex-situ* condition. A checklist of the microbial pathogens of forest insects has also been prepared.

Modeling the growth of teak in relation to soil conditions in the Kerala part of Western Ghats. *KFRI Research Report No. 284a* (Rugmini, P., Balagopalan, M. and Jayaraman, K., 2007)

A study was conducted on modeling the growth of teak in relation to soil conditions from 52 permanent sample plots established in teak plantations in Kerala. The plots belonged to different age, site quality and stocking classes and were distributed in different parts of Kerala State. The plots were of size 50 m x 50 m, except a few, which were of size 40 m x 40 m and 20 m x 20 m. The plots were established during 2000-2001 and re-measured during 2004. Girth at breast-height (1.37 m above ground) was recorded on all the trees in the plots. Height was measured on a sub-sample of less than ten trees covering the range of diameters in each plot. Diameter increment was computed for all the 52

plots. From each of the 52 plots, soil samples were taken from pits at three depth layers *viz.*, 0-20, 20-40, 40-60 cm and leaf samples were also collected. The soils were subjected to analysis for determination of particle size separates, bulk density (BD), particle density (PD), water holding capacity (WHC), soil pH, organic carbon (OC), exchange bases (EB), exchange acidity (EA), cation exchange capacity (CEC), base saturation (BS), total N, available P, K, Na, Ca and Mg. Leaf samples were also analyzed for N, P, K, Ca and Mg contents.

The overall objective of this study was to evaluate alternative model structures useful for characterizing the interrelation between soil, foliar nutrient status and growth of plantation teak and select the most suitable model for the purpose. Two major modeling approaches *viz.*, empirical and process-based were tried to characterize the interrelation of tree growth *vs* soil properties and tree growth *vs* nutrient status of leaves observed in the sample plots. The relationship between the leaf and soil attributes was studied through canonical correlation analysis.

Under the empirical approach, it was observed that the relationship between tree growth and soil characteristics varied with the soil depth levels. In the 0-20 cm depth level, it was found that there was no significant relationship between soil properties and tree growth.

Teak trees marked for girth measurement

In the 20-40 and 40-60 cm depth levels, the tree growth was significantly influenced by soil pH (acidity). The results showed that with increase in soil pH in both depth levels, there was corresponding increase in the tree diameter growth. In the 20-40 cm depth level, in addition to soil pH, soil bulk density had significant influence on tree growth. It was found that, with the increase in soil bulk density, there was subsequent decrease in tree diameter growth. Almost 33 per cent of the variation in tree diameter growth was explained by the soil attributes *viz.*, soil bulk density and pH in the 20-40 cm depth level.

In all the depth levels, the models obtained through stepwise regression were all linear in nature and no quadratic terms were present. As such, the optimum levels of soil attributes, which maximize the tree growth, could not be determined through canonical analysis. This could be because of the shorter range of soil properties observed under natural conditions.

Under process-based approach, WHC in the 20-40 cm depth level turned out as the foremost soil variable significantly influencing tree growth. The adjusted R^2 for the diameter increment function was 0.55, a reasonable value to expect under uncontrolled conditions. However, this implies that a substantial part of the variation in growth happens on account of factors not included in the model. The results also indicated an almost linear decrease in diameter growth with increase in the soil WHC in 20-40 cm depth level, keeping other factors constant.

The overall result that comes out through the above two modeling approaches is that soil compaction (bulk density) and soil reaction (pH) have much to do with tree growth. Equally important is the soil depth level (20-40 cm), which exerts maximum influence on the growth of trees occupying the site.

In the process-based approach also, the optimum levels of soil attributes, which maximize the tree growth, could not be determined because of restricted range of soil properties in the data set. The process-based approach was preferable over empirical approach to study soil-tree growth relationship on account of its biological validity.

Study on the relation between leaf nutrient status and tree growth indicated that the growth is influenced by multifarious factors and nutrient composition of leaves alone cannot be considered as a good indicator in this regard.

The interrelationship between the leaf and soil attributes at different soil depth levels was studied separately through canonical correlation analysis. For all the depth levels, leaf Ca had a significant positive influence on soil Ca. For the second and third depth levels (20 - 40 cm and 40 - 60 cm) significant positive correlations were obtained for soil Mg and leaf Ca. In all the three depth levels, the canonical redundancy analysis showed that leaf nutrient status is greatly influenced by soil attributes. On the whole, canonical correlation analyses revealed the intercorrelations existing between leaf and soil characters.

Land-use change and its impact on selected biophysical and socio-economic aspects of Karuvannur river basin in Thrissur District of Kerala. *KFRI Research Report No. 298* (Muralidharan, P.K., Kallarackal, J., Balagopalan, M., Menon, A.R.R., Sasidharan, N., Rugmini, P., 2007)

Manali watershed of Karuvannur river basin, where a major part of the forest area of the basin is located, was selected for detailed study. The broad objective was to examine land-use change and its effects on eco-hydrology and socio-economic conditions of the

people in the study area. Specific attempts were made to study the nature, extent and socio-economic factors affecting land-use changes and forest degradation and its effects on sediment production and water discharge rates and on-site and off-site agricultural production. Assessment of surface run-off and stream flow from watersheds, economic value of water resource, surface water use pattern and pricing and use conflict over water resources among different sections in the society were also made. Further, it examined linkages between ecological and socio-economic systems of the upland and downstream areas of the watershed were examined in determining overall development.

Experiments conducted to assess sedimentation

The study indicated that there were land-use changes, particularly conversion of forest land in to agricultural land in the study area during the analysis period 1960-61 to 2004-05. For instance, during 1996-2004, the area under agriculture increased by 50 per cent, mostly through conversion of forests. Migration, encroachment, and expansion of agricultural activities were the major socio-economic drivers of land-use changes in the study area. Side by side, with conversion of forest land into agricultural fields, there was a change in cropping pattern in the study area; from subsistence agriculture to commercial crops. Variation in the relative price of crops was one of the major factors, which influenced the cropping pattern change. Although this change increased in the income of the farmers, it reduced food security, employment opportunity and water availability in the study area.

There existed more sustained stream flow in forested watershed as compared to agricultural watershed. The upland areas where plant diversity was more, was prone to seasonal fire in the past, indicating degradation. Sedimentation was low in forested watershed, while it was high in the upper part of downstream areas. Degradation of forests and frequent crop shifts in upland areas resulted in sedimentation in Peechi Dam (annually 0.9%). The study suggested the need for undertaking conservation and afforestation measures in the degraded forest areas for better availability of water.

Since water is a naturally existing and freely available commodity, most people do not attach any value to it. Therefore, total economic valuation of the Peechi wetland was attempted. Per hectare economic value of Peechi wetland was found to be Rs.146,039/. Willingness to pay for regular and steady supply of water from Peechi reservoir was also assessed. About 80 per cent of the people, who use drinking water from Peechi, were willing to pay more for timely and regular supply of water whereas 20 per cent agreed with the existing price.

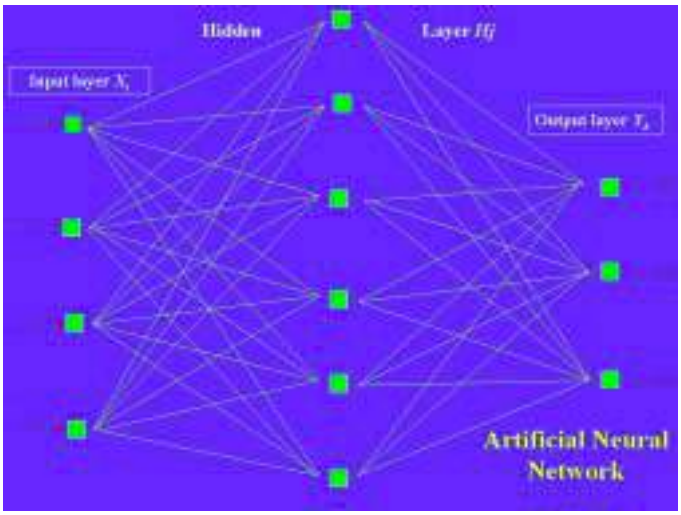
There was conflict over water resources from Peechi Dam among farmers, between farmers and users of drinking water and between urban dwellers and villagers. This was partly due to increase in demand and partly due to inefficient management. There existed a close interaction between upland and downstream areas of the watershed and also between watershed and market shed (demand, supply and price, among others). Further, bio-physical and socio-economic factors in upland and downstream areas were also interlinked. They may be taken into account while implementing any watershed projects. The study also suggested undertaking proper pricing of water from the Dam to generate more funds to meet the cost of supply and water resource development. Promotion of integrated watershed development programmes through effective participation of local people for preventing further ecological degradation in the study areas was also suggested.

Comparison of prediction models developed by statistical and neural network techniques in applied forest research. *KFRI Research Report No. 299* (Sivaram, M., 2007)

Neural Network or Artificial Neural Network (ANN) is a powerful data modeling tool that is able to capture and represent complex input/output relationships, whether it be linear or non-linear. The motivation for the development of neural network technology stemmed from the desire to develop an artificial system that could perform 'intelligent' tasks similar to those performed by the human brain. ANN acquires knowledge through learning and the knowledge is stored within inter-neuron connection strengths known as synaptic weights.

The most common ANN model is the Multilayer Perceptron (MLP). This type of ANN is known as a supervised network because it requires a desired output in order to learn. In MLP with one hidden layer, the inputs are fed into the input layer which get multiplied by interconnection weights (synaptic weights) as they are passed from the input layer to the hidden layer. Within the hidden layer, they get summed and then processed by a nonlinear function (usually the sigmoid/hyperbolic tangent). The processed data leaves the hidden layer and is finally processed again last time within the output layer to produce the neural network output. The MLP and many other ANNs learn using an algorithm called backpropagation. With backpropagation, the input data is repeatedly presented to the

neural network. With each presentation the output of the neural network is compared to the desired output and an error is computed. This error is then fed back to the neural network and used to adjust the weights such that the error decreases with each iteration and the neural model gets closer and closer to produce the desired output. This process is known as 'training'. The trained neural network is tested and validated for applications.



Typical architecture of Multi Layer Perceptron

In this study, the performance of ANN model was compared with traditional statistical models for certain datasets in forestry. The nature of statistical problems that could be considered for the investigation is of regression type (functional approximation) and time series prediction using Auto Regressive Integrated Moving Average (ARIMA) model. For regression problem, three data sets were used. First two data sets were related to the prediction of bark thickness using diameter measurements of two species *Lagerstroemia reginae* and *Acacia caesia*. The third dataset was related to the prediction of the ratio of germination percentage to the viability percentage at different days of germination of teak (*Tectona grandis*) seeds. With regard to time series prediction problem, the prices of teakwood in different girth classes were considered. The architecture of ANN used was MLP with one hidden layer for all the problems. The activation function used in the hidden neuron was sigmoid. The error minimization algorithm used was Levenberg-Marquardit algorithm. While the performance of ANN with regression was assessed by the root mean square error, the performance of ANN with ARIMA was assessed by mean absolute percentage error. The performance statistics suggest that ANN is comparable with that of regression and ARIMA models.

Estimation of moisture content in bamboo for deriving the weight and price conversion factors. *KFRI Research Report No. 300* (Krishnankutty, C.N., 2007)

Bamboo (*Bambusa bambos*) from the forests in Kerala is allotted by the State Government to the Hindustan Newsprint Limited, a public sector newsprint factory in the State, for harvesting. Selling price of bamboo, known as notified price, is fixed annually by the government per metric tonne of standing weight of bamboo in the forests. Weight of the utilizable portion of the standing green mature bamboo culms in the forests is referred to as the standing weight, whereas the weight of the harvested bamboo when weighed at the factory gate is known as the net weight. Conversion factors are required to determine the equivalent standing weight from the weight of harvested bamboo and to derive the selling price of bamboo at 50% moisture content from the notified price.

For deriving the weight and price conversion factors, an estimate of the average moisture content in bamboo in the forests was necessary. To estimate the average moisture content, 312 sample culms were felled from 52 bamboo coupes during the harvesting period from October to May through a sample survey in the forest bamboo coupes in Kerala. As soon as the sample culms were felled from the sub-sample of two bamboo clumps in each of the selected coupes, sample discs of 5 cm length were prepared by cutting at different height levels of each culm without any change in the moisture content in the standing condition of the culm and the disc. Immediately after cutting, green weight of each disc was measured at the felling site in an electronic balance. Altogether 858 discs from nodes and 1,157 discs from mid-internodes were prepared and the oven-dry weight of each disc was determined in the laboratory. Based on the green and oven-dry weights of the sample discs, the average moisture content in bamboo in the forests was developed through ratio estimator.

Using the estimated average moisture content of 45.23%, the weight and price conversion factors were derived. The weight conversion factors for various values of the moisture content in harvested bamboo are calculated and presented. For converting the net weight of harvested bamboo with known moisture content to the equivalent standing weight of bamboo as in the forests, the weight figure has to be multiplied with the respective weight conversion factor. The derived price conversion factor is 0.9129. The selling price in a financial year per metric tonne of bamboo at 50% moisture content can be found out by simply multiplying the notified price in the same year with the price conversion factor of 0.9129. The price payable by the factory to the Government for the net weight of harvested bamboo in a financial year can directly be arrived at by calculating its equivalent standing weight using the weight conversion factor and multiplying it with the notified price in the same year.

Transfer of some selected wood processing technologies to wood-using industries in Kerala. *KFRI Research Report No. 301*(Dhamodaran, T.K., Thulasidas, P.K., 2007)

Transfer of appropriate technologies for product diversification and value-addition is vital for the substance of wood-based industries in Kerala. Support from the Indian

Council of Forestry Research and Education (ICFRE) has resulted in an earlier project for transferring a package of technologies; solar kiln for economical drying of timber, plasticizing wood with ammonia gas for the manufacture of bent wood articles, liquor ammonia fumigation of wood for improved surface colour – by way of installing the facilities and equipments at KFRI, conducting Wood Technology Clinics at selected districts of the State where wood industries are concentrated and by conducting Open House Programmes for the benefit of the interested participants of the Technology Clinics and by publishing promotional literature. As a follow-up action of the above project, it was planned to conduct more Wood Technology Clinics to a wider audience. The installed facilities and equipments (solar kiln, ammonia plasticization equipment, ammonia fumigation chamber and wood treatment facilities) were maintained for demonstration to the participants of Open House programme or for interested general visitors.

Eleven Wood Technology Clinics were conducted at various districts of Kerala where wood industry is concentrated. The course curriculum was so designed to disseminate the details of the techniques among the wood industries, technologists, students, end-users/ consumers, entrepreneurs, and other interested public. Promotional literature (KFRI Information Bulletin) was prepared and circulated to the participants and other interested persons. The Wood Technology Clinics were organized with the help of the respective District Industries Centre and the audience comprised supervisory, managerial staff and workers of wood-based industries, engineers, technocrats, professional consultants, representatives of trade organizations, NGOs, end-users, students and other interested general public. The techniques were transferred through interactive lectures, demonstrations, slide shows, etc. Open House programme was also arranged for the benefit of the interested participants of the Technology Clinics, which further offered opportunity to the prospective entrepreneurs for familiarizing the installed facilities and equipments. Appropriate scientific/technical inputs were also provided to potential entrepreneurs in order to start new units.

The message of product diversification for better profit through the adoption of the available technologies for value-addition was popularized and the wood-based industries in the State as well as new entrepreneurs were benefited by this action research project supported by STEC of the Kerala Government.

Strengthening and enriching the palmetum. KFRI *Research Report No. 302* (Renuka, C. 2008)

KFRI Palmetum has 95 species under 47 genera. Of them 49 under 16 genera are indigenous palms and 46 under 33 genera are exotic ornamental species. Data sheet for the species contains description with identifying features, origin of the scientific name of the plant, common and local names, distribution, silvicultural characters, flowering condition

Dypsis lutescens

Bismarckia nobilis

in the Palmetum, uses of the palm if any, source of the plant and year of planting in the Palmetum and photographs. A layout map of the Palmetum along with the list of palms is also given.

Growth enhancement of *Dalbergia latifolia* through soil management techniques. *KFRI Research Report No. 303* (Sujatha, M.P., Thomas P. Thomas and Florence, E.J.M., 2008)

Considering the drastic depletion, slow growing nature and long gestation period of *Dalbergia latifolia,* a nitrogen fixing as well as high valued timber yielding forest species, this study was conducted during 2001-2004 with the view of increasing its growth through various soil management practices using different types of planting materials such as root suckers, seedlings and rooted cuttings. The study also aimed at finding out the association and variability of isolate of rhizobium and the clonal propagation in this species. Growth response to various treatments such as lime, vermi compost, cowdung, chemical fertilizer, rhizobium and combinations of organic manures with chemical fertilizer were studied by conducting pot trial at Field Research Centre of KFRI in Velupadam and field trial at Sub Centre of KFRI in Nilambur. Changes in soil properties due to the application of various treatments were also studied. Results indicated that organic

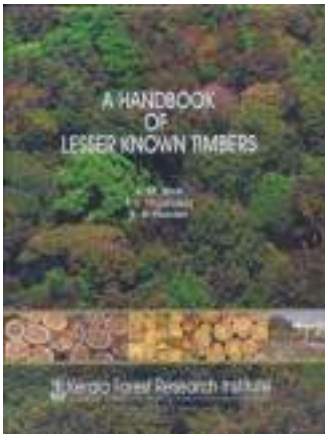
Plants raised from cuttings

manures such as cowdung (1kg/plant) or compost (1kg/plant) either alone or in combination with chemical fertiliser (½ kg cow dung or ½ kg compost + potash-15g + amophos-50g) were effective in achieving a substantial increase in the growth of *Dalbergia latifolia* coupled with improvement in soil quality. All the three types of planting materials used in the study responded very well to the above treatments and the maximum growth responses were observed in root suckers followed by seedlings and cuttings. The best strain of rhizobia was isolated from those collected from Nilambur and all the cultures were capable of forming nodulation on *Dalbergia* seedlings. But the application of these rhizobia had no significant impact on the growth of *Dalbergia latifolia*. In order to produce rooted cuttings from suckers, the best concentration of IBA was 5000 ppm.

Remarkable growth of seedlings

A handbook of lesser-known timbers. *KFRI Research Report No. 304* (Bhat, K.M., 2008)

A handbook was prepared on a total of 77 lesser known timbers including the imported species. This handbook will serve as a source of ready reference in the wood trade and user-sectors to get acquainted with the lesser known timbers of domestic market particularly in Kerala. The book gives the botanical identity and vernacular names, family and origin, physical features of wood including colour, weight, grain, texture and strength. Properties such as drying behaviour including shrinkage values, natural durability, working properties and typical uses of the timber. Colour illustrations of transverse and longitudinal faces of wood are provided. The handbook contains glossary of terms and index to possible substitute timbers of the species dealt with. The book is a handy reference book to wood users, timber traders and others concerned with timber industry. This will also be of use to organizations like State Forest Departments, Central Public Works Department, and various public-sector units/ Corporations, who commonly handle timbers.



This user-friendly handbook will point to right choice of timbers especially to substitute the well known commercial

Photographs of wood samples

timbers which are increasingly becoming scarce in the market. The market price of timber (as on year 2006) wherever available, and the substitutes for some of the well-known timbers are also highlighted for the benefit of end-users. Besides the hard copy, computer CD-ROM is also provided for the benefit of those who seek real images of wood figure (colour, grain, texture) and the contents can be browsed using Adobe Acrobat Reader in addition to navigation through suitability indices.

