KFRI

EVERGREEN

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Bambusa bamboos

Bamboo for Centuries

Advancement in the industrial use of bamboo has rendered it as one of the promising raw materials for future with a potential for poverty alleviation through employment generation in various sectors including cultivation, harvesting, processing, product development and marketing. In India, recently a re-discovery of the potential of bamboo for developing as one of the sunrise industries has resulted in launching of an integrated Bamboo Development Programme by the Prime Minister on 5 June 1999 to focus on the development of bamboo sector. Planning Commission, Government of India took a lead in this and launched 'National Mission on Bamboo Technology and Trade Development' with an intention to implement an action programme involving bamboo as a key component for generation of employment through establishment and strengthening of existing bamboo industries and achieving environmental sustainability through establishment of new bamboo plantations.

The Planning Commission evolved a strategic perspective and developed an action plan to give maximum emphasis for promotion and development of bamboo during tenth plan (Planning Commission, 2003). Ecological security through restoration of degraded lands, productivity improvement of existing bamboo stands and development of industry specific plantations are some of the programmes proposed for resource enhancement. Creation of 8.6 million jobs in the bamboo based development programmes with a target of 5.01 million families to escape poverty on a sustainable basis, upgradation of skil of crafts persons, food and nutritional security through consumption of bamboo shoots etc. are proposed. Ultimately, the action plan envisages laying down the foundation of a modern bamboo economy based on science, technology, people's participation, industrial application and strong linkage with market capable of meeting global competition. A financial outlay of Rs. 2608 crores has been alloted for various activities to be undertaken immediately during 10th plan.

Minister for Science and Technology, Government of India announced on the Technology Day, 2002 of the establishment of the National Mission on Bamboo Applications (NMBA) under Technology, Information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology to focus on the commercialization of value added applications in the bamboo sector (NMBA, 2004). Various State Governments like Tripura, Mizoram and Kerala have already developed policies for integrated development of this sector.

It is envisaged to expand Indian bamboo economy steadily to the level of Rs. 26,000 crores by the year 2015 from that of about Rs. 2000 crores at present. In addition to the paper pulp industries, the potential to start other large-scale industries like bamboo shoot processing, bamboo boards, flooring boards, furniture, new uses in building and road construction etc., was also emphasized.

Resource development to meet the raw-material requirement for industries is a matter of concern at present. Although bamboos are available in forest and non-forest areas, due to various constraints like lack of sustainable management, unscientific harvesting practices, gregarious flowering and death of flowered clumps, policies governing allotment of raw material to entrepreneurs in private sectors etc., are the major constrains for upcoming industries. To meet raw material requirement a long term planning for management of existing resources and augmentation of resources with establishment of industry specific plantations along with policy changes promoting cultivation and supply of raw material to industries are required.

Lack of information on appropriate species for different uses, species site matching and plantation/agro forestry techniques for large-scale cultivation, synergy between micro and macro

Dendrocalamus giganteus

Issue Highlights

Dendrocalamus brandisii

propagation techniques to produce planting stock in large-quantity are some of the constraints identified for development of industrial plantations. Although re-discovery of the potential of bamboo for integrated development is a recent initiative in India, Research Institutions have identified bamboo as a priority species as early as 19th century as indicated by publications on production of planting stock through vegetative methods, observations on flowering, management of bamboo stands etc (Sarojam, 2003; Hussain, 2004). Information on the above aspects are available in research publications based on the results of limited local experiments in different regions, it requires testing and validation to implement in large-scale.

Since it is difficult to promote the development of all the potential bamboo species that are restricted in distribution and limited in quantity, NMBA has recommended to focus on 15 commercially important bamboo species. The recommendation is on the basis of the expert group's meetings on resource and utilization, distribution of the species, testing of characteristics and matching with existing uses.