Completed Extension Projects

Requirement of important raw drugs for Ayurvedic medicines, estimation of planting materials, development of protocols for collection, grading and seed storage for cultivation of medicinal plants in Kerala. *KFRI Extension Report No. 25* (Sasidharan, N., 2007)

The annual consumption of the 50 selected medicinal raw drugs in Kerala is about 11,830 tonnes. Consumption of raw drugs is highest in the Thrissur and Malappuram districts as some of the larger units are located in these districts. The source of the raw drugs is mostly from the forests. Only six items are obtained from cultivated sources and seven items from sources out side Kerala. The requirements of the *Pachamarunnu* items are met through collection from the wild during the wet seasons. But there is scarcity for these items during the dry seasons. Considering the present requirement of raw drugs and the growth of the Ayurvedic Drug Industry, cultivation of the much-needed raw drug is essential. Though wide coverage on the proposed programme of distribution of the planting materials of medicinal plants was given in the leading Malayalam Dailies in Kerala, only farmers responded. However, their number is relatively few and also the requests for the planting materials. Many farmers are of the opinion that at present cultivation of many medicinal plants are not profitable when compared with the cash crops. A major problem faced by the farmers is in selling the medicinal plants, especially

when they cultivate a few items. The medicine manufacturing units prefer to buy the raw drugs through a contract system so that they will get the required quantity of raw drugs at the specified time. We received several enquiries regarding the cost of the planting materials and the marketing of the medicinal plants. We explained that the distribution of the planting materials would be on a no loss no profit basis produced by the Kerala Forest Department. Among the requests for planting materials, *kattarvazha (Aloe vera*) and *Chappangam* (*Caesalpinia sappan*) are the most demanded ones.

Bundles of medicinal roots stored for supply

Development of protocols for collection, grading and storage of medicinal plants is a time-consuming process as the seeds/root-shoot cuttings/rhizomes are available only at certain periods of the year and some of the species are not even cultivated in any part of the State. Details of seed biological aspects of most of the short listed plants have been assembled. The difficulty in obtaining live medicinal plants either from the homesteads or from the wild is yet another major impediment for data collection. Lack of standard procedures for obtaining the planting materials especially for species cultivated through root-shoot cuttings and rhizome is another hurdle for developing appropriate protocols. In addition, there is dearth of information on aspects like propagation and cultivation methods in the case of a large number of medicinal plants.

Hence the thrust of the project, due to the typical crop pattern of Kerala, should be to promote cultivation of selected medicinal plants not only in the farmlands but even in forest areas through mixed/miscellaneous species afforestation programmes, being taken up by the Forest Department. This way, constant depletion of these medicinal plants from the forest areas can be partially compensated. Species worth mentioning in this regard is *Coscinium fenestratum* from the list of species selected for the present study. This species is alarmingly diminishing from the natural forests of the State. Therefore, a concentrated effort for planting the species through the projects already mentioned, as well as through allied schemes of the Forest Department is actually the need of the hour.

Population estimation of wild elephants in the Elephant Reserves of Kerala. *KFRI Extension Report No. 27* (Sivaram M., Ramachandran K.K., Nair, P.V. and Jayson, E.A. 2007)

Population estimation of wild elephants was undertaken in all the four Elephant Reserves of Kerala State, using Block Count Method on 07-05-2007 and Line Transect Sampling of dung on 09-05-2007. The forest was divided into number of small blocks utilizing the maps of the Survey of India. A random sample of blocks was chosen in each Forest Division for the survey. In the Block Count Method, elephants were counted in the sample blocks and the elephant density was estimated (number of elephants per km^2). The total number of elephants was calculated by multiplying the elephant density with the actual extent of elephant habitat. The direct sighting of elephants further provided information on the population structure.

An elephant herd at Thekkady

In the estimation of elephant population based on the Line Transect Sampling of Dung, there were three components involved *viz*., dung density from Line Transect Sampling, dung decay rate from dung decay experiments and the defecation rate. The elephant density was obtained by multiplying decay rate with the ratio of dung density to defecation rate.

A total of 1679 elephants were sighted in the selected blocks. The estimated wild elephant population for the State by the Block Count method was 3002 elephants with 95 per cent confidence interval, ranging from 2543 to 3461. The highest elephant density (No./km^2) was found in Wayanad Elephant Reserve (0.5250), followed by Anamudi Elephant Reserve (0.4574), Periyar Elephant Reserve (0.3754)

A charging tusker

and Nilambur Elephant Reserve (0.0758). In terms of total number, Anamudi Elephant Reserve ranked first with 1289 elephants followed by Periyar (1136 elephants), Wayanad (490 elephants) and Nilambur Elephant Reserve (87 elephants).

The estimated elephant population in the State, based on the Dung Survey, was 6068 elephants with 95 per cent confidence interval, ranging from 4950 to 7481. This figure is considerably higher than the population estimated from the Block Count Method.

The estimated elephant population could not be directly compared with the past results due to differences in census methods, coverage and the methods of analysis. However, an attempt made on the analysis of trends in elephant density and dung density revealed that, in general, there is an increasing trend in the wild elephant population in the State.

Kerala State waterfowl census (Trichur and Palghat Districts). *KFRI Extension Report No. 28* (Sivaram, M., Jayson, E.A., Nameer P.O. and Namasivayam, L., 2008)

With the initiative of the Kerala State Biodiversity Board, Thiruvanathapuram the survey of wetland birds was done in January 2008. In this programme, the Kerala State Forest and Wildlife Department also cooperated along with the Kerala Forest Research Institute, College of Forestry, Vellanikkara and other prominent NGO's. The objective of this volunteer-participated survey was to conduct the enumeration of birds in all the wetlands in the State and also to carry out the surveys in a stipulated short period, so that double counting of birds will be avoided. The method of total count was employed for the bird survey. Binoculars and spotting scope were used to locate and identify the birds and performa developed by the KSBB was used for recording the data. Selection of the wetlands was carried out using the available maps. The surveyed areas mainly constituted the reservoirs and its surroundings, estuaries, apart from these local ponds and other water bodies were also taken into account. This report covers the data collected from the Central Kerala, namely the Trichur and Palghat Districts.

Wetland birds

Gulls and terns were present in all the areas near the seashore and their numbers were extremely high. Cormorants were also present in all the wetlands, similarly the herons and egrets were also common. Migratory ducks showed a reduction in number and the overall total of birds at Trichur District did not show much variation. Distinct trends were not available for Palghat District due to lack of earlier data.

ONGOING RESEARCH PROJECTS

Taxonomy of microlepidoptera (George Mathew 2000 April - 2008 March. Ministry of Environment and Forests, Govt. of India).

Taxonomy of bamboos (Muktesh Kumar, M.S. 2000 April - 2008 March. Ministry of Environment and Forests, Govt. of India)

Taxonomy of palms (Renuka, C. 2000 May - 2008 March. Ministry of Environment and Forests, Govt. of India)

Capacity building of tribal community in managing NWFP resources: Monitoring of empowerment and sustainability in Nilambur (Mammen Chundamannil, Anitha, V. 2003 April - 2007 September. Planning and Economic Affairs Dept., Govt. of Kerala)

Micropropagation of three selected species of bamboo (Muralidharan, E.M., Pandalai, R.C. 2003 April - 2008 May. KFRI Plan Grants)

Standardization of nursery and plantation techniques of mahogany with particular reference to soil, nutrition and shoot borer incidence (Thomas P. Thomas, Mohanadas, K., Rugmini, P. 2003 April - 2008 May. KFRI Plan Grants)

Demonstrating the effect of controlling the teak defoliator on volume increment in teak in the permanent plots established at Nilambur (Sajeev, T.V., Sudheendrakumar, V.V. 2003 April - 2009 March. KFRI Plan Grants)

Productivity and growth studies on sympodial bamboos and establishment of a monopodial bambusetum (Pandalai, R.C., Rugmini, P. 2003 April - 2009 March. KFRI Plan Grants)

Establishment of an arboretum of rare and characteristic species of the moist deciduous forests of Kerala (Nair, K.K.N., Yesodharan, K., Unni, K.K. 2003 April - 2009 March. KFRI Plan Grants)

Growth and yield studies in species trial plots established by KFRI (Chandrashekara, U.M., Nandakumar, U.N. 2003 April - 2009 March. KFRI Plan Grants)

Appropriate technology for production of charcoal and activated carbon from bamboo. (Dhamodaran, T.K., Thulasidas, P.K., Gnanaharan, R. 2003 April - 2008 March. KFRI Plan Grants)

Standardization of bamboo cultivation practices for homesteads of Kerala (Nandakumar, U.N., Thomas P. Thomas, Unni, K.K. 2003 April - 2008 May. KFRI Plan Grants)

Maintenance of provenance trial plots of eucalypts and acacia and development of new clones for establishment of Clonal Multiplication Area (CMA) (Maria Florence, E.J., Balasundaran, M. 2003 August - 2009 March. KFRI Plan Grants)

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

Establishment of ex-situ gardens of species of *Dalbergia* and monocotyledons in Bioresources Nature Trail in the Kerala part of Western Ghats

(Chandrashekara, U.M., Sasidharan, N. 2004 April - 2009 March. Planning and Economic Affairs Dept., Govt. of Kerala).

Improvement of teak through genetic evaluation (Indira, E.P. 2004 April - 2008 March. KFRI Plan Grants)

Growth of field-planted teak clones at Karulai (Surendran, T. 2004 April - 2008 March. KFRI Plan Grants)

Enriching of live collections of wild orchids and ferns of Kerala and preparation of an illustrated manual (Muktesh Kumar, M.S. 2004 April - 2008 March. KFRI Plan Grants)

Enrichment of insect and microbial culture collections at KFRIn(George Mathew, Mohanan, C. 2004 April - 2009 March. KFRI Plan Grants)

Habitat enrichment in the butterfly garden at KFRI campus, Peechi (George Mathew 2004 April - 2009 March. KFRI Plan Grants)

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

Strengthening and enriching the Palmetum (Renuka, C. 2004 April - 2009 March. KFRI Plan Grants)

Strengthening medicinal plants garden in the Peechi campus

(Sasidharan, N. 2004 April - 2009 March. KFRI Plan Grants)

Ecology and behaviour of arboreal mammals of Nelliampathy forests (Ramachandran, K.K. 2004 April - 2008 March. KFRI Plan Grants)

Participatory Forest Management and ecodevelopment alternatives: Initiatives and challenges in Kerala (Mammen Chundamannil, Hussain, K.H., Unnikrishnan, P.N. (KFD). 2004 April - 2007 March. KFRI Plan Grants**)**

Biotechnological approaches for improvement of plant species with special reference to pulp and paper (Bhat, K.M., Muralidharan, E.M., Pandalai, R.C., Thulasidas, P.K. 2004 September - 2008 March. CSIR-New Millennium Indian Technology Leadership Initiative (NMITLI) Project, Govt. of India)

Production of quality planting material for rare medicinal plants of commercial importance (Sasidharan, N., Muraleedharan, E.M., Chacko, K.C. 2004 November - 2007 October. National Medicinal Plants Board, Ministry of Health and Family Welfare, Govt. of India)

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

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

Ecology and behaviour of owls in the Western Ghats and developing a habitat model for their conservation (Jayson, E.A., Sivaram, M. 2005 February - 2008 January. Ministry of Environment and Forests, Govt. of India)

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

Regeneration study of selected terminalias in Kerala (Pillai, P.K.C., Chandrashekara, U.M. 2005 April - 2008 March. KFRI Plan Grants)

Genetic diversity and conservation of teak (Indira, E.P., Bhat, K.M. 2005 April - 2008 March. KFRI Plan Grants)

Recording of weather data at different centers of KFRI (Jose Kallarackal, Pillai, P.K.C. 2005 April - 2008 March. KFRI Plan Grants)

Establishment of a Clonal Multiplication Area for teak (Surendran, T. 2005 April - 2008 March. KFRI Plan Grants)

Improving sandal population in Marayur Sandal Reserve through assisted natural regeneration and planting improved seedlings and clones (Balasundaran, M., Dy. Conservator of Forests (KFD). 2005 April - 2008 March. KFRI Plan Grants)

Studies on the growth performance of the rattan species under plantations (Renuka, C. 2005 April - 2008 March. KFRI Plan Grants)

Documentation and conservation of small mammals of the sacred groves of Kerala State, Peninsular India (Padmanabhan, P. 2005 April - 2008 March. KFRI Plan Grants)

Identification of mammals based on hair structure, flesh, tissue and preparation of a manual (Ramachandran K.K., Jayson, E.A., Balasundaran, M. 2005 April - 2009 September. KFRI Plan Grants)

Enrichment of microbial culture collections at KFRI (Mohanan, C. 2005 April - 2009 March. KFRI Plan Grants)

Bamboo for affordable shelter: Demonstration of appropriate construction practices and construction of durable model Bamboo House (Dhamodaran, T.K., Gnanaharan, R. 2005 April - 2008 March. KFRI Plan Grants)

Developing an innovative industrial technology of shockwave-assisted protection of bamboo against fungi and insect borers (Dhamodaran, T.K., Gnanaharan, R., Maria Florence, E.J., Jagdeesh, E. (IISC, Bangalore). 2005 April - 2008 March. KFRI Plan Grants)

Qualitative and quantitative analysis of biologically active principles, Baicalein, Luteolin and Psoralen from *Oroxylum indicum, Premna integrifolia* and *Aegle marmelos* respectively and its allied species (Sasidharan, N. 2005 April - 2008 March. KFRI Plan Grants)

The conservation of mangroves in Kerala: Economic and ecological linkages (Muraleedharan, P.K., Anitha, V. 2005 April - 2008 March. KFRI Plan Grants)

Organising educational programmes at Teak Museum , KFRI Subcentre, Nilambur (Sani Lookose 2005 April - 2008 March. KFRI Plan Grants)

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

Establishment of a bamboo stand for conservation and sustainable utilization of Arayambu (*Pseudoxytenanthera bourdillonii* (Gamble) Naithani (Phase II) (Muktesh kumar, M.S., Seethalakshmi, K.K. 2005 August - 2007 July. Kerala Forest Department (Dev. Fund)

Multilocational field trials for selected bamboo species in Kerala (Raveendran, V.P., Unni, K.K., Seethalakshmi, K.K. 2005 August - 2007 July. National Mission on Bamboo Applications (NMBA)

Improving livelihood of bamboo artisans and bamboo farmers in ten clusters through technological interventions (Seethalakshmi, K.K., Sankar, S.,

Pandalai, R.C., Muralidharan, E.M., Dhamodaran, T.K. 2006 April - 2011 March. KFRI Plan Grants)

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

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

Strengthening and enriching Institute Central Nursery (Pandalai, R.C., Pillai, P.K.C. 2006 April - 2009 March. KFRI Plan Grants)

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

Establishment of a Bamboo Technical Support Group for South Zone under National Bamboo Mission at KFRI, Peechi (Seethalakshmi, K.K., Pandalai, R.C., Sankar, S., Mohanan, C., Muraleedharan, E.M., Muraleedharan, P.K., Krishnankutty, C.N., Anitha, V., Vijayakumaran Nair, P., Unni, K.K., Soman, C.K., Thulasidas P.K., and Mohammed Kunhi, K.V. 2007 September - 2008 March. National Bamboo Mission, Govt. of India)

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

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

Conservation and sustainable management of below-ground biodiversity in the Kerala part of Nilgiri Biosphere Reserve – Phase II (Chandrasekhara, U.M., Balasundaran, M., Sujatha M.P., Varma R.V. (KSBB). 2008 January - 2010 January. TSBF-SARNET, J. N. University, New Delhi)

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

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

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

RESEARCH HIGHLIGHTS

Biodiversity documentation/conservation

Biodiversity of macrofungi

A total of 1175 macrofungal specimens were collected from different forest ecosystems in the State. Of these, 15 were dung-inhabiting (coprophilous), 210 litter-dwelling, 320 wood-inhabiting (lignicolous) and the rest (630) were terrestrial. Of the 320 lignicolous members, 95% were from the rotting wood and the rest were from roots, stems or bark of living trees.

Entoloma bribadum

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

Amanita hembapha

The coprophilous genera were rather poorly represented by *Psilocybe, Agrocybe,* and *Coprinus*. The common Gasteromycetes

species collected were *Aseroe, Clathrus, Dictyophora, Scleroderma, Calvatia, Lycoperdon, Mutinus*. Macromycetes belonging to Ascomycete group included *Xylaria, Daldinia, Bulgaria,* and *Cookenia.*

Conservation and sustainable management of below-ground biodiversity in the Kerala Part of Nilgiri Biosphere Reserve-Phase I

A study was initiated in the Kerala part of Nilgiri Biosphere to a) analyse the nature and pattern of landuse changes, b) document the above-ground and below-ground biodiversity in different agricultural and agroforestry landuse systems, and c) identify strategies for sustainable management of soil fertility, below-ground biodiversity and overall productivity of different landuse systems. The study site covered landuse systems such as primary forests, secondary forests, managed plantations, agroforestry systems

Experiment on decomposition of litter

Preparation of vermi-compost

and annual crop-based systems. Over the last three decades, landuse pattern and land-cover under different landuses have changed tremendously. As also reported elsewhere in the State, a large area once under paddy cultivation has been transformed into perennial cropping systems.

The moist deciduous forest located away from the human habitation and near the human habitation were found similar in terms of species composition in above-ground vegetation. However, in the latter forest site, vegetation was sparse, soil was nutrient-poor and compact, and density and diversity of ants were comparatively more. Thus ants, particularly *Lobopelta* sp. and *Leptogenys* sp., could be considered as indicator species of forest disturbance.

It was also noticed that in a variety of landuse patterns in the study area, the endogenic earthworms *Parryodrilus lavelee and Pontoscolex corethrurus* were most abundant due to their

wide tolerance to landuse changes. Therefore, these species may be suitable for land restoration purpose. The study also revealed that the diversity of AM fungi in soils in cashew plantations and degraded forests was comparatively higher than that in other landuse systems. Thus it can be concluded that the plant dependency on mycorrhiza is apparently more in highly degraded sites.

During this study, it was also recorded that out of the 13 species of naturally growing legumes in the study area, *Desmodium triflorum* produced most profuse nodulation. Thus the wild legumes such as *Desmodium triflorum* could be a potential source of green cover crops. The study also revealed the fact that in majority of farms, low productivity and soil organic matter depletion are the serious problem. Thus, works are in progress to identify location-specific techniques of conservation and management of below-ground biodiversity with an aim to increase crop productivity.