Bamboo species recommended by NMBA (synonyms in bracket)

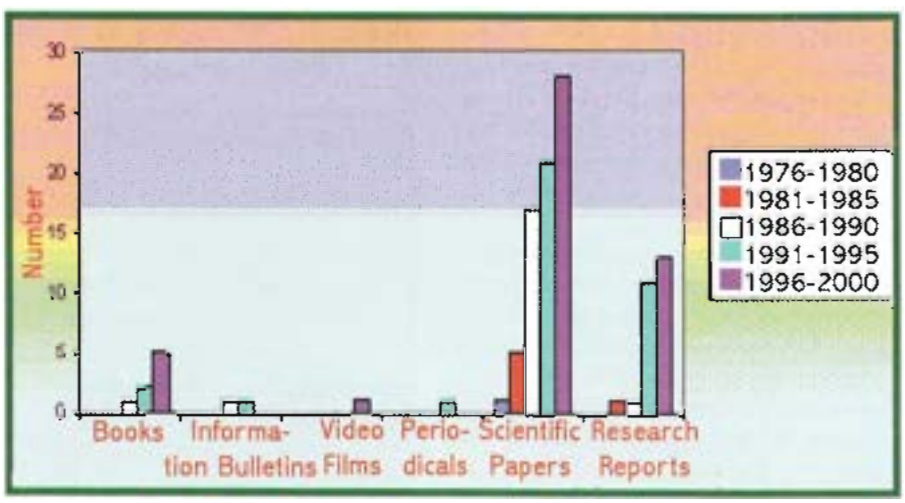
1. *Bambusa affinis* Munro
2. *Bambusa balcooa Roxb. (Dendrocalamus balcooa* (Roxb.) Voigt)
3. *B. bambos* (L.) A.Voss
4. *B. nutans* Wall. ex. Munro
5. *B. polymorpha* Munro
6. *B. tulda* Roxb (*Dendrocalamus tulda* (Roxb.) Voigt
7. *Dendrocalamus asper* (Schult.) Backer ex Heyne
8. *D. brandisii* (Munro) Kurz
9. *D. giganteus* Munro
10. *D. hamiltonii* Nees and Arn.
11. *D. strictus (Roxb.)* Nees
12. *D. stocksii* (Munro) M.Kumar, Ramesh and Unnikrishnan
13. *Melocanna baccifera* (Roxb.) Kurz.
14. *Ochlandra travancorica* (Beddome) Bentham
15. *Phyllostachys pubescens* Mazel ex H.de Lehaie

In Southern India, the Kerala Forest Research Institute, Peechi situated in the Western Ghats, one of the bamboo rich areas, has gained national and international recognition in bamboo research in various aspects which was initiated during 1980's and supported initially by various agencies like Food and Agriculture Organization (FAO), International Development Research Centre (IDRC), International Network for Bamboo and Rattan (INBAR). This was continued with the assistance of Overseas Development Authority (ODA), United Nations Development Programme (UNDP) Indian Council for Forestry Research and Education (ICFRE), Ministry of Textiles, Ministry of Environment and Forests, National Mission on Bamboo Applications (NMBA) etc. Contributions to bamboo and rattan research, one of the strengths of the Institute, is the result of collective short and long-term inputs from about 40 Scientists. KFRI has a bambusetum with 64 species covering both sympodial and monopodial types. The Bamboo Information Centre and the two websites, bamboobiblio.info containing annotated bibliography of more than 3000 publications and bamboo and rattan research at KFRI attached to the KFRI website (kfri.org) are KFRI's initiatives to meet the information requirement of stakeholders. With a strong knowledge base as evident through more than 200 publications brought out during the past two decades and excellent trained manpower involved in multi-disciplinary research, the Institute is geared up to take a leading role in bamboo and rattan research, education and extension in the country.

In the context of resource enhancement through industry specific plantations, a recent extension programme implemented by KFRI to enhance bamboo and rattan resource suitable for handicraft industry, sponsored by the Development Commissioner (Handicrafts), Ministry of Textiles requires special mention. As a nodal agency, the Insitute implemented this important project in five states (Kerala, Assam, Arunachal Pradesh, Tripura and Manipur) in collaboration with Rain Forest Research Institute, Jorhat, Assam and State Forest Research Institute, Itanagar, Arunachal Pradesh.

It was clear while implementing the project that in spite of the national importance given to bamboo, lack of awareness existed among the public on species availability, sustainable harvesting methods and scientific management of bamboo clumps, value added uses such as flooring, edible shoots, composite boards and charcoal. While attempting popularization of bamboo cultivation in homesteads and private lands, the need for changes in government policies to promote cultivation of bamboo and forest trees was stressed by the public.

Some of these issues were addressed through identification of interest groups for taking up cultivation and organizing specialized training programmes to develop capacity building. In Kerala, about 1000 farmers/NGOs/SHGs/ department officials were trained in nursery and plantation techniques. Through field visits bambusetum and the wide range of species available for cultivation was presented to the interest groups. Familiarization with various species resulted in a "bamboo species shopping"



Different types of publications on bamboo for the last 25 years

Dendrocalamus strictus

by the user groups through which they indicated the required species and quantity of planting stock. Demand for planting stock of species such as *Dendrocalamus giganteus*, *Thyrsostachys oliveri*, *Bambusa nutans*, *Dendrocalamus brandisii* and *Bambusa bambos* was high.

Seeds were not available for most of the species selected by the interest groups and hence meeting the planting stock requirement was one of the major challenges. Establishment of decentralized nurseries with participation of trained farmers/NGOs/SHGs and establishment of demonstration plots in the area provided by the interest groups were some of the promising methods found to meet the targets. A national level workshop on policy and legal issues organized to address the policy changes required resulted in solid recommendations for promotion of cultivation (Mohanan et al., 2002). The project in general laid the foundation for initiating bamboo cultivation in private sector, increased the awareness about the immense potential of bamboo and invited the attention of policy makers to some of the constraints to be addressed in the development of this sector in general and Kerala in particular.

In the context of launching of a national level programme for bamboo development, the expertise and the infrastructure at KFRI, sufficient to cater to the requirement of various stakeholders, can be put to maximum use. The expertise developed through implementation of research and extension projects and training received and imparted covers broad areas such as resource inventory through remote sensing and GIS, taxonomical identification and herbarium techniques, flowering and reproductive biology, seed and vegetative propagation methods, seed storage, tissue culture techniques, nursery and silvicultural methods, soil and nutrient management, genetic improvement through superior clones, molecular biology, pests and diseases problems and their management, anatomical, physical, chemical, mechanical properties and strength testing, harvest and post-harvest technologies, socio-economic aspects and indigenous knowledge and information and networking.

Through the recognition received from the Ministry of Environment and Forests as the Centre of Excellence in Bamboo and Rattan Research the institute is open to share the experience at national level and looking forward for the input from all interest groups in developing the bamboo sector.

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K.K. Seethalakshmi
Plant Physiology Division

Kattunaragam - a money spinning tree

Atalantia monophylla (L.) DC belonging to the family of *Rutaceae* and locally known as Kattunaragam is a small thorny tree. This tree grows naturally in Peninsular India including Kerala, Orissa, Assam, Meghalaya and Andamans. *A. monophylla* is a small tree, spines straight, axillary; leaves elliptic, lanceolate, apex emarginated; corymos axillary, flowers white, fascicled in the leaf axils, pedicels pubescent; calyx 4-lobed; petals 4; ovary 4-celled; berry as large as a lime or nutmeg, globose, usually 4 celled.

The wood is pale-yellow to yellowish white, turning light brownish yellow with age. It is smooth, odourless, hard and durable. It is easy to saw when green and is difficult to season as it develops endse its. The timber is useful for making scales, small tool handles, camp furniture and for engraving.

The berries are pickled. They yield an essential oil having medicinal property which is useful in treatment of chronic rheumatism and paralysis. The oil has anti-bacterial and anti-fungal properties. The juice of the plant is used as a dye. A decoction of the leaves is used in treatments of cutaneous complaints.

On steam distillation, the leaves yield a brown essential oil with a pleasant odour. The roots possess anti-spasmodic stimulant and resolvent properties. They are used in rheumatism and in swellings.

The tree is said to be money spinning and in West Bengal farmers have recognised its commercial value and started cultivating it. It is reported that a mature tree would yield about 6 Kg of fruit and one kg. of fruit fetches about Rs.1000. Even though *Atalantia monophylla* grows in our evergreen forests, we have not attempted to cultivate it. It is a tree species worth popularizing among farmers.