Ex situ conservation

Enriching of live collections of wild orchids and ferns of Kerala and preparation of an illustrated manual

The Western Ghats region, which is one of the richest centers of pteridophytes and orchids, holds nearly 250 species of pteridophytes and 240 species of orchids in the Kerala region. They represent a broad spectrum of biological types. The fern house established at KFRI a few years back with a view of assembling a live collection of indigenous ferns and orchids has been one of the attractions to visitors and students. An effort has recently been made to enrich the collections in the KFRI fern house. To start with, pteridophytes/orchids that are potted and available in the fernery/orchid house at KFRI campus were used as primary specimens in the fernery. Gradually, specimens from different forest areas of Kerala as well as from other part of South India were collected and maintained. In the fern/orchid house, different species are maintained in their nearly natural habit (terrestrial, lithophytes and epiphytes) using appropriate techniques. Additional live plants with special reference to the epiphytic groups were added to the fern house collections. Hybrids of orchids such as, *Vanda* and *Oncidium* were also added to the

Eulophiacullenii endemic to Kerala and Tamil Nadu

orchid collection. Recently, a rare endangered species of, *Eulophia cullenii* was added to the collection. This species is rare and regional endemic to Kerala and Tamil Nadu. Over 110 species of orchids representing 40 genera have been added. Ferns presently available in the collection belong to different families such as Lycopodiaceae (7), Selaginellaceae (1), Psilotaceae (1), Ophioglossaceae (1), Vittariaceae (4), Davalliaceae (5), Oleandraceae (1), Hymenophyllaceae (8), Aspleniaceae (14), Lomariopsidaceae (2), Polypodiaceae (17) and Grammitidaceae (4).

Angiopteris evecta

Establishment of *ex-situ* gardens of species of *Dalbergia* and monocotyledons in a Bioresources Nature Trail in the Kerala part of the Western Ghats

This project is aimed to establish, a live collection of species of *Dalbergia* and monocotyledons with particular reference to palms, rattans, bamboos and other species which have conservation and academic importance along a Bioresources Nature Trail. The Project is designed to promote nature education and ecotourism.

In the KFRI Sub centre campus at Nilambur, about 1.5 ha area was selected. The weeds were cleared and the area landscaped for establishing thematic gardens. During the reporting period pipelines and sprinklers were fixed to facilitate irrigation. Propagules of 10 species of rattans and 27 species of palms were collected from

Palmetum in KFRI Subcentre, Nilambur

Livistonia rotundifolia

different sources and planted. To establish a *Dalbergia* garden, propagules of 10 species of *Dalbergia* have been collected which are being multiplied in the KFRI Sub Centre nursery for subsequent introduction in the garden. The palm and rattan gardens have been opened for the public and student community to demonstrate the features and diversity of palms.

Establishment of an arboretum of rare and characteristic species of the moist deciduous forests of Kerala

The Institute arboretum extending over an area of 5 ha in the Peechi campus has sample plots of 25x 25 m with all the existing trees identified, labeled and marked in the grids. The gaps are being planted with typical species of moist deciduous forests, that are absent in and around the site and a few rare and endangered species. The arboretum also houses representatives of evergreen, semi-evergreen, dry-deciduous and swamp species. At present

Views of the Arboretum

the total holding of the arboretum is around 3569 accessions of 170 species belonging to 122 genera and 46 families. All the surviving/existing trees are provided with permanent boards containing details like species and family names, local names, source locality, date of planting and accession numbers. A computerized database of the arboretum is being developed with details of existing and planted species available and their exact location details.

In-situ Conservation

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

Mapping of Dali swamps, Munnam chal, Chithira kala pacha, Chuvannakarikkam, Poovanthu mood stream and Nerrattuthadam swamps was undertaken . More than 100

Semecarpus kathalekanensis seedlings

seeds/wildlings each of four swamp species were raised and were kept ready for replanting. Seedlings of *Semecarpus kathalekanensis* were planted in a 10 x 10 block configuration in October 2006. By 2008 March, 85% of the plants survived. Gathering growth details of the restoration species and associates was continued.

Species recovery of *Dipterocarpus bourdilloni* and *Humboldtia bourdilloni,* two critically endangered endemic trees of Western Ghats

Distribution of *D. bourdillonii* is limited to south of Coorg in the Western Ghats. The species is not riparian; it occupies areas between streamlets, prefers medium-high slopes and rocky terrain. The species is found to occur in small discrete patches with an estimated total population of around 200 trees and 100 seedlings in Kerala.

The patch size ranges from 0.8-1.0 ha. Density of trees (>= 30 cm gbh) ranges from 32 to 447/ha. Though it flowers profusely, very low percentage of viable seeds are seen. Germination trials gave but only one seedling.

Natural habitat of *D. bourdillonii*

A large proportion of flowers were seen damaged by insects feeding on flowers, pollen and seeds. Moreover fungal attack by *Phomopsis* and *Fusarium* led to browning and abscission of flowers and fruits. Fungicides and insecticides were sprayed on selected branches to protect and thereby helping the seeds to develop. Artificial selfing, crossing and apomixis were tried. Role of insects as pollinators was also looked into.

Seedlings of *D. bourdillonii*

The population of *Humboltia bourdillonii* consisted of about 1,100 trees. The species was represented fairly in all the size classes; seedlings, saplings, poles and mature trees The largest tree measured 209 cm (gbh). Flowering occurred regularly between January and March and fruits matured by May. The fruits failed to germinate as they contained only dead embryos. Artificial pollination experiments conducted in the species showed that *Humboldtia bourdilloni* is completely cross-pollinating species with total self incompatibility. Altogether 77% of the fruits were found damaged by insects and animals.

Shoot tips and embryos of *H. bourdillonii* were cultured with media having varied hormone compositions. Zygotic embryos showed callus development. A few samples showed tissue differentiation. In *D. bourdillonii* embryo culture showed slight callus development.

Bamboo

Establishment of a pilot scale bamboo stand for edible bamboo shoot production in Kerala

The project was initiated in the middle of January 1997. From the known 18 species of bamboos that could be used for edible shoot production 6 species were tried in the experimental plots. Plots of 0.5 ha (80 x 65 m) each were established at FRC Palappilly and at KFRI Subcentre, Nilambur. Six species of bamboos namely, *Bambusa bambos* (L.) Voss, *B. tulda* Roxb., *Dendrocalamus brandisii* (Munro) Kurz , *D. hamiltonii* Nees and Arn. ex Munro, *D. longispathus* Kurz and *D. strictus* (Roxb.) Nees were planted in these permanent plots established at FRC, Palappilly and KFRI Subcentre, Nilambur.

Preliminary studies were conducted on edible bamboos on six species. It was observed that the shoot production season in Kerala was from June-September. Three to six shoots were produced from a clump during this period. Shoots were also produced during November-December during North-east monsoon period. However, if regularly watered, new shoots developed at specific intervals. The shoots could be harvested in 7-14 days

days after the emergence when they attained a height of about 15-30 cm depending upon the species. It was estimated that freshly harvested young shoots of *B. bambos* weighing 5 kg could yield 1.5-2.5 kg edible bamboo. Bamboos attained harvestable maturity in less than five years. The average production of shoots in *B. bambos* was 23 nos. per annum with an approximate weight of 32-50 kg. In *D. hamiltonii* the average culm production was recorded as 53 nos. weighing approximately 20-40 kg.

Establishment of a bamboo stand for conservation and sustainable utilization of arayambu (*Pseudxytenanthera bourdillonii* (Gamble) Naithani)

Recently it has been estimated that only about 64 clumps of arayambu (*Pseudxytenanthera bourdillonii*) are naturally distributed which are spread over Malappuram, Thrissur, Palakkad and Idukki districts in Kerala State. Observation of the arayambu populations in their natural stands showed no flowering or fruit production. Hence, conventional vegetative propagation methods like offset planting and rooting of culm and branch cuttings were attempted.

P. bourdillonii - clump

An area of 0.5 ha was selected near the Forest Station, Kaikatty, Nelliampathy Range, Nemmara Forest Division for the establishment of nursery in the field. Weeding, soil working and growth measurements and other silvicultural operations are in progress.

P. bourdillonii - Habit

Experimental plots have been selected in Nelliampathy and Sholayar. So far 200 culm cuttings and 250 branch cuttings of *P.bourdillonii* have been planted in the nursery bed.

Nine populations were identified from Meenmutty (Nilambur), Odalappara (Nilambur), Mukkali (Nelliampathy), Vazhakundu (Kollengode Range), Victoria (Nelliampathy), Sholayar, Kuttikanam, Periyar (Idukki). So far, 445 two-noded cuttings were planted. The survival rate was found to be very low. The plant does not show favourable response to either

IBA or NAA. It has been observed that if the rhizomes are planted they can be propagated. The suitable period for rhizome planting is April-May, just before the rains begin.

In the present investigation it was found that out of the three methods used, offset planting was successful. Rooting of culm cuttings showed limited success. Although there was an indication that with IBA treatments during February-May rooting is possible, the success rate of 10-15 per cent was not promising.

P. bourdillonii has good potential as a commercial species. The erect culms with medium thick wall, diffuse clump forming nature, branching only from top parts and its typical characteristics make it suitable for commercial plantations. The culms are ideal for stick industries as seen from tests conducted by toothpick industries in Kerala. The shoots are edible and highly favoured by the tribals due to its taste. The present population is restricted to a few clumps in restricted localities. Limited observations have shown that offset planting is successful. Success rate, although very low in current experiments, indicates the possibility of rooting of culm cuttings.

With regard to conservation and commercial exploitation, *P. bourdillonii* requires special attention. The natural habitat where the species is distributed needs to be protected as far as possible from biotic factors. For *ex situ* conservation, plots need to be established in other agro-climatic regions similar to its natural distri-bution. Agro-silvi practices can be developed for this species and domestication can be attempted. A cost-effective propagation method including micropropagation techni-ques needs to be developed. In the context of forthcoming plans for integrated development for the bamboo sector in India, this species can be regarded as a promising one.

A preliminary study for conservation and sustainable utilization of arayambu (*Pseudoxytenanthera ritchiei* (Munro) Blatt. & Mc.Cann) and koorankolly (*Dendrocalamus strictus* (Roxb.) Nees)

Among the bamboos that are closely linked to the economy of the rural people, erankol (*Pseudoxytenanthera ritchiei* (Munro) Blatt. & McCann) and koorankolly (*Dendrocalamus strictus* (Roxb.) Nees are the best examples. Erankol is a rare and endemic bamboo of Western Ghats. This species has been exploited for the manufacture of umbrella handles, walking sticks, lathi, furniture, etc. It is also used as a support for betel plants in northern Kerala. Due to the potential uses, the culms of this species are extracted by the local people in large quantities, which has led to depletion of the natural stock. It is distributed in northern Kerala and Karnataka and is also reported from Maharastra. This bamboo forms a component of moist deciduous

forests and also occurs as pure patches. In Kerala *O. ritchiei* is distributed in Palakkad, Malappuram, Kozhikode and Kannur districts. Koorankolly (*D. strictus* (*Roxb.*) Nees) is another species with limited distribution in forests of Kerala. It is being used for

Oxytenanthera ritchiei Natural habitat, Nilambur

props, agricultural implements and handi-crafts. This species is distributed in semi-dry and dry zones along the plains of Attappady, Nelliampathy, Chinnar Wildlife Sanctuary and Nilambur and is in high demand. It is being extracted from Nilambur without any consideration for sustainability of the resource.

It has been noted that both of the species are found in well-drained hill slopes at altitude of 250-850 m. The extraction of erankol is periodical in Mannarkkad and it is annual and regular in Nilambur Range. Due to its high utilization potential, erankol is cultivated in some of the homesteads of Mannarkkad, Nilambur and adjoining areas. Kooranckolly is cultivated in large scale by the Kerala Forest Department under various schemes.

Oxytenanthera ritchiei Natural regeneration

Long term observations on the growth of *P. ritchiei* have shown that an average of 20 to 30 new shoots are produced every year. Mean length of the new shoots varies from 4 to 4.5 m in five years. Mean girth varies from 5 to 8 cm. The culms achieve a maximum height of 5 m. *D. strictus* achieves a maximum of 24m height. Average height of the new shoots varies from 8 to 18 m in six years. A mean number of 17 new shoots are produced each year. A maximum of 26 culms per year was recorded. Mean girth of the culm ranges from 11 to 14 cm.

Taxonomy of bamboos (component of an All India Co-ordinated Project on Taxonomy, Capacity Building on Bamboos and Grasses [AICOPTAX])

Taxonomically, bamboos are highly problematic for taxonomy, field studies and collection owing to the non-availability of flowers and fruits, since most bamboo species flower

only at irregular intervals and often die soon after. Due to the vast morphological variations found within species and between closely related species, the generic and specific delimitations are not clearly defined.

Within South India, Kerala is perhaps the richest habitat of natural bamboo species. Evergreen forests of Western Ghats are the largest natural home for reed bamboos. Based on the extensive survey and field observations throughout Kerala, the Investigator has collected the specimens and constructed an artificial key for the identification of bamboos of Kerala both at generic and specific levels mainly depending on fresh specimens. Both the floral and vegetative characters have been used for the preparation of the key.

Dinochloa andamanica

As an outcome of the study, one species was added to the genus *Dendrocalamus* as a new combination *Dendrocalamus stocksii* (Munro) Kumar *et al.,* formerly treated under *Oxytenanthera-Pseudoxytenanthera* complex. The lectotypification of *D. stocksii, D. colletianus, D. callostachyus, D. longispathus* and the neotypication of *D. strictus*, the type species of the genus have been carried out.Two species of *Dendrocalamus* namely, *D. sahinii, D. somedevai* have been considered as conspecific and synonymised under *D. hamiltonii*. Another species *D. sericeus* was found to be conspecific with *D. strictus*. The genus *Pseudoxytenanthera* was merged under *Oxytenanthera* and the genus *Oxytenanthera* was retained with two species, *O. bourdillonii* and *O. monodelpha*. The lectotypification of *O. bourdillonii* has been carried out. The generic status of *Schizostachyum* was critically examined and three new species have been described from Andaman Islands. The species *Schizostachyum rogersii* was relocated and collected after a gap of 98 years from the type locality and the lectotypification of the species is carried out.

Gigantochloa andamanica

The position of Indian Arundinoid bamboos is still not clear owing to the complexity of the group and unless further studies are conducted, the exact position of Indian genera under this group will not be understood.

Establishment of a Bamboo Technical Support Group (BTSG) for South Zone at KFRI, Peechi under the National Bamboo Mission

National Bamboo Mission established under Ministry of Agriculture and Co-operation approved Kerala Forest Research Institute, Peechi for hosting the Bamboo Technical Support Group (BTSG) for the South Zone covering six states viz., Kerala, Karnataka, Tamil Nadu, Andhra Pradesh, Goa and Maharashtra in September 2007. The objectives of BTSG have been: 1. To give technical support to National Bamboo Cell in implementation and monitoring of all programmes under National Bamboo Mission, 2.

Bamboo Technical Support Group Meeting and lecture sessions

To provide training to the farmers on suitable species and technology for cultivation of bamboo, 3. To conduct training programme for capacity building of stakeholders such as field functionaries involved in development of bamboo sector in six southern states, 4. To compile materials and produce field manuals in English and regional languages of six southern states, 5. To undertake publicity campaigns to promote the objectives of National Bamboo Mission and the potential of bamboo, and 6. To organize an interaction workshop for preparation of an action-plan for development of the bamboo sector in six southern states. A team of 15 experts from KFRI has taken up the responsibility of setting up BTSG.

A meeting of the officials of National Bamboo Mission was held on August 4, 2007. The meeting was chaired by Mr. S. M. Desalphine IAS, Additional Secretary to Govt. of India, Ministry of Agriculture, Krishi Bhavan, New Delhi. Dr. M. L. Choudhary, Horticulture Commissioner and Mission Director, gave a general briefing about the NBM and emphasized about the opportunities that are provided for the development of bamboo sector in the states.

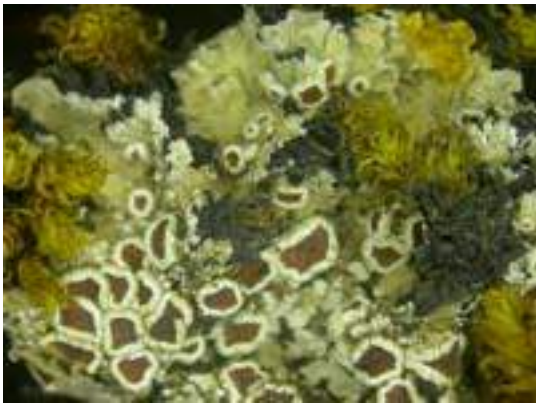
Three training programmes (November 26 - December 1, 2007; December 10 - 15, 2007 and February 4-9, 2008) were organized for field functionaries. A total of 52 participants form six southern states attended the programme. An interaction workshop

on Bamboo Resource Development and Utilization in Southern India was organized during February 26-28, 2008 at KFRI, Peechi. Projects from five southern states were discussed in the meeting.

Preparation of illustrated keys on the macrolichens of Kerala

Illustrated field identification key for 130 macrolichens is being prepared. More than 1000 microphotographs of various morphotaxonomic characters were taken. The keys are prepared with emphasis on morphological characters over chemical and spore

Cladonia cartilaginea



Pannaria rubiginosa

characters. Very few technical terms are used unless otherwise necessary. Equal weightage is given for phylogenetic relatedness and morphological similarity.

Species descriptions of 96 macrolichens have been completed. Checklist of medicinal lichens is compiled.

Palms / Rattans

Studies on growth performance of the rattan species under plantations

Plantations raised by the Forest Department during 1998 were selected. Plots were laid at Pattikkad, Kottiyoor, Kannavam and Thodupuzha Ranges. Only *C. thwaitesii* was planted in all these plots. Observations on growth characteristics like height, diameter, number of suckers, sucker height, number of new leaves, survival, etc. were recorded at half-yearly intervals.

At each site, the plots were divided into different groups based on the dendrograms drawn with various growth parameters. Thus, at Thodupuzha, there were 19 groups; at Kottiyur, 26 groups; at Kannavam, 13 groups; and at Kuthiran, 23 groups. Soil samples

Calamus thwaitesii showing appreciable growth under plantation

were collected (0-10 and 10-20 cm depths) from each group and these samples were analyzed for pH, organic carbon and extractable phosphorus.

Ecological Studies

Regeneration study of selected Terminalias in Kerala.

The project is envisaged to study regeneration of selected *Terminalia* species in Kerala. Reconnaissance survey and regeneration enumeration of *Terminalia crenulata, T. paniculata* and *T. travancorensis* was completed in the Northern, Olavakkod, Central, High range and

T. travancorensis

Southern Forest Circles of Kerala. Enumeration was carried out from 211 (46.55 ha.) temporary plots representing all the Forest Ranges. The density of mother trees was found to be 61 trees per ha for *T. paniculata,* 23 trees per ha for *T. crenulata* and 0.54 trees per ha for *T. travancorensis*. The regeneration was highest for *T. paniculata* (76 trees per ha), and lowest for *T. travancorensis* (0.002% trees per ha); *T. crenulata* was placed in between with 22 trees per ha. Seed germination percentage was, however, highest for *T. crenulata* (40%*)* followed by *T. travancorensis* (35%) but was extremely low (0.75%) for *T. paniculata.*

Ecological studies to conserve and rehabilitate the mangrove vegetation in the coastal landscapes of Kerala

This multidisciplinary study was undertaken to look at various aspects of conservation of mangrove vegetation including climate, plant, animal and microbial diversity, vegetation ecology, water and soil quality. Temperature, RH and rainfall have been monitored for one complete year. Three study sites were selected in Kannur District,

A view of mangrove vegetation in Kannur District

Kerala after an intensive survey of mangrove vegetation in the whole area. First site was at Madakkara which is 2 km away from the sea and the second site was at Thekkumbad which is 2.6 km away from the sea and the third one was at Dalil which was 3.00 km away from the sea.