K. Yesodharan
Botany Division

RELEASING SHORTLY

Teak Bibliography in CD

This is an annotated bibliography on teak (*Tectona grandis* L.) in CD covering world literature on the topic. The CD will contain about 5000 references and will have a user friendly search mechanism to retrieve information. This will be the biggest source of information on teak and will be highly useful to all concerned with this magnificent tree including researchers, forest officials, farmers, students etc.

For more details contact the Librarian, KFRI:
E-mail : lsolliai@kfri.org

Aggregation of butterflies in the Butterfly Garden at KFRI

Aggregation of blue tiger on *Crotalaria retusa* in the Butterfly Garden at KFRI

A butterfly garden is established in the KFRI campus at Peechi as part of a butterfly conservation programme sponsored by the Ministry of Environment and Forests, New Delhi. The garden has an area of about 0.5 ha. The terrain undulating with steep slopes, has been landscaped and planted with suitable butterfly host plants for attracting and sustaining various groups of butterflies. In order to develop appropriate habitats, bushes, lianas, and ponds are also set up. There are two major sections in the butterfly garden 1) a butterfly foraging cum oviposition area to sustain butterfly populations and 2) a butterfly exhibit area to enable the visitors to observe the butterflies closely. The slopes are planted with various flowering plants such as *Cassia alata, Clerodendrum paniculatum* and *Lantana camara* interspersed with various butterfly larval host plants such as *Citrus* spp., *Cinnamomum* spp., *Murraya koenigi, Ficus* spp., *Aristolochia indica* and *Cassia* spp. formed the main foraging area for several species of butterflies such as common rose (*Pachliopta aristolochiae*), crimson rose (*Pachliopta hector*), Birdwing (*Troides minos*), common crow (*Euploea core*), Emigrants (*Catopsilia* spp.) and grass yellows (*Eurema hecabe*). Many of these butterflies have colonized this area because of the availability of various adult and larval host plants. The ridge of the hillock is landscaped by setting up a pond and a rock garden and formed the butterfly exhibit area. In this area, various flowering plants such as *Ixora* spp., *Cassia* spp., alamanda, hibiscus, cuphea, zinnia, and *Lantana camara* besides selected butterfly larval host plants such as *Wattakaka volubilis, Tylophora indica* (Blue Tiger); *Tylophora camosa* (Striped Tiger); *Asclepias* sp., *Calotropis gigantea* (Plain Tiger); *Carissa carandus* (common crow); *Albizia lebbeck, Cassia* spp. (grass yellow, emigrants); *Citrus* spp., *Murraya koenigii* (Lime butterflies), *Mussaenda* spp. (commander); *Ixora* spp. (monkey puzzle) and *Kalanchoe* spp. (Red Pierrot) for attracting specific butterflies as indicated in parenthesis. In addition to these, various butterfly roosting plants such as *Heliotropium keralense* and *Crotalaria retusa* that promote aggregation of danaine butterflies have also been introduced.

During the last week of June 2004, large aggregation of butterflies particularly of the blue tiger, striped tiger and common crow has been observed on *Crotalaria retusa* plants maintained in the butterfly exhibit area. The common crow and the blue tiger were the most abundant and dominant species in the aggregation. Since Crotalaria plants were established at several places in the garden, there was a huge population build up and spread of these butterflies. On an average, 000 butterflies were recorded. Fifty to one hundred butterflies were seen on a single Crotalaria plant during the peak season. In the previous years, the peak period of aggregation varied between July to September depending upon the prevailing climatic condition. A climatic regime having a temperature of 25-26° C, 80-100% RH and 50mm rainfall is the most appropriate condition for many species of butterflies including the danaines. Although aggregation of danaine butterflies has been observed during the months June to December in the past five years since the establishment of the garden, this is the first time that such large-scale aggregation is noticed on *Crotalaria retusa*. From December onwards as the climate get drier, the butterflies normally migrate to the shades in the nearby natural forests in the catchments area of Peechi Dam where very large aggregations of these butterflies have been observed till April in the succeeding year. Such aggregations may contain as high as 8000-15000 butterflies.