At Dalil South, the stand was dominated by *Sonneratia alba*, *Avicennia marina* and *A. officinalis*. Other species found were *Bruguiera cylindrica, Aegiceras corniculatum* and *Excoecaria agallocha*. At Thekkumbad, the stand was dominated by *R. mucronata*. 51% of the IVI was contributed by this species. Other species were *Avicennia officinalis, Sonneratia alba, Kandela candal* and *Aegiceras*. Phenology was studied for five mangrove species. *R. mucronata* was found to bear fruits almost throughout the year. Fruiting in *S. alba* extended for over 8 months. In *A. officinalis* and *B. cylindrica* it extended for over 4 and 6 months respectively. A seedling release and re-capture experiment was conducted with *R. mucronata*. Seedlings were found

distributed as far as 1.5 km from the site of release. Four days after release, only 50% of the seedlings could be collected again. Strips of 2.5 m width were sampled for the study of regeneration in different stands. Two enumerations were done at a time gap of two years. There was not much of loss in regeneration in the two-year period.

One set of water samples was collected from the 6 locations. Soil samples were collected

A denuded mangrove area

from stands of different mangroves like *Rhizophora*, *Avicennia*, *Acanthus ilicifolius* and their associations. Thirty-three genera of fungi were recorded These included fungi causing foliage disease, stem canker, and dieback, lignicolous macrofungi and endophytic fungi. Six species of prawns, five species of crabs 6 species of molluscs and 48 species of fishes have been identified. Data on seasonal abundance of fishes was generated.

Jackal, grey mongoose and bats were sighted in the study area. Eighty-three species of birds belonging to 13 Orders and 31 Families were recorded from the study locations. One roosting site was located at Madakkara. Only 18 migratory species were sighted from the area. Highest species richness was seen in November during winter followed by October and December. Lowest was recorded during February and June. When feeding guild is analysed, highest number of birds were omnivorous (29) followed by insectivores (27) and others.

Forests and agricultural ecosystem analysis to assess ecosystem health and to identify rehabilitation strategies in the Kerala part of Nilgiri Biosphere Reserve

The Nilgiri Biosphere Reserve (NBR), the first Biosphere Reserve of India constituted under the Biosphere Reserve Programme is rich in biological diversity due to a wide range of biophysical and climatic conditions. However, like any other area in the tropics, the NBR is also facing the threat of forest degradation in the Buffer and Manipulation zones and thus natural resource depletion at a landscape level. Very often, agricultural practices adjacent to forests directly or indirectly affect the forest regeneration and stand

quality. In this context, a detailed study on ecological and economic features of crop cultivation systems has been initiated with an overall aim of identifying locations where rehabilitation is necessary, appropriate methods including the species that play a key role in the rehabilitation process.

The study of girth classes indicated that in Munnadi, Pannichal, Manaliampadam and Manikkunnumalai, disturbance was more in the interior part than in the border of the

Agricultural land use in the study area

forest. On the other hand, in Adackakundu, Appancappu, Paracklel and Patakarimbu, the degree of disturbance was more in the border areas than in interior regions of the forest. The forest plot at Kadassery was an example for the site showing heavy disturbance in the form pole cutting from slightly interior of the forest. Among different forest patches studied, the one at Pannichal was experiencing heavy anthropogenic disturbance. This may be due to the fact that the forest was surrounded by human habitation all around. Another feature noticed here was that only trees of higher girth classes were present and recruitment from seedling to sapling and sapling to mature stages was lacking. In Patakarimbu, adjacent to human habitation, trees belonging to higher girth class alone were present indicating poor regeneration and recruitment.

It was also noticed that different bioresources such as understorey vegetation, grass, bamboo, wood and litter were collected from the study plots by the neighbouring villagers. Green leaf obtained by pruning trees and the litter collected from the forest floor were the two major resources being flown into different cropping systems. These were used mainly for the monocropping systems like coconut, arecanut and rubber plantations. On the other hand, for mixed farming systems, including homegardens, the flow of these two resources was considerably less. Information collected on the landuse and land cover changes by PRA and elderly citizens' interviews indicated that both number and area under mono-cropping systems increased considerably. Thus it is possible to conclude that pressure on forests for these two resources is increasing considerably.

During the study, farmers' species preference for green leaf manure and leaf litter for mulching for different crops was recorded. Based on the information collected, species which were used as green leaf manure and mulching can be broadly categorized into those preferred for a) initial growth of crop plants, b) flowering and fruit setting, and c) retaining moisture around the crop plants. Such a preference for different species for different purposes could be due to the differences in nutrient contents and the rates of nutrient release after mulching by the above species. This traditional knowledge needs to be tested. Thus, the study was initiated to estimate the nutrient contents of leaf and leaf litter of the above species and also time required for the mulching materials to decompose.

During the reporting period, PRA meetings were conducted. In each such meeting, strategies that need to be adopted for the conservation and management of each forest were discussed and documented. Some of the strategies suggested by the participants include creation of a 200 m wide green belt, protection of such green belt, financial assistance to local Government and conservation education.

Ecosystem structure and dynamism, biodiversity, human dimensions and their linkages of Eringole Sacred Grove in the Western Ghats of India.

In a study conducted on Eringole sacred grove, qualitative data on the floral and faunal diversity were generated from the 50x50 m subplots demarcated for data collection. Survey for biodiversity richness of more than 2/3 of the area, coming under 26 full

Views of Eringole sacred grove

subplots, was completed. From the 50x50 m subplots, structural and population data of the floral components of the vegetation were generated for different life forms, namely trees, shrubs and herbs. The survey recorded of 175 angiosperms, 3 gymnosperms, 225 fungi and 284 faunal elements. Collection of qualitative data on the floral and faunal diversity from 52 plots of 50x50 m size (full and partial), demarcated for data collection

was almost completed. Data collection subplots on structural and population aspects of the floral components of the vegetation were almost completed.

Different stakeholders were identified and suitable proformas designed for collection of data on historic, religious, cultural and present management practices of the grove, including details on the inflow of visitors and other human interferences there. Collection of soil samples for analysis from the subplots was completed. Hygrothermographs were installed within and outside the grove and microclimatic data were gathered at weekly intervals for comparison.

DNA barcoding of *Dalbergia* species

Data on the distribution of the 12 *Dalbergia* species in the Western Ghats of Kerala and Tamil Nadu from BSI-SC Herbarium and literature to facilitate sample collection have

Dalbergia volubilis twig with flowers

Dalbergia horrida twig with flowers

been collected. Fifty-eight samples of six species were collected from different locations in Kerala and sent to NIPGR and NCL, Pune. Taxonomical studies and morphological characterization of the collected *Dalbergia* germplasm were undertaken. Sample preservation methods and processing of collected samples and DNA extraction were standardised.

Forest Management

Forestry sector analysis for the State of Kerala

A forest sector analysis was carried out in terms of changes in Net State Domestic Product of forest sector over time in relation to other sectors of the State. As this was found inadequate, a better framework was adopted which was the set of Criteria and Indicators for Sustainable Forest Management (SFM) formulated as part of Bhopal India Process. Using the relevant data at the State level, progress towards sustainability was assessed.

A survey of sawmilling units in the State was conducted and problems and prospects of the industry were examined. The potential of ecotourism in the State was evaluated by gathering data pertaining to the forest-based ecotourism centres.

A supply demand model for teakwood in Kerala was formulated and data required for estimating the model parameters were gathered.

A sawmill in Thrissur District

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

The Western Ghats area was divided into 6.25 km^2 grids and a subset was selected using appropriate sampling strategy. Satellite imagery was used for identifying vegetation types and its density status prior to sampling. Vegetation data from 5 m X 1000 m strips of the grids were gathered for structural and species distribution analysis. Out of 300 grids, 190

Vegeation study of the selected area

Bauhinea phoenicea - an endemic tree

grids covering Thrissur, Nemmara, Chalakkudy, Vazhachal, Malayattoor, Kothamangalam, Sholayar, Munnar, Kulathupuzha and Goodrical Forest Divisions, Chimmony and Peechi-Vazhani Wildlife Sanctuaries, Parambikulam WLS, PTR area, and Thattekad bird sanctuary in Central Kerala were completed. The major forest vegetation types covered are tropical wet-evergreen, semi-evergreen, moist deciduous, scrubs, grasslands and forest plantations. About 1750 Photographs were taken for flier preparation. The field data collection of the southern part of Kerala is now in progress.

Plantation Forestry

Standardization of nursery and plantation techniques of mahogany with particular reference to soil, nutrition and shoot borer incidence

Mahagany experimental plantation

Mahogany plantations are less attempted due to fear of shoot borer *(Hypsipyla robusta)* infestation, though the timber is highly remunerative. A field experiment is being continued with 2 levels of spacing (2x2m, 3x3m) and 4 different manures (cowdung, compost, sterameal, NPK) in split plot design with the hope of controlling or at least reducing shoot borer incidence at the field research centre of the institute. Observations till now indicate no escape from the pest due to the treatments, though 2x2m spacing has resulted in faster height growth and slight reduction in pest incidence in later stages. Slight reduction in pest incidence has occurred only after the plants reached 6-8m after 5 years of planting. Underplanting in young teak did not help in escaping the pest and both species of mahogany, namely *Swietennia macrophylla* and *S.mahogany* are seen to be equally susceptible to the pest, *H.robusta*.

Genetic diversity and conservation of teak

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

Branching habit of Teak

Explorations were carried out in natural teak populations in different states of India and 25 populations were selected for in depth studies. Thirty-one morphological characters related to tree height, GBH, tree form and leaves were measured or observed to study the phenotypic variations. The data collected were computerized. All the characters related to tree form were recorded as per the recommendations of international teak provenance trials .of DANIDA Forest Seed Center. After collecting seeds from 25 different geographic locations, nursery was raised to establish a germplasm bank so as to study the genetic variations.

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

The results of the studies show that the mean ring width (growth rate) decreases after the initial increase up to 30-40 years. There is an increase in heartwood percentage up to 30-40 years and then stabilized. Faster growth rate with mean ring width> 4.7mm and greater heartwood content > 90% was noted in trees grown in provenances of southern states such as Nilambur (Kerala), Asambu O:.N.) and Dandeli (Karnataka). Densest wood (692 kg/m3) was obtained from Banaswara (Rajasthan) and lightest wood (524 kg/m3) from Khariar (Orissa).

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

Teak is the most important plantation species of Kerala, covering more than 70,000 ha ofthe state's total plantation area. As part of tree improvement programmes for teak in Kerala, KFRI had selected 50 plus trees during 1980s from plantations of teak located in Waynad, Nilambur, Konni and Thenmala Forest Divisions. Of these, about 35 plus trees are now existing and they fall in the age group of> 50 years. Using the recently developed new technique for clonal multiplication, 30 plus trees were successfully cloned in KFRI and clonal gardens were raised using rooted ramets of these plus trees at Emangad (Nilambur), Kalkulam (Nilambur), Decent Mukku (Quilon), and at Chettikulam (Thrissur). Some of the clones have exhibited exceptionally good growth in height and girth during the initial months of field trial. A detailed multi-locational field study is very essential for assessing their superior qualities. This could be achieved only through production and field planting of sufficient

CMA established in KFRI, Peechi

number of rooted ramets of all the promising plus trees. **In** order to produce large number of rooted ramets of superior teak trees a Clonal Multiplication Area (CMA) is highly necessary to provide sufficient number of juvenile shoot materials for propagation. With this as background, a project on establishment of a Clonal Multiplication Area was under taken during 2005-2009.

About 750 rooted cuttings produced by cloning 10 selected superior teak plus trees using the cloning technique developed at KFRI, were utilized to establish the CMA. These cloned teak plants were planted in the nursery area of the Institute campus during the month of August, 2008. The spacing provided was IXlm between plants. All the clones were planted in a linear design in four different blocks. Each block is separated by sufficient space provided between them. When these plants grow and attain height of about I m they will be cut back and allowed to branch profusely, so that they develop into hedge plants. These hedge plants will be the source for fresh shoot material for future clonal propagation programme on a large scale. By raising clonal plantations of superior teak trees the yield, and quality of timber from our teak plantations could be substantially increased.

Improving sandal population in Marayur Sandal Reserve through assisted natural regeneration and planting improved seedlings

In reserve forests, sandal regeneration work by sowing seeds on mounds/pits of size 45 cm x 45 cm and protecting the group of seedlings from browsing wild animals and cattle using tree guards showed success. About 7500 seedlings of 2-to 3-year age survived in 10 ha experimental plot at Nachivayal Sandal Reserve in Marayur. Complete protection from browsing animals including wild animals is absolutely necessary for success in sandal regeneration work and survival of seedlings in reserve forests.

Seedlings protectedby tree guards in Marayur

Sandal seedlings require decreasing intensity of shade from seed germination stage to one-year growth, and thereafter, seedlings require good sunlight. In seed stands, identical genotypes oftrees growing in clusters observed using molecular markers indicating clonal origin of trees within clusters. The poor seed set may be due to lack of genetic diversity among trees of clonal origin with in a cluster.

Early selection and mass multiplication of *Eucalyptus* interspecific hybrid crosses

Microsatellite markers identified and protocols standardized for identifying natural hybrid seedlings of *E. tereticornis, E. urophylla, E. pellita, E. camaldulensis and E. grandis* and their pollen parents. Seedlings of *E. tereticornis, E. urophylla* and *E. pellita* raised in KFRI nursery for hybrid seedling identification. Test plots were raised in KFRI clonal nursery in Kodanad Range for testing performance of apparently hybrid seedlings which show faster growth and disease resistance.

Wildlife Management

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

A study was undertaken to examine the ecological and behavioural aspects of forest owls of Western Ghats. Short-eared owl *(Asio otus),* a migrant species is newly reported from the Peechi-Vazhani Wildlife Sanctuary. Oriental bay owl *(Phodilus badius)* is reported for the first time from Idukki Wildlife Sanctuary and Neyyar Wildlife Sanctuary. Brown hawk owl *(Ninox scutulata)* is recorded in 72 points. Southernmost distribution limit of brown hawk owl was identified in the southern Western Ghats. Maximum number of species were recorded from the Indira Gandhi Wildlife Sanctuary (7 Species). The complex habitat requirement of large owls both at habitat level and at landscape level was revealed in the study.

Oriental bay owl

Brown fish owl

Call playback of conspecific calls is recommended as an efficient census method to enhance the detection of brown hawk owl. Microhabitat utilization of barred jungle owlet revealed that the species is abundant at low altitudes (less than 500 above msl) and disturbed forest areas. Barred jungle owlet predominantly feed on insects, which are abundantly

available in the thick canopies of trees, which explains the preference of the species to areas with tal! trees and thick canopy.

Genetic diversity assessment of captive Asian elephant *(Elephas maxim us)* population at Guruvayur elephant camp using microsatellite DNA markers

DNA fingerprinting using microsatellite markers and genetic characterization of.43 captive Asian elephants *(Elephas maximus)* of Guruvayur temple has been carried out standardizing a non-invasive method of DNA extraction from dung samples using QIAamp DNA stool mini kit. Dung samples collected within six hours after defecation gave success in DNA extraction. Polymerase chain reaction was carried out using the microsatellite primers EMX 1, EMX 2 and EMX 3 reported by Fernando for Asian elephants of Sri Lanka.

A view of Guruvayur elephant camp

Five alleles were recorded for EMX 1 and EMX 2, while EMX 3 showed only two alleles. The geographic origins of only 28 animals were known. The 43 animals were grouped as populations of South India, Assam, Bihar and Andaman Islands origin, and animals of unknown origin. The genetic distance between the five populations ranged from 0.0044 to 0.3595. UPGMA dendrogram constructed using genetic distance coefficients showed that Bihar and Assam populations clustered into one group conforming to the geographic proximity of the two populations. The South Indian population clustered together with animal population of unknown origin. The Andaman population stood out as a separate group. The elephant population of Andamans was reported to be a mixture of mainland origin but later transported to the islands.

Participatory forestry

Depletion of Mangroves in Kerala: Economic - Ecological Linkages

Mangrove forests that once oc~upied about 700 km^2, have now dwindled to 17 km^2. As in many other parts of the world, the vegetation has diminished in its extent drastically and has acquired a 'threatened' status in Kerala. Most of the mangrove areas (89%) in Kerala are owned by private owners of whom some live within the system. In addition to owners, some people who live outside the system also depend on the mangroves for their livelihood (dependents). But the owners as well as dependents derive a number of direct benefits from the mangroves such as firewood, charcoal, fish and shellfish, tourism, etc. The mangroves in

the State are threatened with unprecedented destruction, which includes 'commercial exploitation of raw materials, land reclamation for agriculture, aquaculture and housing. It was found that there existed a close interlink between socio-economic system and ecological system of the mangroves in Kerala. Economic value of the mangrove ecosystem is worked to be Rs. 3 lakhs/ ha.

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

The project work of establishing bioshields along coastal areas started in January 2008 in collaboration with Social Forestry Wing, Thrissur, Kerala Forest Department. In order to

Nursery of casuarina (L) and bamboo seedlings planted

raise seedlings of of casuarina and bamboos, a mother nursery was established at Chendrappinni. Forty-two mother beds were raised in order to produce 1,40,000, 5000 and 15,000 good quality seedlings of casuarinas, mahogany and bamboos, respectively. The casuarina seeds were purchased from Kerala Forest Seed Centre, while seeds of mahogany were collected from forest areas. Casuarina seeds were sown in the 35 mother nursery beds whereas those of mahogany were sown in three beds. Germination started after three days and the percent germination of seeds was 40 for casuarinas and 60 for mahogany. The nursery beds were watered regularly and after 60 days, healthy seedlings from the mother nursery were transplanted into polythene bags of 12 cm x 18cm and 150-gauge size, filled with red soil, sand and cowdung. The transplanted seedlings were watered regularly.

In the case of bamboos, 1,000 two-noded'cuttings of *Bambusa vulgaris,* 75cm long were treated with hormone solution ofIBA (concentration 100 ppm) and the treated cuttings were laid under soil in the five nursery beds. Sprouting of new shoots started after six days. The nursery beds were watered regularly and after 60 days, the average height of sprouts was 45 cm.

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

The success of participatory management depends on active involvement of the stakeholders which is again decided upon by the income/benefits received by them from the activities. Thus, higher the benefits from the participatory activities, more is the involvement of the stakeholders in the conservation and management ofNTFPs. This project intends to develop an improved and effective participatory management system of stakeholders and demonstrate its impacts on conservation and sustainable management ofNTFPs in the study areas. The study is conducted in Begur area of Wayanad district. A number of meetings of the stakeholders were conducted to develop effective participatory management in the study area. An advanced training programme on bamboo handicraft was organised to enhance their income. A training

Training programme organized for the tribal participants of Wayanad

programme on honey collection was also organised. Data collection on economic and ecological aspects is progressing. A society of the tribes to undertake bamboo handicraft was formed as part of the project.