Butterfly aggregations have been reported from Vazhachal, Thenmala, KFRI Campus at Nilambur (under the dense canopy of *Hopea parviflora*) and at Silent Valley National Park in the past. It is very interesting that the number of individuals involved in aggregation in the KFRI butterfly Garden is increasing year after year which is attributable to restoration of appropriate butterfly habitats in the area.

George Mathew
Rashmi Chandran
R.S.M. Shamsudeen
Division of Entomology

The Science behind "Chandattam" - Teak wood distillate a wood preservative

In ancient Kali Temples of Kerala, the idol of the deity is generally made up of jack wood. In many of these temples, there exists an offering called "Chandattam". In this offering, the black liquor distillate of teak heartwood which is known as "Thekkuchandu" is poured ('Abhisenka') over the idol. As a result, the wooden idols look jet-black in colour. As the "Sreekovil" (sanctum sanctorum), where the idol is kept in a closed room without much air circulation, the environmental conditions are favourable for fungal infestation and decay of wood. However in Kali temples, the woocen idol remain protected against biodeterioration which is attributable to the application of teak wood distillate. It is known that the tarry liquor product obtained through destructive distillation of wood contains phenolic compounds which have fungicidal properties.

Thus chandattam as an offering appears to be a truly scientific approach for wood protection. Eventhough the preservative effect of such a practice was well evident, the science behind it was unknown to the people who practiced it. The technology for destructive distillation of teak heartwood for producing "Thekkuchandu" (teak distillate) lies with the rural people connected with ancient Kali temples of Kerala. This indigenous knowledge (IK) needs protection and documentation for the posterity.

Considering the wood preservative value of the distillate for protecting ancient idols of archaeological value, further studies are being taken up at KFRI to characterize the chemical nature of the distillate and the utilization potential of the by-product, charcoal.

T. K. Dhamodaran
Wood Science Division

Situated on the lap of Anamalai hills, in the Revenue District of Palakkad, the Parambikulam Wildlife Sanctuary occupies an area of 274 km^2. The sanctuary abodes all the major vegetation types of the Western Ghats. Teak is the major plantation species covering about 87 km^2. The study resulted in documenting 1434 plant species belonging to 755 genera under 142 families, including two gymnosperms. Three hundred and sixty species recorded from the sanctuary are endemic to Peninsular India of which 28 are exclusive to the Anamalai-High Range circle. One genus (*Haplothismia* Airy Shaw) and four species are so far known only from the sanctuary. The sanctuary abodes 109 species belonging to various threatened categories of which 10 are considered as '*possibly extinct*'. *Haplothismia exannulata* Airy Shaw and *Syzygium palghatense* Gamble were collected for the first time after their type collections. Endangered species like *Atuna travancorica* (Bedd.) Kosterm., *Piper barberi* Gamble, *Pothos crassipedunculatus* Sivad. *et al.*, *Morinda reticulata* Gamble, *Smithia venkobarowii* Gamble, considered restricted to southern Kerala, have now been recorded from the sanctuary.

Two new species *viz. Medinilla anamalaiana* Sasidh. & Sujanapal and *Pteroceras monsooniae* Sasidh. & Sujanapal could be described from the sanctuary. Species such as *Argyreia osyrensis* (Roth) Choisy, *Chlorophytum malabaricum* Baker, *Cocculus hirsutus* (L.) Diels, *Dalechampia scandens* L. var. *velutina* (Wight) Muell.-Arg., *Heliotropium bracteatum* R. Br., *Heterophragma roxburghii* DC., *Meyenia hawtayneana* (Wall.) Nees, *Monothecium aristatum* (Wall. ex Nees) T. Anders. and *Triumfetta rotundifolia* Lam. are additions to the flora of Kerala. Though the sanctuary occupies only about 6 per cent of the total area of Palakkad district, the number of flowering plants collected during the study is more than the number of flowering plants recorded in the flora of Palakkad district.