Forest Utilization

Biotechnological approaches for improvement of plant species with reference to pulp and paper

A total of 373 (including 136 collected by CIMAP) accessions of *Ochlandra* were collected from 20 major reed-growing areas of Kerala, Karnataka and Tamil Nadu. The passport data and descriptors prepared for *Ochlandra* along with the soil samples from 19 locations were sent to NBRI. Digital photos of 159 accessions from 12 locations were also sent to NBRI. Twenty-five tree samples of *Leucaena* were collected from Tamil Nadu and Kerala; wood samples were supplied to FRI and passport data to NBRI.

Low ligin seeds and germplasm established

Microtechnique procedure was standardised for anatomical study of reed bamboos. NIR protocols were developed for chemical characterisation of reed bamboos and validated by inter-lab testing. Benchmarks were defined for selection of lead plants of superior quality pulping raw material based on physical, chemical and anatomical (fibre) properties of373 samples of *Ochlandra*. Elite plants /populations of low lignin / high cellulose with low silica content, acceptable fibre length and physical properties were located from the natural habitats.

The raw drugs requirement of Ayurvedic medicine manufacturing industry in Kerala

Forests are the main source of medicinal plants, which are collected by tribes and local communities. A study was undertaken to assess the annual requirement of raw drugs for medicine manufacturing in different districts of Kerala. Annual consumption of 231 raw drugs by the Ayurvedic Medicine manufacturing industry in Kerala is about 17,899 tonnes. Consumption of raw drugs is highest in Thrissur, Malappuram and Palakkad districts as some of the large units are located in these districts. The sources of raw drugs are mostly from the wild (forests and non-forests), only very little quantity is obtained from cultivated source. Among the plant/parts used as raw drugs, roots and rhizomes constitute 45 per cent. Among these, roots of 5 tree species constitute 14 per cent of total consumption. Collection of roots of trees is mostly destructive and there is scarcity for the roots of tree species. A comparison of the consumption of 125 items in 2000 and in 2006 (present study) reveals that there is an overall increase of 19,42,915 kg. Among the 125 items compared, there is increase in the consumption of 101 items and decrease in the case of 24 items.

Gathering plant materials from the wild is costeffective than cultivation, which requires investment in land, fertilizers, herbicides and other inputs. However, current practice of harvesting medicinal

plants from the wild is unsustainable which would ultimately lead to the depletion of resource base as well as extinction of the species. Since the price paid for NWFPs is very low, the collectors are compelled to collect more, often without considering the future regeneration of the species.

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

As a part of the study, vegetative propagation of *Salacia oblonga* and *Merremia turpethum* was standardised. The juvenile (3- months old) stem cuttings of *S.oblonga* excised at the nodal region treated with 3000 ppm of IBA gave the maximum rooting percentage (i.e., 80 %) when planted in the month of April-May. Whereas mature stem (1 year old) cuttings excise<;l at the internode gave 70 % of rooting when treated with 5000 ppm of IBA. The juvenile (less than three month old) stem cuttings of *M turpethum* excised at the nodal region treated with 1000 ppm of IBA gave a maximum 90 % rooting success; while juvenile stem cuttings excised at the internode gave 92 % of rooting with 5000 ppm ofIBA which were planted in the month of May. In S. *oblonga* sprouting of buds from the upper nodes was observed after 45 days in the case of juvenile cuttings and in mature cuttings it took 50-60 days. In *M. turpethum* sprouting of buds started from the nodes after 15 days in the cuttings excised at nodal as well as internodal regions.

Vegetative propagation in mist chamber

The survival of rooted cuttings of *Ipomoea mauritiana* in the field, was 100 per cent and in *M turpethum* 90-95 per cent plants survied. The survival and growth of rooted cuttings of *Trichosanthes cucumerina* is poor than the plants raised from seeds. Flowering and fruit settings in vegetatively propagated plants of *T cucumerina* were more than that of plants raised from seeds. Seeds are the best planting materials for the growth and yield for *T cucumerina.*

Routing of cuttings for propagation

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

Psoralen, a phototoxic phytoallexin naturally occurs in *Psoralea corylifolia* L.which belongs to the family Fabaceae. Psoralen is used in the treatment of vitiligo, psoriasis, eczema etc. Recent report suggests that *Aegle marmelose* may also posses the compound psoralen. The root of *A. marmelos,* one of the Dasamoola in Ayurveda, is used in the treatment of ulcer, earache, etc. Considering the wide spectrum properties of psoralen, its presence was screened in plants belonging to family Rutaceae - *A. marmelos, Murryya koenigii, Glycomis pentaphylla, Paramignya monophylla* and *Clausena indica* belonging to Rutaceae were selected for screening the content. The fruits of these species were dried, powdered and extracted with methanol, ethanol, chloroform, and acetone. The samples were fractioned through thin layer chromatography with various solvent systems. Most suitable solvent system was Toluene: Petroleum benzene: Acetic acid (4.4: 4.4: 1.2). Profiles obtained for samples showed more or less similar patterns in the intensity of bands as the control. When ethanolic extracts were used, separation and intensity of bands were more.

The fractions collected from TLC plates were used for the absorbance measure-ments using a spectrophotometer. The absorbance profile of different plants was compared. *A. marmelos* and *M koenigii* showed more or less similar optical density in methanolic, ethanolic, chloroform and acetone extract with the control. The methanolic extract of *M koenigii* showed better result than *A. marmelos*. Ethanol extract was a good solvent for yield both in *A. marmelos* and *M koenigii*. Chloroform · and acetone extracts did not give much yield compared with the other two. *P. monophylla* and G. *pentaphylla* gave similar results with each other but deviated from the absorbance value of the control. The plant C. *indica* produced comparatively different result.

Organising educational programmes at Teak Museum, KFRI Sub-Centre, Nilambur

Different educational programmes were organised in Teak Museum for students, teacher trainees, Nature Club members and the general public. A summer course was organised for students during 23-30 April 2007.

South India river camp was organised by Regional Museum of Natural History Mysore *(M/O* Envt. & Forests) in collaboration with Teak Museum KFRI Sub Centre, CPRCEE of Tamil Nadu

Workshop of Teak cultivation

and Andhra Pradesh during May 20-25,2007. The camp was aimed at orienting the participants to the importance of rivers and the need to conserve them. Four best participants of the summer course 2007 organised in Teak Museum were selected for participation in the South India river camp. Altogether 30 students from the South Indian States of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu participated. The Camp involved exposure to the natural heritage of Kodagu district of Karnataka lying in the lap of Western Ghats.

Summer programme

Study on social awareness oftraditional teak wood articles used in households of Nilambur and Malappuram areas of Kerala is conducted in the Museum through visitor survey. Besides, two workshops were organized on Teak Cultivation and Management in June and July 2007 for members of Nilambur Block Panchayat and farmers of Malappuram District. A study was also conducted in Teak museum at Nilambur on 'Social awareness of traditional teak wood articles used in households of Nil am bur and Malappuram areas of Kerala' as part of the educational programmes, with different sections of the society viz., students, teachers, agriculturists and the general visitors so as to assess the awareness of the society about teak.

Wildlife Week activities were organised during 3-8 October 2007 for nature club members, members of nature education centers and other student groups with prior registration. A quiz competition for students on wildlife was organised during the week. A total number of 699 participants and 70 teachers attended the Wildlife week activities.

PUBLICATIONS

Scientific Papers in Journals

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Joyce Jose, Ramachandran, K.K. and Vijayakumaran Nair, P. 2007. Occurrence of the forest cane turtle *Geoemyda silvatica* (Reptilia, Testudines, Bataguridae) from a *Myristica* swamp of Kulathupuzha Forest Range, Southern Kerala. Myristica Swamp Ecosystem, *Wetland Ecosystem ENVIS Newsletter* 3 (1): 3-4.

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Anupama, C. and Balasundaran, M. 2008. Molecular detection of sandalwood adulteration. *In:* S. Gairola, T.S. Rathore, Geetha Joshi, A.N.A. Kumar and P.K. Aggarwal (eds.) Proceedings, National Seminar on Conservation, Improvement, Cultivation and Management of Sandal *(Santalum album* L.*)*. Institute of Wood Science and Technology, Bangalore. pp. 172-178.

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Bhat, K.M., Jisha Chand, A.R., Arun Vijayan, Thulasidas, P.K., Sojan Jose and Indira, E.P. 2007. Wood property survey of Indian teak provenances. *In*: K.M. Bhat, M. Balasundaran, K.V. Bhat, E.M. Muralidharan and P.K. Thulasidas (eds.). Processing and Marketing of Teak Wood Products of Planted Forests. Proc. Regional Workshop. 25-28 September 2007, Kerala Forest Research Institute, Peechi, India. pp. 117-125.

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Thulasidas P.K., Bhat, K.M and Maria Florence, E.J. 2007. Wood quality of teak grown outside forests (ToF). *In*: K.M. Bhat, M. Balasundaran, K.V. Bhat, E.M. Muralidharan and P.K. Thulasidas (eds.). Processing and Marketing of Teak Wood Products of Planted Forests. Proc. Regional Workshop. 25-28 September 2007, Kerala Forest Research Institute, Peechi, India. pp. 256-263.

PARTICIPATION IN SEMINARS/ SYMPOSIA/WORKSHOPS

N. Sasidharan

- participated in the Seminar on *Medicinal Plants: Strategies for Conservation* at Arya Vaidya Sala, Kottakkal on 4 Dec. 2007 and presented a paper *In situ conservation of medicinal plants in Kerala*.

- delivered the keynote address *Principal events in the life of Carl Linnaeus and an introduction to his literary works* in the Seminar on *Bioresources of Kerala: Problems and Prospects* in connection with the Tercentenary of Carl Linnaeus at the College of Forestry, Vellanikkara on 23 May 2007.

- participated in the *National Seminar on Saraca asoca* and presented the paper *Mass multiplication of Saraca asoca (Roxb.) de Wilde, through stem cuttings and air layering* during 16-17 Oct. 2007 at KFRI, Peechi.

- participated in the National Workshop on *Grower Industry Linkage for Promotion of Medicinal Plants Cultivation* at Cochin, organised by the Aromatic and Medicinal Plant Research Station, Odakkali, Kerala Agricultural University during 12-13 Feb. 2008. Chaired two Technical Sessions of the Seminar.

- participated in the Seminar on *Biodiversity Conservation* at Victoria College, Palakkad on 26 Feb. 2008. Made a presentation on the *Forest Resources of Kerala*.

K.K.N.Nair

- attended the National Conference on *Prioritisation and Characterization of Fast Growing Native Tree Resources* during 8-9 Aug. 2007, organized by the Institute of Forest Genetics and Tree Breeding, ICFRE, Coimbatore.

- as Programme Coordinator, Biodiversity Technical Programme Committee of Kerala State Biodiversity Board at KFRI attended various meetings of the KSBB, Thiruvananthapuram as a special invitee and contributed to chalking out and implementation of various programmes of the Board.

A.R.R. Menon

-attended the National Conference on *Ecorestoration of Derelict Mined Lands* at the National Inst. Oceanography, Goa on 1-2 March 2007and presented a paper entitled *Feasibility of remote sensing and Geographical Information System (GIS) in environmental protection*

aspects: A case study from Goodrical Forest Range, Kerala by Abhilash, E.S. and Menon, A.R.R.

E.A. Jayson

- attended the XXXVI Annual Conference of the Ethological Society of India at Bangalore on 10 to 12 April 2007 and delivered the keynote address on *Status distribution, food and feeding of Malabar spiny dormouse in the Western Ghats of Kerala*. He also presented a paper entitled *Habitat use and response of Brown Hawk owl (Ninox scutulata) to the broadcast of conspecific calls* by Babu, S. and Jayson, E.A.

- attended a seminar organized by the Kerala Forest and Wildlife Department on 7 Oct. 2007 at Calicut and presented a paper entitled *Problems of wildlife management in the Northern Malabar, Kerala.*

- attended the workshop in connection with the inauguration of the buffer zone for the Silent Valley National Park on 23 Sept. 2007 at Mannarkad, Palakkad.

- presented a paper in the International Biodiversity Conference organized by the Cochin University of Science and Technology during Feb. 2008.

- presented a paper entitled *Ecological niche modeling of two sympatric owls in the Southern Western Ghats, India* in the Kerala Science Congress (30 Jan. 08).

Jose Kallarackal

- attended a seminar on *Modern Tools for Plantation Forestry* on 25 March 2008 at Forestry College, Mettupalayam, Tamil Nadu Agricultural University

- participated in the Seminar on *Global Warming and its Impact on the World Today* held on 5 Aug. 2007 at Don Bosco Higher Secondary School, Thrissur and delivered the keynote address on Global climate change.

- participated in the National Conference on *Wetlands, Science and Society – An Assessment of their Integration* organized by the Delhi University Botanical Society. He chaired in the Plenary Session of the above Conference held at INSA, New Delhi on 11-13 Dec. 2007.

M. Balagopalan

- participated in the National Workshop on *Fertility Evaluation for Soil Health Enhancement* organized by Soil Survey Organization, Govt. of Kerala, Thiruvananthapuram on 11-13 September 2007.

CK Soman

- attended a workshop in AWS Network and Application on 27 September 2007 at CUSAT.

Sani Lookose

- participated in the first National Conference on *Intangible Natural Heritage and Museums* organised by Regional Museum of Natural History (MoEF) during 18-20 April 2007 in Calicut and presented a paper on *Social awareness of traditional teak wood articles used in households of Nilambur and Malappuram areas of Kerala.*

M. Balasundaran

- attended the National Seminar on *Conservation, Improvement, Cultivation and Management of Sandal* (*Santalum album* L.) at Institute of Wood science and Technology during 12-13 Dec. 2007 and presented a paper entitled *Variation in genetic diversity and seedling survival of sandal provenances.*

- attended a National Seminar on *From Chromosomes to Genomes – Challenges and Prospects* at University of Kerala, Thiruvananthapuram and presented a paper on *Genome analysis* on 28 March 2008.

V.V. Sudheendrakumar

-attended *Public and private partnership in plant protection for sustainable agriculture* organized by DBT at Pune during 12-13 May 2006**.**

U.M. Chandrashekara

- attended National Conference on *Intangible Natural Heritage and Museums* organised by the Regional Museum of Natural History (Mysore)on 18-20 April 2007 at Calicut, Kerala, and presented a paper *Ecological and socio-cultural dimensions of a traditional cropping system of Muthuvas in Chinnar Wildlife Sanctuary, Kerala.*

- attended Fourth International Conference on Environmental Education towards Sustainable Development on 26-28 Nov. 2007 at Centre for Environmental Education, Ahmedabad and presented a paper *Role of bioresources nature park as a non-formal space of learning in the Western Ghats of Kerala.*

M. Sivaram

- participated in the International Training Workshop on *Forest Biodiversity Conservation and Management of Forest Genetic Resources* at Forest Research Institute Malaysia, Kuala Lumpur, Malaysia during 11-16 June 2007.

-participated in Regional Workshop on *Establishment of Network to Facilitate Collection, Processing and Dissemination of Statistics Pertaining to Tropical Timber and other Forestry Parameters of India (IITO Project)* 20 December 2007 at IFGTB, Coimbatore and presented a paper *Database on Kerala forest resources and its applications in forest planning and management.*

-participated in the National Seminar cum Workshop on *Forestry Statistics* at the Indian Council of Forestry Research and Education, Dehra Dun on 26-27 March 2008 and presented a paper entitled *Computerized database on Kerala forest resources and its applications*.

M.S. Mukteshkumar

- participated in the International Tropical Ecology Congress on 2-5 December, 2007 at FRI, Dehra Dun and presented a paper entitled *Distribution and ecology of macrolichens in tropical wet evergreen forests of Silent Valley National Park, with special reference to the environmental factors* by Stephen Sequiera and Kumar, M.

P.K. Thulasidas

- participated in the Regional Workshop *Processing and Marketing of Teakwood Products of Planted Forests*, 25-28 September 2007, Kerala Forest Research Institute, Peechi, Kerala and presented a paper entitled *Wood quality of teak grown outside forests (ToF)* by Thulasidas P.K., Bhat K.M and Maria Florence E.J.

- also presented another paper as poster entitled *Wood property survey of Indian teak provenances* by Bhat, K. M., Jisha Chand A.R., Arun Vijayan, Thulasidas, P.K., Sojan Jose and Indira E.P.

C. Mohanan

- attended National Workshop on *Mangroves in India: Biodiversity, Protection and Environmental Services* organized by MoEF, at IWST, Bangalore, during 7-8 Feb. 2008. Presented a paper entitled *Fungal diversity in mangrove ecosystem in the West Coast region, Kerala.*

- attended 2nd Asian Congress of Mycology and Plant Pathology held at Osmania University, Hyderabad, during 19-22 Dec. 2007 and presented a paper entitled *Biodiversity of plant pathogenic fungi in the Western Ghats.*

OUTREACH PROGRAMMES

Jose Kallarackal

- conducted a course on *Ecological Philosophy* to the second year Philosophy students of Mary Matha Major Seminary, Mulayam, Thrissur.

- provided the necessary inputs to an Advocates' Commission enquiring into the impact of HNL eucalypt plantations in Munnar on 19 Oct. 2007 at Munnar.

- gave a talk on *Biodiversity and Climate Change* organized by the Kerala State Biodiversity Board on 14 March 2008 at St. Thomas College, Thrissur.

- acted as a Resource Person for the training of IFS Officers in *Statistical Methods in Forestry*; gave a talk on *Acquisition and Processing of Weather Data using Automated Instruments from Remote Locations* on 21 Feb. 2008.

V. Anitha

- acted as Resource Person and imparted training for college lecturers, agricultural university lecturers and teachers in September 2007 on *Interlinkages between Environment and Economics – A Theoretical and Empirical Approach* and *Economic Valuation of Eco-tourism Development of a Recreational Site in the Natural Forest of southern Western Ghats*.

- acted as a Resource Person for National Bamboo Mission- sponsored training for field functionaries of the Bamboo Technical Support Group for South Zone and delivered a talk on the *Economic and livelihood potential of bamboo resource in Kerala*.

- functioned as a Resource Person and conducted a training course on *Social Environmental Impact Assessment* on 25-26 March 2008.

N. Sasidharan

- evaluated selected M.Sc. Botany dissertations of students of various universities in Kerala on 21 April 2007 for awarding the prize constituted by the Botany Association of Kerala.

- gave technical report to the State Medicinal Plant Board for establishing a herbal garden at the Collectorate, Thrissur on 25 June 2007.

- gave a lecture on 23 July 2007 to the officers of Rehabilitation Plantation, Punalur on *Conservation and Collection of Medicinal Plants*.

- participated in the meeting of the Technical Committee of State Medicinal Plants Board on 20 Aug. 2007 for screening proposals for forwarding to National Medicinal Plants Board, New Delhi for financial assistance.

- valued the M.Sc. Dissertation of a student from Horticultural College, Thrissur and also conducted the *viva voce* as external examiner on 22 Aug. 2007.

- participated as member of the committee in the meeting of the National Programme on *Promoting Conservation of Medicinal Plants and Traditional Knowledge for Enhancing Health and Livelihood Security* at Thiruvananthapuram on 22 Oct. 2007.

- participated in the workshop for establishing a centre for conservation of heritage plants based on *Hortus Malabaricus* at Calicut as a invited member on 8 Dec. 2007.

- prepared the question paper for the written examination for the Fellowship in Botany of KSCSTE, Kerala. Also acted as a member of the interview board for awarding the fellowship.