New Amarambalam Reserved Forests form part of the Nilgiri Biosphere Reserve (NBR), extending to about 265.72 km^2. The area is located in between 11° 14' and 11° 24 N latitude and between 76° 11' and 76° 33' E longitude in Nilambur South Forest Division of Malappuram District. The area is having seven forest types of southern India namely, tropical moist deciduous, semievergreen, evergreen, hill forests, subtropical savannahs and montane wet temperate forests, other than teak plantations raised in the moist deciduous zone. The different vegetation types of the Reserve were analysed for the floristic, insect, bird and mammalian diversity and the study was funded by the Ministry of Environment and Forests, Govt. of India, with the following objectives.

- Floristic diversity with emphasis on arborescent species
- Analysis of species and community diversity
- Inventory and diversity of selected insect groups, viz. Lepidoptera and Coleptera
- Inventory and diversity of birds and mammals
- Integration of biodiversity data using GIS

The most dominant family represented in the area is Euphorbiaceae (33 species), followed by Lauraceae (18 species) and Rubiaceae (17 species). The diversity analysis showed that arborescent species of tropical semievergreen forests have highest diversity index (H') value of 3.89, which is followed by subtropical hill forests (3.58), tropical evergreen forests (3.45), montane wet temperate forests (3.15) and tropical moist deciduous forests (3.07). Maximum number of insects and species were recorded from the semi-evergreen and evergreen forests. With regard to species diversity, the evergreen forest recorded the highest value (4.51) followed by semievergreen (4.35), moist deciduous (4.21) and subtropical hill forest (4.30). Species richness and diversity of Lepidoptera was greatest in the evergreen forests, followed by semievergreen, subtropical, moist deciduous and shola forests. Among butterflies, of the 133 species recorded, 28 species were found to be of high conservation status being either endemic/protected species. The evergreen forests had the maximum number of endemic/protected species (20) followed by semievergreen forests (15 spp.), moist deciduous forests (7 spp.), subtropical hill forests (7 spp.) and montane shola forests (5 spp.). Slightly higher bird diversity was recorded in the moist deciduous forests (3.70) than the evergreen forests (3.15). Species richness indices were also higher in moist deciduous forests (RI = 11.23) than the evergreen forest (RI = 9.88). Highest density of birds was recorded in the moist deciduous forests (775 birds/km^2), followed by Shola (402 birds/km^2) and the evergreen forests (400 birds/km^2). Order Carnivora had eight species, followed by Artiodactyla with seven species and Rodentia with four species. Bonnet macaque was sighted in moist deciduous forests, teak plantations, semi-evergreen and low elevation evergreen forests. Nilgiri langur was observed in moist deciduous forests, semievergreen and evergreen forests of low, middle and high altitude areas of the reserve.

A study was conducted to diagnose the deficiency symptoms of Fe, Cu, Zn, Mn, Mo and B in teak seedlings using sand culture. Two month old seedlings were planted in acid washed white quartz sand and provided with nutrient solution deficient in Fe, Cu, Zn, Mn, Mo and B to identify the deficiency symptoms of respective nutrients. Symptoms due to Fe deficiency were observed 55 days after planting followed by Zn, Mn, Mo, Cu and B. The deficiency of Fe resulted in interveinal yellowing of new leaves followed by necrosis, inward curling and cupping of leaves and appearance of rusty patches on lower leaves. Appearance of yellow patches on margins of lower leaves, interveinal yellowing and vein clearing of lower leaves, appearance of small and wrinkled new leaves and necrosis of chlorotic leaves were the characteristic symptoms of Cu deficiency. The Zn deficient plants expressed chlorosis of midrib and veins followed by necrosis and premature shedding of affected leaves and emergence of large and drooping new leaves. During the early stage of Mn deficiency, chlorotic spots appeared on younger leaves while at later stage they were confined only to older leaves. Yellowing of leaf tip and margins of new leaves followed by necrosis, production of bluish green new leaves, interveinal yellowing and absence of tip in new leaves were the characteristic symptoms of Mo deficiency. In B deficient plants, clustering and brittling of new leaves, blotching and premature shedding of lower leaves and emergence of slendering and tapering of leaves were the characteristic symptoms.