- participated in the Technical Committee Meeting organized by MSSRF, Kalpetta on *Conservation and Documenting the Biodiversity of Wayanad, Particularly the Endangered Species* on 22 Jan. 2008

- identified the plants referred by Dr. T. Sasikumar, Reader, Department of Botany, Sree Kerala Varma College, Thrissur, on 2 Feb. 2008.

- gave lectures on *Concept of Plant taxonomy, Plant nomenclature and Computer-aided Tree Identification Program* to the M.Sc. students of Govt. Victoria College, Palakkad during their visit to the Institute on 5 Feb. 2008.

C. Renuka

- took classes for the Research Range Officers from Andhra Pradesh on *Taxonomy and Identification of Rattans* and on *Seed Handling and Nursery Practices and Cultivation of Rattans* during January 2007.

- delivered a lecture on *Plant Diversity in Kerala* to IFS Officers during the one week compulsory training course on *Management of Tropical Forests: Issues and Challenges* during July 2007.

- took classes for the forest officers from Bhutan on *Taxonomy and Identification of Rattans* and on *Seed Handling and Nursery Practices and Cultivation of Rattans* during September 2007.

- participated in the National Workshop to identify stakeholders and capacity building needs in Forest Genetic Resource Conservation under Asia Pacific Forest Genetic

Resource programme conducted at the Institute of Forest Genetics and Tree Breeding, Coimbatore during June 2007.

- did the editorial scrutiny of scientific papers for the journals Rheedea, Current Science and Journal of Non-Timber Forest Products.

- extended necessary advise to the Kerala Forest Development Corporation for the establishment of *Caryota urens* plantation for Guruvayur Devaswom in their land at Valanchery.

K.K.N.Nair

- as Programme Coordinator, Biodiversity Technical Programme Committee of Kerala State Biodiversity Board at KFRI, attended various meetings of the Board as a special invitee and contributed to chalking out and implementation of various programmes of the Board.

- attended two organising committee meetings of the Kerala Environment Congress-2008 to be organised in April 2008 by Centre for Environment and Development, Thiruvananthapuram.

- co-ordinated and took classes for over 750 Grama Panchayath Presidents on Biodiversity in collaboration with Kerala Institute of Local Administration (KILA) under the *Biodiversity Awareness Programme.*

- took classes on *Biodiversity* to trainees from Indian Institute of Public Administration, New Delhi, teachers of Irinjalakuda Sub District and students of Forestry College, KAU, Mannuthy.

Muktesh Kumar

- participated as a resource person in National Workshop on *Grass Systematics* organized by Shivaji University, Kolhapur during 3-8 March 2008.

- participated in a training programme as a resource person on *Bamboo Technology and Trade Development* held at SFRI, Jabalpur during 29 Sept.-5 Oct. 2008.

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

- participated as a resource person in the workshop on *Bamboo Taxonomy* organized by Botanical Survey of India, Kolkota during 26-30 April 2007.

- organized a Training Workshop on lichens for the college teachers and researchers of Kerala State, at KFRI during 10-11 Jan. 2008 sponsored by the Kerala State Biodiversity Board, Thiruvanathapuram.

E.P. Indira

- served as a Member of Board of Examiners and evaluated a Ph.D. thesis entitled *A study of variability, performance and adaptability of some elite land races and hybrids of small cardamom* (*Elettaria cardamomum* Maton) submitted to Calicut University.

- acted as a Member of Board of Examiners for the M.Sc. Plantation Development Course and evaluated the students' dissertations during 18-20 Feb. 2008.

- did the editorial scrutiny of many scientific papers for Indian Journal of Forestry and Journal of Non-timber Forest Products.

U.M.Chandrashekara

- took classes for the Forest Department trainees (Forest Guards to IFS probationers) on various aspects of forest conservation and management.

- produced plant propagules of different tree species and bamboo and supplied at the nominal price to the Government Departments, NGOs and farmers to promote tree farming both within and outside Kerala.

- gave training to farmers and forest staff on management of teak nursery.

K.K. Ramachandran

- visited Kuttiadi Forest Range on the request of Kerala Forest Department to study the crop damage problems during February 2008 and submitted the report.

E.A.Jayson

- visited the Kadalundi area in the Malappuram District, as per the request of DFO, to study the damage done by the birds on the windows of the houses. Based on a one-day survey, a report was submitted to the DFO.

- attended the Nilgiri Tahr Census programme of the Eravikulam National Park on 22 April 2007.

- visited the Mudumalai National Park, Tamil Nadu on 18- 20 Sept. 2007 for evaluating the protected area for the management effectiveness evaluation programme of the Ministry of Environment and Forests, Govt. of India.

- offered a class to the High School Students on the subject *Animal diversity in Kerala* during the Open house Programme at KFRI on 11 May 2007.

- conducted training class on 26 Sept. 2007 at Forest School, Arippa on *Wildlife census techniques* and also on 27 June 2007 for the staff attending the refresher course.

- offered a class on *Animal diversity in Kerala* on 6 Aug. 2007 to the IFS officers undergoing the in-service training at KFRI.

- took class at Vivekodayam Higher Secondary School, Trichur on *The environmental conservation problems in Kerala* on 20 Nov. 2007.

- took class at Chinmaya College, Trichur on *Environmental conservation problems in Kerala* on 29 Nov. 2007.

- took classes for the students of Vivekodayam School, Thrissur and Chinmaya School, Kolazhy, on *Wildlife conservation* during January 2008.

- took classes to the B.Sc. Zoology students, of Govt. College, Chittur, Palakkad on 29 Jan. 2008 on *Biodiversity conservation*.

- evaluated a Ph.D. thesis each of Bharathiar University, Coimbatore and M.G. University, Kottayam.

- attended the organizing committee meeting of the Environmental Science Congress – 2008, organized by the Centre for Environment and Education, Thiruvananthapuram at Trichur, KILA during April 2008.

C.N. Krishnankutty

- acted as a Resource Person to handle a session on *Estimation of bamboo resource in farmlands,* as part of the Training for 17 Field Functionaries from Maharashtra, Andhra Pradesh and Kerala States, under the National Bamboo Mission Bamboo Technical Support Group for South Zone, during 26 Nov. -1 Dec. 2007.

- acted as a resource person to handle a session on *Wood-balance study: Methodology and data requirements* during the Training Workshop on *Collection, Compilation and Dissemination of Forestry Statistics* on 21-22 Feb. 2008.

M. Sivaram

- served as the Course Coordinator of the Training Workshop on *Collection, Compilation, Validation and Dissemination of Forestry Statistics* for Indian Forest Service (IFS) Officers, 21-22 Feb. 2008 at Kerala Forest Research Institute and delivered two lectures, one on *An overview of forestry statistics with particular reference to Kerala State* and another on *Computerized database on Kerala forest resources and its applications*.

K. Jayaraman

- delivered a lecture on *Data needs for sustainable forest management* in the Training Workshop on *Collection, Compilation, Validation and Dissemination of Forestry Statistics* for Indian Forest Service (IFS) Officers on 21-22 Feb. 2008 held at Kerala Forest Research Institute, Peechi.

A.R.R. Menon

- delivered a lecture on *GIS application* in the Training Programme on *Earthquake and Risk Management* held at Govt. Engg. College, Thrissur on 18 April 2007.

- gave a lecture and hands-on-training on *Basics of remote sensing* in the Training Course on *Remote Sensing and GIS* for School Teachers at DIET, Thrissur, 14 May 2007.

- gave a lecture and hands-on-training on *Geomatics and its applications* in the Refresher Training Programme for Officials of Civil Engg. Wing, KSEB on 20 Sept. 2007.

- delivered a lecture on *Participatory forest management and ecosystem services* in the Experimental Learning Programme on the State of Environment in Kerala held at Environmental Center, Thrissur on 29 Sept. 2007.

- gave a lecture on *Bioshielding for coastal area protection* in the CADA training Programme for CADA officials on 26 Oct. 2007.

- delivered a lecture on *Remote sensing and GPS technology* in the Training Programme in *Geo-information Technology Applications*. Socio Economic Unit Foundation, Thrissur on 13 Nov. 2007.

- served as resource person in *Biodiversity conservation and practices* at the National Conference on *Sustainable Agriculture* held on 6 Feb. 2008 at C.M.S College, Kottayam.

- gave a talk on *Remote sensing applications* at Govt. Model School, Thrissur on 9 May 2007.

- took a class on *Remote sensing and GIS* at St. Antony's High School, Ammadom on 14 Nov. 2007.

- gave a talk on *Forest status of Kerala* under Nature Lecture Series at M.G. University, Kottayam on 19 Oct. 2007.

- gave a talk on *Geoinformatics tools in education and resource management* at Socio- Economic Foundation, Thrissur on 23 Oct. 2007.

- took a class on *Remote sensing* at Govt. High School Poonkunnam, Thrissur on 21 July 2007

V.V. Sudheendrakumar

- organised a meeting of DBT Task Force *Biopesticide and Crop Management* at KFRI on 21 April 2007.

M. Balasundaran

-acted as Coordinator for a two-day training programme for the benefit of higher secondary school teachers at KFRI during 15-16 May 2007.

- took classes on *Organic composting* for the benefit of Agricultural Officers attending Training Programme on *Organic Farming* at the College of Engineering, Thavanur, Kerala Agricultural University on 29 May, 13 and 26 June 2007.

- acted as course coordinator for one-week-training given to two participants from Myanmar on *Molecular Techniques in Tree Improvement.*

Sani Lookose

- acted as Resource Person for South India Summer River Camp organised by Regional Museum of Natural History in collaboration with Teak Museum, KFRI Subcentre and CPRCEE Chennai during 20-25 May 2007 at Mysore.

- inaugurated *Ente Maram* Project in Erinjimangad Govt. School as per their invitation and took a class on World Environment Day on 5 June 2007.

- inaugurated Social Science Club in Govt. Higher Secondary School, Pullangode on 24 July 2008 as per their invitation and took a class on *Forests of Kerala.*

- organised different educational programmes in Teak Museum for students, teacher trainees, Nature club members and the general public.

- conducted a study on social awareness of traditional teak wood articles used in households of Nilambur and Malappuram areas of Kerala in the Museum through visitor survey.

NOMINATION TO NATIONAL/ INTERNATIONAL COMMITTEES

E. M. Muralidharan

- appointed as International Consultant for tissue culture for the ITTO project on teak implemented by the Forest Department of Myanmar.

- invited to be external expert to evaluate the tissue culture lab being set up at Hindustan Paper Corporation at Naogaon Paper Mills.

- invited to be Member Advisory Committee for BIOTRIM , Tirupathi.

Jose Kallarackal

- functioned as Associate Editor for IForest (Internet Journal) Journal of Italian Silviculture Society.

- acted as a member, Faculty of Environmental Studies, CUSAT.

- acted as a member, District Level Technical Advisory Committee of Thrissur District Planning Committee.

- acted as a member, Committee for Evaluation of Clean Development Technologies and Project Evaluation under Carbon Credit for local self Government Department, Kerala.

- functioned as a Member, Management Board, St. Berchmans College, M.G. University, Changanassery.

E.A. Jayson

- took charge as the Nodal Officer of KFRI Research Centre of FRI University, Dehra Dun.

K.M. Bhat

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

- nominated as Member of Editorial Advisory Board, Journal of Tropical Forest Science (refereed international journal), Malaysia (since 2006).

E.P. Indira

- nominated as a member of Board of Studies for M.Sc. (Plantation Development), University of Calicut.

M. Balasundaran

- nominated as Expert Member, Board of Studies in Biotechnology and Expert member, Faculty of Science, Cochin University of Science and Technology

- nominated as External Expert for Ph.D. thesis evaluation and *viva voce* examination of Banaras Hindu University, Osmania University, University of Agricultural Sciences, Bangalore, Kerala Agricultural University and Bharathiar University.

- nominated as one of the members in the Panel of Judges to evaluate the paper presentation for Young Scientist Award on the subject area Life Science for 20th Kerala Science Congress 28th-31 January 2008 at Thiruvananthapuram.

- nominated as a member of Advisory Committee of BIOTRIM, Andhra Pradesh Forest Department, Tirupathi, Andhra Pradesh.

EXTENSION AND TRAINING ACTIVITIES

Extension Activities attended

Sl. No.	Year & Month	Problem attended	Client	Persons involved
1.	2007 April	Information regarding plant	Mr. T. A. Lalu, Thalakkottoor Veedu, Pazhamukku, Mundoor P. O. Thrissur – 680 541	Dr. N. Sasidharan
2.	2007 April	Wood sample testing	The Addl. Chief Manager (Civil), Civil Maintenance/North Zone Township Administrative Office Block – 10, Neyveli 607 801 Tamil Nadu	Dr. K. M. Bhat
3.	2007 May	Wood sample testing	M/s. Wood Crafts, A – 18, Industrial Estate, Thattanchavadi Pondicherry – 605 009	Dr. K. M. Bhat
4.	2007 May	Wood sample testing	Sree Balaji Timbers, 119, Meenakshi Rd. Zamin Uthukuli, Pollachi – 642 004	Dr. K. M. Bhat
5.	2007 May	Wood sample testing	Prof. P. J. Cherian, Director, Kerala Council for Historical Research, P. B. No. 839, Vyloppilly Samskrithi Bhavan, Thiruvananthapuram – 695 003	Dr. K. M. Bhat
6.	2007 May	Wood sample testing	The Production Manager "OUSHADHI", The Pharmaceutical Corporation (I.M.) Kerala Limited P. B. No. 174, Thrissur – 680 001	Dr. K. M. Bhat
7.	2007 June	Information about plant	Dr. N. C. Shah Retd. Scientist (CIMAP) CSIRMS – 78, Sector D, AliganjLucknow – 226 024	Dr. N. Sasidharan
8.	2007 June	Wood sample testing	M/s Sree Balaji Timbers, 199, Meenkarai Road, Zamin Uthukuli Pollachi – 642 004	Dr. K. M. Bhat
9.	2007 July	Wood sample testing	M/s Adarsh Wood Industries Door No. 11/132, Kadungamangalam, Thiruvamkulam, Ernakulam Dist.	Dr. K. M. Bhat

10.	2007 July	Wood sample testing	The Assistant Engineer (Civil) Lakshadweep, P. W. D.W/Island,	Dr. K. M. Bhat
			Kochi -3	
11.	2007 July	Wood sample testing	The Addl. Chief Manager (Civil) Civil MTCE/South Zone, Neyveli Lignite Corporation Ltd., Township Administrative Office, Block – 10, Neyveli 607 801 Tamil Nadu	Dr. K. M. Bhat
12.	2007 July	Wood sample testing	M/s. Sathyan Associates, Marar Road	Dr. K. M. Bhat
			Near Lucia Palace Hotel, Thrissur	
13.	2007 July	Drying of leaves of eucalypts	Mr. Rajan Sehgal, IFS, Dy. Conservator, Forests Research Division, Thiruvananthapuram	Dr. E. J. Maria Florence
14.	2007 July	Fungal attack of eucalypts	The Range Officer, Chettikkulam Central Nursery, Chettikkulam – 680 721	Dr. K. Mohandas
15.	2007	Wood sample testing	The Asst. Engineer, CPWD,	Dr. K. M. Bhat
	August		Idukki Sub Division, Kulamavu 685 601	
16.	2007	Wood sample testing	Sandeepni Garg,	Dr. K. M. Bhat
	August		Sub-Inspector of Police, Central Bureau of Investigation, Anti-Corruption Branch, Kathrikadavu, Cochin – 682 017	
17.	2007	Wood sample testing	The Addl. Chief Manager/	Dr. K. M. Bhat
	September		CivilCivil Maintenance/North Zone, Township Administrative Office Block–10, Neyveli 607 801Tamil Nadu	
18.	2007	Wood sample testing	The Assistant Engineer, CPW D	Dr. K. M. Bhat
	September		Trichur Central Sub Division No. 1 Mundassery Memorial Building Chembukkavu, Thrissur – 680 020	
19.	2007	Wood sample testing	M/s. Romko Umas Enterprises	Dr. K. M. Bhat
	September		158, Valayamadevi Road, Neyveli – 607 802	
20.	2007 September	Age of tree	The Sub Collector Mananthavady, Wayanad	Dr. K. M. Bhat
21.	2007	Wood sample testing	The Asst. Engineer	Dr. K. M. Bhat
	September		Trichur Central Sub Division No. II CPWD, Pullazhi, Thrissur	
22.	2007	Mortality of KFRI	The Divisional Manager	Dr. M. Balasundaran
	October	eucalypt clone	KFDC, Thrissur	

23. 2007 October	Botanical names of plant & trees	P. A. Paulose paulosepalatty@hotmail.com	Dr. N. Sasidharan
24. 2007 October	Wood sample testing	The Addl. Chief Manager/CIVIL Civil/Maintanance/North Zone Township Administration Office Block – 10, Neyveli – 607 801,TN	Dr. K. M. Bhat
25. 2007 October	Wood sample testing	M/s. Adarsh Wood Industries Church Road, Kadungamangalam, Thiruvamkulam, Ernakulam – 682 305	Dr. K. M. Bhat
26. 2007 October	Testing of coir pith	Mr. Febi VargheseDirector, Coir BoardCoir House, M. G. Road, Kochi – 682 016	Dr. R. Gnanaharan
27. 2007 November	Wood sample testing	The Engineer-in-charge, Kerala Forest Research Institute, Peechi 680 653, Thrissur	Dr. K. V. Bhat
28. 2007 December	Information about rubber tree for coastal	Mr. P. Prasad Babu, IFS Chief Conservator of Forests protection, Social Forestry, Edappally	Dr. K. C. Chacko
29. 2007 December	Wood sample testing	The Addl. Chief Manager(Civil) Civil Maintenance/North Zone Township Administrative Office Block 10, Neyveli 607 801, Tamil Nadu	Dr. K. M. Bhat
30. 2007 December	Wood sample testing	The Addl. Chief Manager/Civil Civil/MTCE/South Zone Township Administrative Office Neyveli Lignite Corporation Limited Block 10, Neyveli 607 801, Tamil Nadu	Dr. K. M. Bhat
31. 2008 January	Kuttichira teak plantation - Extension report	Mr. Christo George, Managing Director, M/S Hykon Ltd. Near Malayala Manorama Ikkanda Warrier Road, Thrissur	Dr. K. C. Chacko
32. 2008 January	Wood sample testing	The Assistant Engineer CPWD, Idukki Sub Division Kulamavu - 685 601	Dr. K. M. Bhat
33. 2008 January	Extension activity of Wildlife Biology	Chief Conservator of Forests (Northern Region)	Dr. K. K. Ramachandran
34. 2008 January	Report of Laboratory Investigation on wood identity	Dr. S. Hemachandran, Director in charge, Department of Archaeology Directorate of Archaeology, Sreepadam Palace, Fort P. O, Thiruvananthapuram - 23	Dr. K. V. Bhat
35. 2008 February	Wood sample testing	Mr. Abhilash P. Kailas QA VKL, 9/102, Varikoli P. O Puthencruz, Ernakulam - 682 308	Dr. K. M. Bhat

36.	2008 February	Proposed book on History of Forests in India - After 1947 - details called for -reg.	Shri Lakhwinder Singh IFS, Chief Conservator of Forests, Working Plan & Research, Vanasree Complex, Forest Headquarters, Thiruvananthapuram - 695014	Dr. K. C. Chacko
37.	2008 February	Procurement of seeds	Dr. H. S. Singh IFS, Chief Conservator of Forests (Research), Gujarat Forest Research Institute, Near Akshardham, 'J' Road, Sector No. 30, Gandhinagar	Dr. R. Gnanaharan
38.	2008 February	Wood sample testing - Properties of silver oak , pine & vellapine wood	S.V. Paithankar, Manager(Vigilance), 1st Floor, West Block Building, Dockyard Road, Mazagon Dock Ltd., Mumbai-400010.	Dr. K. M. Bhat
39.	2008 February	Suggestion for including rubber tree in Harithatheeram Padhathi	The Chief Conservator of Forests Social Forestry, Edappally, Ernakulam	Dr. R. Gnanaharan
40.	2008 February	Wood sample testing	The Assistant Engineer CPWD, Trichur Central Sub Division No. II, AG'S Staff Quarters Campus Pullazhi, Thrissur	Dr. K. M. Bhat
41.	2008 March	Transfer of Technology and Collaborative Research	Dr. K. R. Rao, Chief General Manager National Bank for Agriculture and Rural Development, Post Box No. 8121Mumbai - 400 051	Dr. R. Gnanaharan
42.	2008 March	Wood sample testing	M/s Sree Balaji Timbers 119, Meenkarai Road, Zamin Uthukuli, Pollachi - 642 004	Dr. K. M. Bhat
43.	2008 March	Wood sample testing	Hon'ble Chief Judicial Magistrate Kalpetta 673 122, Wyanad Distt.	Dr. K. V. Bhat
44.	2008 March	Wood sample testing	Mr. K. H. Mohammed Thoppil House, Mannam P. O. Vedimara, North Paravur, Ernakulam - 683 511	Dr. K. M. Bhat
45.	2008 March	Wood sample testing	The Additional Chief Manager/Civil Civil/Maintenance/North Zone, township Administrative Office, Block-10, Neyveli-607 801Tamil Nadu	Dr. K. M. Bhat

Training Programmes conducted

Sl. No.	Date & Year	Title	KFRI Project No.	No. of Participants	Sponsor
1.	29 Mar. - 7 April 2007	Propagation, Cultivation Management and Post- harvest Technology of Bamboos	Ext/109 07	2	ITTO-FRI yezin
2.	23 April- 2 May 2007	Tissue Culture Techniques for Forest and Medicinal Plants	Ext.119/2007	2	Andhra Forest Department
3.	15-16 May 2007	Biotechnology for School Teachers	Ext.102/07		Self generating
4.	17-18 May 2007	Remote Sensing & Geographic Information System for School Teachers	Ext.103/07		Self generating
5.	July-Aug 2007	Computer Training Course in use of Photoshop	Ext.120/07	14	Self generating
6.	6-10 Aug 2007	Management of Tropical Forests- Issues and Challenges	Ext.123/07	26	MoEF
7.	10-16 Sept. 2007	Propagation, Cultivation and Post-harvest Technology of Bamboos	Ext. 124/07	20	Directorate of Horticulture, Rajasthan
8.	11-20 Sept. 2007	Propagation, Cultivation, Management and Post-harvest Technology of Bamboos and Rattans	Ext. 125/07	4	Renewable Resource Research Center, Bhutan
9.	19-24 Nov. 2007	Wood Microtechniques- Pulpwood Quality and NIRS	Ext. 130/07	1	ITC R&D Centre, Hyderabad
10.	30 Dec 2007 - 5 Jan 2008	Training Course on Propagation, Cultivation Management and Post-harvest Technology of Bamboos	Ext.131/2007	10	Gujarat Forest Department
11.	10-11 Jan. 2008	Lichen Diversity, Significance and Taxonomy	Ext. 129/07	16	Kerala State Biodiversity Board
12.	21-22 Feb. 2008	Training Workshop on Collection, Compilation, Validation and Dissemination of Forestry Statistics	Ext. 134/08	22	MoEF
13.	Feb 27- Mar 72008	Training Course on Molecular and Biotechnological Techniques in Tree Improvement	Ext. 138/08	2	FRI - Yezin
14.	Mar 25 -27 2008	Training Workshop on Environmental Impact Assessment	Ext.139/08	27	Kerala State Biodiversity Board
15.	Mar 9-15 2008	Propagation, Cultivation, Management and Post-harvest technology of Bamboos	Ext.137/08	24	Directorate of Horticulture, Rajasthan

Collection compilation validation and dissemination of forestry statistics

Training on Management of tropical forests issues and challenges

Propagation, Cultivation, Management and Post harvest technology of Bamboos

Exhibitions Conducted

Sl. No.	Title of the exhibition	Period	Name of the Organization
1.	Swasraya Bharath 2007	6 days	Swadeshi Science Management,
		(9-15 Oct. 2007)	Kerala
2.	Kerala Forestry Exhibition	4 days	Dept. of Forests, Govt. of Kerala
		(10-13 Nov. 2007)	
3.	Bamboo Fest, Kerala	4 days (6-9 Dec.2007)	K-Bip, Department of Industries, Govt. of Kerala
4.	Agri-Horti Society Flower show, 2008	7 days (23-29 Jan. 2008)	Agri-Horti Society, Thrissur
5.	Science Technology Exhibition 2008	5 days (24-28 Jan. 08)	Kerala University Union, Thiruvananthapuram
6.	Kerala Science Congress 2008	3 days	Kerala State Council for Science,
		(29-31 Jan. 2008)	Technology and Environment, Pattom, Thiruvananthapuram
7.	National Exhibition on Biodiversity of India	4 days (9-12 Feb.2008)	National Exhibition on Biodiversity of India, Malabar Botanical Garden, Kozhikode.

Teak Planner

Dr. K. Jayaraman developed one computer programme *viz*., *Teak Planner* a short description of which is given below.

Teak Planner functionally is a growth simulator for teak plantations. Its scope of application is the range of growing conditions that is available in Kerala. This programme can be used to identify the optimum thinning schedule and rotation age for even-aged teak stands under a range of site quality and management levels. The optimum thinning schedule is that which maximizes the net present value of cash flows, out of a variety of possible thinning schedules in a plantation. It also enables the user to make an investment plan by providing information on net present value (NPV), internal rate of return (IRR) and benefit cost ratio (BCR) and payback period (PBP) for a range of management options. The software is also an effective tool for financial valuation of the growing stock for commercial purposes. One additional feature is that the user is supplied with the option of making the financial projections either under 'constant' levels of teak timber price, input cost and management interventions or under 'varying' rates. This option provides the user a whole scenario of possible projections and every time the simulator identifies the best thinning schedule to be followed to maximize the returns.

The simulator has been built using Visual Basic software. The equations used for projecting the different stand features were developed using long-term data gathered from permanent sample plots laid out in teak plantations in Kerala. Whole stand models based on Richards function with biologically meaningful parameters formed the basis of diameter and volume growth functions.

ACADEMIC ACTIVITIES

Ph.D. Programme

During the year Ph.D was awarded to the following.

Sl. No.	Name	Topic	Guide	University
1	Mr. R. Sheik Mohammed Shamsudeen	Studies on Microheterocera (Insecta: Lepidoptera) in Kerala part of Western Ghats	Dr. George Mathew	FRI University, Dehra Dun
2	Mrs. P. Rugmini	Optimising stand density in teak plantations using growth models based on intrinsic biological units.	Dr. A.P.Thomas (M.G. University) Dr. K. Jayaraman	M.G. University

Ph.D. theses of following students were processed and forwarded to FRI University.

Sl. No.	Name	Topic for research approved by FRI	Date	Supervisor
1.	Julia Rani Francis	Fungal pathogens associated with forest insects in the Kerala part of the Western Ghats.	11 Dec. 2007	Dr. R.V. Varma
2.	S. Sabna Prabha	Analysis of mating system and contemporary gene flow in natural teak forests and plantations through DNA marker studies	8 Feb. 2008	Dr. E. P. Indira
3.	P. K. Thulasidas	Timber properties of teak (*Tectona grandis* L.f.) grown in the homesteads of Kerala	20 Feb. 2008	Dr. K. M. Bhat
4.	K.M. Jayahari	Ecology and behavior of small mammals in the Western Ghats of Kerala, Southern India, with special reference to rodents.	20 Feb. 2008	Dr. E.A. Jayson
5.	Pramod N. Nair	Assessment of the impact of human disturbance on genetic diversity in teak through DNA marker studies	6 March 2008	Dr. E. P. Indira

Academic Attachments

More than 50 applications were received for academic attachment during the year and the following students were selected for the programme.

Sl. No.	Name of the student	Supervising Guide	Name of the College	Subject
1.	Divya, K. V.	Dr. M. Balasundaran	Mar Athanasius College, Kothamangalam	Biotechnology
2.	Ramya, T.G	Dr. M. Balasundaran	S. S. V. College, Perumbavoor	Biotechnology
3.	Deepthi Ravindran	Dr. M. Balasundaran	S. S. V. College, Perumbavoor	Biotechnology
4.	Rani Thomas	Dr. E.M. Muraleedharan	Bishop Heber College, Trichy	Biotechnology
5.	Siji Vijayan	Dr. E. P. Indira	Nehru Arts and Science College, Coimbatore	Biotechnology
6.	Shabna, T.G.	Dr. V. V. Sudheendra Kumar	RVS College of Arts &Science, Coimbatore	Microbiology
7.	Sowmya P. Mohandas	Dr. E. P. Indira	Nehru Arts and Science College,Coimbatore	Biotechnology

SEMINARS/SYMPOSIA/WORKSHOPS ORGANISED

A Regional Workshop on *Processing and Marketing of Teak Wood Products of Planted Forests* was organized during 25-28 September 2007 at Kerala Forest Research Institute, Peechi with financial support of ITTO, Japan and sponsored by MoEF, Govt. of India and IUFRO Division 5.06.02 (Teak Wood Working Party). A total of 90 delegates representing 14 countries

of Asia, Australia, Europe, Central and South America participated in the 4-day Workshop including one day field excursion. In addition to the scientists/researchers from various organizations / universities, the target beneficiaries of the Workshop were small timber holders / farmers, processing enterprises, traders, State Forest Departments, Forest Development Corporations and Policy Makers and NGOs. Dr. K. M. Bhat was the Convener of the workshop.

The Workshop was inaugurated by Mr. S. Reghupathy, the Hon'ble Minister of State for Environment and Forests, Govt. of India and presided over by Mr. Rajaji Mathew Thomas MLA, Govt. of Kerala.

TEAKNET satellite meeting was also held during the Workshop and it was decided to relocate the Secretariat of the Teaknet at KFRI starting 2008 from Myanmar owing to the difficulties experienced in the networking activities in that country.

A National Seminar on *Conservation, Cultivation and Sustainable Utilisation of Saraca asoca* was held at KFRI on 16-17 October 2007. The Seminar was inaugurated by Sri. K.P. Rajendran, Hon'ble Minister for Revenue and land Reforms, Govt. of Kerala. Sri. Rajaji Mathew Thomas, MLA, Kerala State Legislative Assembly presided over the inaugural ceremony. Sri B.S. Sajwan, IFS, the Chief Executive Officer of National Medicinal Plants Board, New Delhi addressed the

audience. Dr. N. Sasidharan of KFRI was the Convenor. A total of 22 papers were presented during the four technical sessions of the Seminar on various aspects of the plant *Saraca asoca*, its conservation, propagation, phytochemical and pharmacognostic properties.

A two-day workshop on *Teak Cultivation and Management* was organised on 23rd and 24th June 2007, for the members of Literacy Mission, Nilambur Block Panchayath. 51 members attended the workshop. Another one-day workshop on was organised on 28th July 2007 for the farmers of Malappuram District. Thirty-seven farmers attended the one day workshop. Mrs. Sani Lookose organized the worksop.

NEW EQUIPMENTS ADDED

New equipments added to the Wood Science and Technology laboratory include a Cyclotec powder mill meant for converting slivers of wood into powder, a soxtec extraction system meant for extraction of wood extractives and a UV-VIS spectrophotometer.

Soxtec Extraction System

UV-VIS Spectrophotometer

Cyclotec Powder mill

The following equipments were added to NWFP laboratory

Refrigerating bath circulator: Multifunctional low temperature circulating bath.

Gel documentation system: For imaging applications specifically for fluorescence and colorimetric imaging.

UV-Visible spectrophotometer: For quantitative measurement of biomolecules, spectrum measurement, kinetic studies, etc

Refrigerating bath circulator

Gel documentation system

UV-Visible spectrophotometer

BALANCE SHEET AS AT 31ST MARCH, 2008

KERALA FOREST RESEARCH INSTITUTE - PEECHI

LIABILITIES	SCH	31/03/2006	31/03/2005	ASSETS	SCH	31/03/2006	31/03/2005
GENERAL FUND	I	52507475.00	52507475.00	FIXED ASSETS	VII	70966088.12	42234750.56
				ADVANCE FOR CAPITAL ASSET		0.00	0.00
CURRENT LIABILITIES	II	11545181.00	14336202.00	CURRENT ASSETS	VIII	35488941.97	32541454.00
UNSPENT BALANCE OF EXTERNAL PROJECTS	III	13935149.68	16544647.72	LOANS & ADVANCES	IX	889882.80	1042570.00
UNSPENT BALANCE OF CONSULTANCY PROJECTS (NET)	IV	0,00	0.00	EXTERNAL PROJECTS:			
				CURRENT ASSETS	X	0,00	0,00
CORPUS FUND	V	0.00	0,00	LOANS & ADVANCES	XI	0,00	0.00
RESERVES & SURPLUS:	VI			CONSULTANCY PROJECTS:			
CAPITAL RESERVE CREATED ON ACQUISITION OF FIXED ASSETS		63081529.17	42234750.56	OVERSPENT BALANCE OF CONSULTANCY PROJECTS (NET)	IV	172128.00	102667.00
				CURRENT ASSETS	XII	0,00	0,00
OTHER RESERVES & SURPLUS		390423.00	390423.00	LOANS & ADVANCES	XIII	0.00	0,00
				CORPUS FUND:	V		
				TERM DEPOSIT WITH BANKS		4240574.70	4240515.70
				INCOME & EXPENDITURE	XIV	29702142.26	45851541.02
TOTAL		**141459757.85**	**126013498.28**	**TOTAL**		**141459757.85**	**126013498.28**

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MARCH, 2008

KERALA FOREST RESEARCH INSTITUTE - PEECHI

EXPENSES	Sch	31/03/2006	31/03/2005	INCOMES	Sch	31/03/2006	31/03/2005
Salaries & Allowances	A	28119734.00	31117764.00	Grant from Government	F	42740792.00	29300000.00
Staff Expenses	B	2078444.00	1721936.00	Receipts from Corpus Fund			
Establishment Expenses	C	4152782.00	3452480.25	Prior Period Income			
Administrative Expenses	D	628363.00	584649.00	Other Receipts	G	9396640.51	7090240.68
General Expenses	E	1008710.75	985382.00				
Expenses of out of Plan fund		2891162.00	404915.00	Proportionate amount transferred from Plan Fund Account towards Revenue expenditure incurred out of Plan Fund		2891162.00	404915.00
Revenue expenses for External Projects		43865481.96	19941024.00	Proportionate amount transferred from External projects Grant received Account towards Revenue expenditure incurred for External projects		43865481.96	19941024.00
Depreciation w/off		6817136.39	6578001.01	Proportionate amount transferred from Capital Reserve Account towards depreciation w/off. in the Income & ExpenditureAccount		6817136.39	6578001.01
Excess of Income over Expenditure		16149398.76	0.00	Excess of Expenditure over income		0.00	1471970.57
TOTAL		**105711212.86**	**64786151.26**	**TOTAL**		**105711212.86**	**64786151.26**

INTERNAL COMMITTEES

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

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

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

1.	The Principal Chief Conservator of Forests	..	Chairman
2.	The Additional Principal Chief Conservator of Forests	..	Member
3.	The Chief Conservator of Forests (Planning & Research)	..	Member
4.	The Chief Conservator of Forests (Wildlife)	..	Member
5.	The Chief Conservator of Forests (Tribal Welfare & Economic Development)	..	Member
6.	The Chief Conservator of Forests (World Bank Projects)	..	Member
7.	The Chief Conservator of Forests (Development)	..	Member
8.	The Chief Conservator of Forests (Protection)	..	Member
9.	The Chief Conservator of Forest (FMIS)	..	Member
10.	The Chief Conservator of Forest (HRD)	..	Member
11.	The Chief Conservator of Forest (Administration)	..	Member
12.	The Chief Conservator of Forest (Vigilance)	..	Member
13.	The Chief Conservator of Forest (Social Forestry)	..	Member
14.	The Regional Chief Conservator of Forests (North)	..	Member
15.	The Regional Chief Conservator of Forests (South)	..	Member
16.	The Conservator of Forests (Biodiversity)	..	Member
17.	The Conservator of Forests (Working Plan & Research)	..	Member
18.	The Deputy Conservator of Forests (Research) North	..	Member
19.	The Deputy Conservator of Forests (Research) South	..	Member
20.	The Managing Director, Kerala Forest Development Corporation	..	Member
21.	The Associate Dean, Forestry Faculty, Kerala Agricultural Univ.		Member
22.	The Director, Tropical Botanic Garden & Research Institute, Palode	..	Member

23.	The Director, Institute of Forest Genetics & Tree Breeding, Coimbatore	..	Member
24.	The Managing Director, Oushadi, Thrissur	..	Member
25.	The Director, Centre for Earth Science Studies	..	Member
26.	The Director, Centre for Water Resources Development & Management	..	Member
27.	The Director, Rajiv Gandhi Centre for Biotechnology	..	Member
28.	'URAVU' Wynad (N.G.O.)	..	Member
29.	The Director, Medicinal Plant Research Centre, Arya Vaidya Sala Kottakkal	..	Member
30.	The Managing Director, Hindustan Newsprint Ltd., Kottayam	..	Member
31.	The Managing Director, Kerala State Wood Industries Ltd., Nilambur	..	Member
32.	The Managing Director, Kerala State Bamboo Corporation Ltd.	..	Member
33.	The Director, Salim Ali Centre for Ornithology and Natural History Coimbatore	..	Member
34.	Director, Kerala Forest Research Institute, Peechi	..	Member
35.	Research Co-ordinator, Kerala Forest Research Institute, Peechi	..	Member
36.	Programme Co-ordinator, Training & Extension Division, KFRI	..	Convenor

Functions

i. Advise the Institute and to suggest problems of relevance to the Forest Department and wood based industries.
ii. Consider and recommend appropriate actions and permission required by KFRI Scientists from the Forest Department for conducting field studies.
iii. Identify forest officials from the Forest Department in specific research projects where KFD's collaboration is required for successful implementation of a field-based study.
iv. Facilitate transfer of technology from KFRI to Forest Department and other stakeholders.

2. PURCHASE COMMITTEE

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

One Scientist F or above:	Dr. KM Bhat	..	Chairperson
One Scientist nominated by the Director	Dr. KC Chacko	..	Member
Registrar		..	Convenor

Function

To examine the feasibility of purchase of equipments or other items screened and suggested by the Equipment Committee, within the financial frame work of the Institute and recommend purchase.