Deficiency of micronutrients also resulted in the retardation of plant growth. The reduction in height at severe stage of deficiency was more in Mo and Cu deficient plants and minimum in B deficient plants. Similarly, there was a drastic reduction in the number of healthy leaves due to the deficiency of all micronutrients, the more reduction in Fe deficient plants and minimum with B. Shortened internodes, production of long abnormal leaves and termination of apical growth were also observed. There was a reduction in the content of nutrients due to the deficiency of respective nutrients and in most cases they were decreasing with advancement of deficiency.

Trials to rectify the deficiency symptoms revealed that recovery was fast and easy if the respective nutrients were applied at the early stage of deficiency. Foliar spray of 0.3% Fe SO_4, 1%

Bordeaux mixture, 0.1% Zn SO_4, 0.1% $MnSO_4$, 0.1% MoO_3 and 0.05 % boric acid were found effective in rectifying the deficiency of Fe, Cu, Zn, Mn, Mo and B respectively.

Objective of the project was to study the effect of various nutrient inputs and silvicultural treatments on the growth and nutrient uptake and partitioning in different parts of eucalypt (*Eucalyptus tereticornis*) trees. The study was carried out on a 5 ha experimental area at the Field Research Centre of Kerala Forest Research Institute, Palappilly. Six silvicultural treatments *viz.*, three levels of spacing (1 m x 1 m, 2 m x 2 m and 3 m x 3 m) and two levels of pit sizes (30 cm x 30 cm x 30 cm and 40 cm x 40 cm x 40 cm) and four nutrient combinations of nitrogen, phosphorus and potassium, selected on the basis of a preliminary study, were tried. Nutrients in the form of urea for nitrogen, Mussorie Rock Phosphate for phosphorus and Muriate of Potash for potassium were used. Two levels of nitrogen (30 and 40 g/plant), three levels of phosphorus (15, 30 and 40 g/plant) and three levels of potassium (0, 15 and 30 g/plant) were applied in combinations in two split doses in the first two years. In the third year, only one application was made.

One-half of the fertilizer dose was applied initially in the pit before planting in June and the remaining half was added in a furrow in October in the first year. In the second year, doses were doubled and one-half was applied in June and the remaining half in October in a furrow. In the third year, application of nutrients was not done in June while in October, nutrients equal to what had been applied in October during the second year was applied.

Height measurements were taken at a three-month interval during the initial 12 months after which measurements were taken at the end of 16, 25, 28 and 34 months during the next 22 months. Girth at breast height (gbh) was measured at a height of 1.37 m. The volume of the trees over bark was estimated using a prediction equation.

There was significant effect due to silvicultural treatments and nutrient combinations on height of trees. Among various silvicultural treatments, trees in the 3 m x 3 m spacing and pit size of 30 cm x 30 cm x 30 cm had the highest values for height and gbh and volume/tree and was found to differ significantly from other treatments.

Among the various nutrient combinations, application of 30 g of nitrogen, 30 g of phosphorus and 15 g of potassium (65 g Urea, 150 g Mussorie Rock Phosphate and 29 g Muriate of Potash) per tree in the first year was found to be the best. This is equal to 72.215 kg of urea, 166.650 kg Mussorie Rock Phosphate and 32.219 kg of Muriate of Potash per ha for 1,111 plants. It was found that bole wood retained most of the nutrients. The quantity of nutrients in bole wood, leaves, bark and branches varied and depended on the spacing. The bole wood had 68, 53 and 35%, bark contained 10, 16 and 22%, branches constituted 9, 16 and 24% while leaves accounted for 13, 15 and 19% of the total tree nutrients in the 1 m x 1 m, 2 m x 2 m and 3 m x 3 m spacing, respectively. Out of the total nutrients, there was considerable quantity of total nutrients in the bole wood in 1 m x 1 m spacing (680 kg/ha out of 999.80 kg/ha) while in the 3 m x 3 m spacing, the bole wood had 64.02 kg/ha out of 184.31 kg/ha. Thus by removing the bole wood alone, a major portion of the stores of nutrients in the above ground biomass is removed.