Procedures

i. The Purchase Committee shall consist of two Scientists (one with F Grade or above) and the Registrar. The Scientist with F or higher grade will be the Chairperson.

ii. The Committee shall take decision on purchase based on price quoted and the quantity of the item required and the Registrar shall sign the purchase order as per the rate approved by the Committee.

iii. A Register of Suppliers containing address and performance or each Supplier, shall be maintained by the Committee. Enquiries in writing shall be sent to all the suppliers whose names are listed in the Register. The quotationer should keep the Quoted Rates Form for a period of one year.

iv. The maximum amount that the Committee can recommend for purchase of a single item will be Rs.10 lakh and the approving authority will be the Director. In recommending purchase of items costing over Rs.10 lakh and less than Rs.50 lakh, the Purchase Committee shall have an external member and the Management Committee will be the approving authority. Any item costing more than Rs.50 lakh should be referred to the Executive Committee of the Council (KSCSTE) for approval.

v. Amendments to the guidelines contained herein shall be made with the approval of the Executive Committee of the Council.

3. BUSINESS DEVELOPMENT GROUP

Director	..	Chairperson
Dr. EJ Maria Florence	..	Working Chairperson
Dr. M Sivaram	..	Member
Shri. VP Ravindran	..	Convenor

Functions

i. The Committee will facilitate: (a) transfer of technology to end users, and (b) commercialization of technology through entrepreneurs or partners, such that research results of applied value emerging from KFRI find field applications for the benefit of Forest Department and other end users (eg. root trainer technology, composting technology, suitability of clones/ tree species, fertilizer dosage, fungicide/pesticide dosage for controlling diseases/pests, wood preservative treatment, etc.).

ii. It is essential that all field based technologies/recommendations are rigorously screened before they are transferred or recommended and therefore, the Group will evaluate the technologies/recommendation proposed/made.

Procedures

i. The Working Chairperson, with prior approval of the Director, will call for meeting of the PIs concerned who have made the recommendations. The Working Chairperson will collect all details (eg. Statistical design, treatments, sample size, data sheets, etc.) pertaining to the proposed recommendation. The PI who has proposed the transfer of technology/field based recommendation will present the details of the technology before the Committee. The Group may visit field site/experimental areas to ascertain the effectiveness of the proposed recommendation. If necessary, the Chairperson may constitute a sub-committee including the PI and the Convener for further screening of the technology/recommendation. Based on the above, the Committee may recommend transfer of technology to user agencies/ entrepreneurs.

ii. In the case of a suggested commercialization the Committee will evaluate the product/ technology/ recommendation, for wider applications/ commercialization through entrepreneurs and other industrial firms. The Chairperson may invite expression of interest from entrepreneurs through media/ website and negotiate and shortlist the interested agencies. In instances where mutual agreement between the entrepreneurs and the Institute has been arrived at in terms of financial benefit sharing and intellectual property rights, the Group will prepare a mutually agreeable MOU. The MOU has to be approved by the Management Committee of the Institute and the Council (KSCSTE), and signed by the Director.

iii. The Convener will prepare minutes of the meeting and circulate to all the members with the approval of the Chairperson.

4. COMMITTEE TO PREVENT SEXUAL HARASSMENT ON WOMEN AT KFRI

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

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

Functions

To receive complaints from the staff on sexual harassment and advice the Director on necessary actions.

Procedures

i. The Committee may make necessary enquires into the matter by various means and report the observations and findings to the Director.
ii. The Committee may also suggest needful actions from the Director.

5. INTERNAL RESEARCH GROUP (IRG)

Director	..	Chairperson
Dr. C. Renuka	..	Convenor
Dr. CN Krishnankutty	..	Associate Convenor
All scientific staff	..	Members

Functions

To review: (a) On-going projects in the Divisions, (b) Constraints in implementation of research initiatives, (c) New facilities/equipments to be organized, (d) Training and extension options/ needs from the Division(s), (e) Research output in terms of new technologies/findings, patents, and publications, (f) Seminars/symposia/ workshops organized and training/extension activities provided, (g) Emerging research fronts and necessary changes in the goals of the Division(s), and (h) New initiatives to be taken up.

Procedures

i. Director shall be the Chairman of IRG and all Scientists will be members.
ii. The IRG is to meet annually in January/February, each year, and if necessary, special IRGs may be called for.
iii. The IRG Convener, will fix a date for the meeting, in consultation with the Director and he will intimate the schedule to the Programme Coordinator(s) and Scientists.
iv. The Programme Coordinators will prepare a *Review Report* by consolidating the information pertaining to items *i-vii* mentioned in functions above. A copy of the same may be provided to the IRG convener.
v. The Programme Coordinators will make a brief presentation of the Review Report giving an overall picture of the activities of the Division(s).
vi. New concept notes/project proposals will be presented in the IRG.
vii. The Convener, will prepare the Minutes of the meeting, get it approved by the Director and send a copy to the Programme Divisions.

6. FOREST SEED CENTRE ADVISORY COMMITTEE

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

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

Functions

To monitor the working of the Forest Seed Center and advise on its smooth functioning. To promote sale and export of seeds and to fix price for seeds.

7. TEAK MUSEUM & NATURE TRAIL ADVISORY COMMITTEE

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

Functions

i. Review the overall activities and functioning of the Teak Museum and the Nature Trail in the Bioresources Park.
ii. Examine requests from the Museum Curator for implementing various activities/ programmes and advising for taking up new activities and programmes.
iii. Offer suggestions for improving the activities and programmes at the Teak Museum and the Nature Trail in the Bioresources Park.

Procedures

i. The Committee shall meet as and when necessary but at least once in six months.
ii. Minutes of the meeting along with observations/recommendations will be submitted to the Director for consideration and approval.

8. LIBRARY & INFORMATION NETWORKING ADVISORY COMMITTEE

Shri K Sankara Pillai	..	Chairperson
Dr. S Sankar	..	Member
Dr. C Mohanan	..	Member

Smt. P Rugmini	..	Member
Smt. N Sarojam	..	Member
Shri. KH Hussain	..	Member
Shri AR Rajan	..	Convenor

Functions

i. To review of the library and information services in the Institute and suggest general management policies.

ii. Review of requests and recommendations for purchase of books and documents and subscription to journals from the Librarian.

Procedures

i. Meetings may be arranged by the Convener as and when necessary, but at least once in three months.

ii. The Chairperson shall communicate the minutes/recommendations to the Director for information/action.

iii. Members of the Committee may also make independent observations on the up keep of the library and report to the Librarian/Director on actions needed.

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

Dr. RV Varma	..	Chairperson
Dr. EA Jayson*	..	Associate Chairperson
Dr. EM Muralidharan	..	Member
Dr. T Surendran	..	Convenor
Invitee(s)	..	Respective guide(s)

*Dr. EA Jayson to take over from the date of Dr. RV Varma's superannuation

Functions

Ph. D. Programme

i. Advice the Director on policy matters related to Ph.D. programme.

ii. Approve the schedule of attachment of part-time students at KFRI.

iii. Screen applications received for Ph.D. registration in due consideration of the guidelines issued by KFRI and the Universities concerned and make recommendations to the Director.

iv. Approve and approve course work of students.

v. Organize seminars by Ph.D. scholars every month in consultation with the Research Guides and Chairperson, Seminar Committee.

M. Sc. Attachment Programme

i. Screen the applications received for M. Sc. Attachment programme in specialized areas and select candidates by examining their merits or conducting interview.
ii. Assign the students to the scientists concerned and coordinate their activities.
iii. Evaluate the performance after attachment and send the report to the College/ University concerned.

Procedures

The Committee shall meet as and when necessary. Three members shall make up the quorum.

10. INTELLECTUAL PROPERTY RIGHTS, PATENT AND MATERIAL TRANSFER COMMITTEE

Dr. K Jayaraman	..	Chairperson
Dr. M Balagopalan	..	Member
Dr. VV Sudheendrakumar	..	Member
Dr. EP Indira	..	Member
Dr. KV Sankaran	..	Convenor

Functions

i. Acquire all available information/literature/procedures on IPR and patenting and make them available to scientists as and when required.
ii. Keep scientists abreast of new developments in the field of IPR and patenting.
iii. Identify new technologies developed by KFRI which can be patented with the help of the scientists concerned.
iv. Facilitate filing of patent applications by the Institute and pursue patent applications at national or international level.

Procedure

i. The Committee will meet as and when required and identify the new technologies which possibly can be patented.
ii. The Committee may also include a new technology for consideration for patenting as suggested by a scientist.
iii. The Committee will hold detailed discussions with the scientists concerned and gather details of the technology.
iv. The Chairperson will make a presentation on the technology/technologies tentatively selected in a special IRC. The scientists concerned will also attend the meeting and provide clarifications.
v. The Committee will submit the final list of new technologies to Director for his approval.

vi. On Director's approval, the Committee will obtain necessary details of the technology in the prescribed format from the concerned scientist(s) and submit to Director for onward transmission to Patent Office.

vii. The Committee will pursue the application with the patent office and keep the Director informed of the developments.

viii. The Convener will prepare minutes and communicate the same along with the approval of the Chairperson to all the members.

11. EQUIPMENT COMMITTEE

Dr. M Balasundaran	..	Chairperson
Dr. MP Sujatha	..	Member
Shri PK Thulasidas	..	Member
Dy. Registrar (Admn)/Supdt./OA (Purchase)	..	Convenor

Functions

i. Screening of requisitions for major equipments, computers, computer accessories, furniture, phone, e-mail connection, etc., to avoid duplication.

ii. Examine necessity for the equipment/furniture and ensure fund allotment in the project.

iii. Scrutinize quotations and recommend for acceptance.

iv. Recommend for proper maintenance, upkeep and use of equipments.

v. To fix up charges for the use of equipments by outsiders.

Procedures

i. Meetings may be arranged by the Convener as and when necessary.

ii. The Convener will prepare the minutes of the meeting including the decisions taken and communicate to the Director for consideration.

12. COMPUTER COMMITTEE

Dr. P Vijayakumaran Nair	..	Chairperson
Dr. KK Ramachandran	..	Member
Shri AR Rajan	..	Member
Dr. Mamman Chundamannil	..	Member
Shri KH Hussain	..	Member
Dy. Registrar (Admn) Supdt./ OA(Purchase)	..	Convener

13. STORES COMMITTEE

Dr. KC Chacko	..	Chairperson
Dr. M Sivaram	..	Member
Dr. V Anitha	..	Member
Dy.Registrar (Admn)/ Stores-in-Charge	..	Convener

Functions

i. The Committee shall take care of all the purchases of stores items, printing of forms, etc.
ii. The Committee shall also make suggestions for the improvement of the customs and services from the Stores.

14. SEMINAR COMMITTEE

Dr. Mamman Chundamannil	..	Chairperson
Dr. KK Seethalakshmi	..	Member
Shri KH Hussain	..	Convenor

Functions

i. Organize lectures by scientists/research fellows of the Institute as well as invited experts on various subjects related to forestry.
ii. Organize debates and discussions on topics of multi-disciplinary interest.
iii. Assist the organization of various Workshops, Meetings in the Institute.

Procedures

i. There shall be at least one Seminar once in three months.
ii. Invited speakers may be paid travel expenses and local hospitality when necessary, and a token honorarium, on prior approval of the Director.
iii. Facilitate presentations by the participating Scientists as and when required.

15. NEWSLETTER COMMITTEE

Dr.K. Swarupanandan	..	Editor
Dr. K.V Bhat	..	Associate Editor
Shri KF George	..	Associate Editor

Functions

i. Publication of the Newsletter (Evergreen) in March and September, every year.
ii. Review of policies for publication and dissemination of the Newsletter.

Procedures

i. Gathering scientific articles, information relating to activities of the Institute and interim research results.

ii. Edit the materials and get the Newsletter printed in time.
iii. Review and suggest improvements to the publication of the Newsletter.

16. ANNUAL REPORT COMMITTEE

Dr. KV Bhat	..	Chairperson
Shri PA Sulaiman	..	Member
Dr. CK Soman	..	Convenor

Functions

i. To compile information on progress of work in each research project, various aspects of research and other activities in a prescribed format from all the Divisions, including Administration, Nilambur Sub Centre and Field Research Centre, Palappilly.
ii. To collect relevant information on budget, fund allocation, expenditure, *etc.* from RME and Administration.
iii. Prepare a draft Annual Report by 30th April each year for approval of the Managing Committee.
iv. To get the Annual Report printed after Council's approval for circulation.

17. CAMPUS DEVELOPMENT COMMITTEE

Dr. MS Mukteshkumar	..	Chairperson
Smt. VK Leela	..	Member
Dr. UM Chandrashekhara	..	Member
Shri K Nanu	..	Member
Shri V Asokan	..	Convenor

Functions

i. To advise the Director on matters related to upkeep of the campus buildings, gardens and surroundings.
ii. To propose development plans for the Institute campuses by preparing a map of the campus marking various building complexes, gardens, (CMA, Palmetum, Rattan germplasm, Central nursery, etc.) and campus facilities such as playgrounds, so as to identify areas where scope exists for future development.
iii. To initiate greening up programmes for the Institute campus including Office Premises.
iv. To evolve a systematic campus life facilitation programme.

Procedures

i. With the input and help from the Engineering Division, prepare a map of the Institute campus at Peechi, Nilambur and Velupadam.

ii. Identify areas for immediate and future campus development and greening up.
iii. Identify, organize and implement suitable garden development programmes.
iv. Evolve a suitable mechanism for periodic interaction with the residents of the Campus and recommend campus development and welfare measures to the authorities.
v. To extend and deploy Institute's facilities to the residents in emergency situations.

18. GARDEN COMMITTEE

Dr. RV Varma	..	Chairperson
Dr. N Sasidharan*	..	Associate Chairperson
Dr. Thomas P.Thomas	..	Convenor

*Dr. N. Sasidharan to take over from the date of Dr. RV Varma's superannuation

19. SPORTS COMMITTEE

Dr. K Mohanadas	..	Convenor
Shri KR Mukundan	..	Member
Shri K Sankara Pillai	..	Member
Shri CK Vincent	..	Member

Functions

i. To organize sports and games in the Institute, each year.
ii. To coordinate athletes from KFRI, facilitate their coaching and partake in the sports and games organized by the State Forest Department, each year.

20. CAFETARIA COMMITTEE

Dr. ARR Menon	..	Chairperson
Smt. Sabitha Balakrishnan	..	Member
Shri James Tidode	..	Convenor

Functions

i. Overall supervision of efficient functioning of the Institute Cafeteria, including maintenance of hygiene and cleanliness.
ii. Ensure price and quality control of food in the Cafeteria through interaction with the contractor and to suggest menus depending upon requirement and demand.
iii. To keep an inventory of all the items such as kitchen equipments, cookware, crockery, cutlery, etc. belonging to the Institute.
iv. To facilitate repairs and maintenance of the Cafeteria and to suggest/ recommend improvements in its working.
v. To ensure prestigious ambience in the Cafeteria to suit the Research Institution.

LIST OF STAFF

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

8.1 Scientific Staff

Dr. R. Gnanaharan, *Director*

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

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

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

Technical staff

No.	Name	Designation	Date of joinig
1.	Shri. P.P. Sunny	Sr. Spl. Grade Technical Officer	23-04-1979
2.	Shri. U.Y. John	Spl. Grade Technical Officer	09-01-1981
3.	Shri. C.A. Jose	Sr. Spl. Grade Technical Assistant	07-05-1982
4.	Shri. D. Skariah	Spl. Grade Technical Assistant	01-09-1983
5.	Shri. K.C Subramanian	Spl. Grade Technical Assistant	22-07-1985
6.	Shri. K.M. Velayudhan	Spl. Grade Technical Assistant	10-03-1986
7.	Shri. M.R. Anilkumar	Spl. Grade Technical Assistant	30-01-1989
8.	Shri. P.B. Sajeeva Rao	Spl. Grade Technical Assistant	30-01-1989

Administrative staff

No.	Name	Designation	Date of joining
1.	Shri. K. Thulaseedharan Nair	Registrar (on deputation leave)	15-03-2002
2.	Dr. C.M. Joy	Registrar	On deputation
3.	Shri. P. Achuthankutty	PS to Director	03-01-1983
4.	Smt. V.K. Leela	Sr. Section Officer	02-07-1979
5.	Smt. K.N. Rajamma	Sr. Section Officer	02-07-1979

6.	Shri. M. Achuthan kutty	Internal Auditor	On deputation
7.	Shri. A. Ramakrishnan	PA to Registrar	16-11-1977
8.	Shri. M.S. Sukumaran	Section Officer	09-01-1980
9.	Sri. V. Asokan	Sr. Office Superintendent	16-10-1976
10.	Smt. K.M. Suseela	Sr. Assistant Office Manager	18-04-1980
11.	Shri. K. Rajendran	Assistant Office Manager	01-07-1986
12.	Shri. P.A. Sulaiman	Assistant Office Manager	12-08-2003
13.	Shri. K.A. Gopalan	Assistant Office Manager	20-05-1987
14.	Smt. Mary Kuruvilla	Sr. Assistant Office Manager	07-07-1980
15.	Smt. Sabitha Balakrishnan	Office Assistant	03-09-1999
16.	Smt. Shirly Issac	Office Assistant	26-08-2003
17.	Smt. K. Annapoorni	PA to Research Coordinator	12-07-1982
18.	Smt. Grace Andrews	Spl. Grade Confidential Assistant	27-01-1987
19.	Shri. P.M. Venugopalan	Spl. Grade Typist	22-05-1978
20.	Shri. E.O. James Tidode	Spl. Grade Typist	31-01-1979
21.	Shri. K.P. Manoj	Sr. Typist	28-08-1992
22.	Shri. T.M. Abdul Vahab	Sr. Word Processing Assistant	27-01-1989
23.	Shri. K.S. Karunakaran	Sr. Clerical Assistant	01-12-1978
24.	Shri. T. Prabhakaran	Sr. Clerical Assistant	23-10-1976
25.	Shri. T. Chandran	Sr. Spl. Grade Driver	19-10-1976
26.	Shri. P.I. Madhavan	Sr. Spl. Grade Driver	22-10-1976
27.	Shri. K. Girijavallabhan	Sr. Spl. Grade Driver	22-03-1977
28.	Shri. S. Shahul Hameed	Sr. Spl. Grade Driver	06-06-1977
29.	Shri. P. Mohandas	Spl. Grade Driver	06-08-1979
30.	Shri. T.C. Paul	Senior Driver	01-07-1994
31.	Shri. V.C. Chandran	Senior Driver	01-07-1994
32.	Shri. K.M. Mathen	Driver	31-03-2001
33.	Shri. M.C. Mohandas	Sr. Attendant	24-10-1977
34.	Shri. P.A. Sankarankutty	Sr. Attendant	30-01-1978
35.	Shri. K.R. George	Sr. Attendant	18-07-1978
36.	Shri. K.R. Sevaraman	Sr. Office Messenger	22-01-1979
37.	Shri. A.V. Velayudhan	Sr. Attendant	13-06-1979
38.	Shri. K.K. Ahammad	Sr. Attendant	02-08-1979
39.	Shri. P.S. Raman	Sr. Attendant	02-04-1980
40.	Shri. M.C. Reghunathan	Sr. Attendant	08-04-1980
41.	Shri. V.N. Balakrishnan	Attendant	24-07-1981

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

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