Consultancy Reports

The study was carried out on the ethnobiology of the tribes living in and around the Periyar Tiger Reserve, the largest protected area in Kerala. Periyar Tiger Reserve is the home of five ethnic tribes viz. *Mannans, Paliyans, Uralis, Mala Arayans* and *Malampandarams*. With the establishment of Nellikkampatty Game Sanctuary in 1933, the tribes living inside the sanctuary, except the Malampandarams were shifted to the fringe areas during 1940s. The latter continue their traditional lifestyle of hunting and gathering food.

During the study, ethnobiological details on plants and animals utilised by the tribes were gathered. The availability and distribution of various NWFP yielding plants in different habitats of the zones of influence were assessed. Ethnobotanical data collected were on plants/plant parts used for preparation of medicine, method of administration against diseases, etc. by each tribe. The quantity of commercially exploited NWFPs was gathered.

The NWFPs collected by the tribes in and around Kumily are not getting a fair price. There is no value addition to the NWFPs. Suggestions are given on sustainable harvesting of the NWFPs and value addition through semi-processing for more job opportunities and income generation.

The implementation of India Eco-development project at Periyar Tiger Reserve has benefited the indigenous as well as the local communities living in the fringe areas. Therefore, the pressure exerted by these communities on bioresources has also been reduced in recent years.

Periyar Tiger Reserve (PTR) in Kerala is a well known wildlife sanctuary in India. Biodiversity conservation, involving people's participation, is being implemented in these project sites including Periyar Tiger Reserve. To enhance the conservation value of the sanctuary, the dependence on PTR for fuelwood is to be reduced and thereby the negative impacts of fuelwood collection in the Reserve can be minimized.

To examine the fuel consumption pattern and to suggest alternatives for reducing pressure on forests for fuelwood, fuel consumption surveys were carried out in households as well as enterprises in and around PTR. Total annual consumption of different fuels during the year 2001-02 was estimated as 70.4 billion kilocalories. The major part of it (90.1%) was obtained from fuelwood, 5.5% from non-wood biomass, 3.5% from LPG and 0.9% from kerosene and biogas. When useful heat consumption was taken into account, fuelwood contributed 70.8%, LPG 20.6%, non-wood biomass 4.4%, kerosene and biogas 4.2%, of the total annual consumption of 7.2 billion kilocalories. This showed that fuelwood was the most important fuel used in and around PTR. Total annual consumption of fuelwood was estimated as 16,684 tonnes (air-dry weight) of which, household sector accounted for 87.9% and the enterprises sector, the remaining 12.1%. Of the total annual consumption of fuelwood, 47.6 % was collected from PTR, 37.5 % from homesteads including rubber plantations inside and outside PTR, and the remainder 14.9 % from adjacent forests outside PTR.

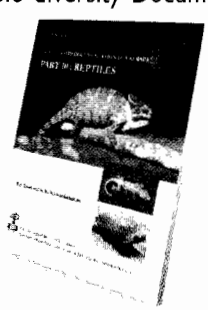
Three-stone or clay stoves were the most commonly used cooking devices in most of the households. Such traditional stoves are less fuel-efficient. Fuelwood consumption can be reduced by replacing these with fuel-efficient wood-burning smokeless stoves. Benefits of using such improved stoves are to be popularised among people through the Eco-Development Committees constituted in different localities as

part of the implementation of Eco-Development Project. Moreover, proximity to forests leads the local inhabitants to a tendency to over-use fuelwood. It is suggested that awareness should be created among people around PTR to reduce consumption of forest fuelwood by its judicious collection from PTR and its utilization, through an extension campaign. Considerable reduction in the fuelwood consumption can also be made by substitution with kerosene, LPG, biogas and non-wood biomass such as coconut leaf, husk, and shell. It is time to launch schemes to provide LPG and kerosene at subsidised rates. To facilitate the availability of LPG to households in and around PTR, Eco-Development Committees may be entrusted with the work of LPG distribution. These committees can also distribute LPG, coconut husk and shell, to the tea-shops, restaurants as well as the Devaswom establishments serving the pilgrims to *Sree Ayyappa* Temple, *Sabarimala*. Non-wood biomass from coconut palms was also used as fuel in households in certain localities. If forest households with large homesteads are encouraged to plant coconut seedlings in their homesteads, availability of fuel materials within homesteads will improve in the long run. There are biogas plants in a few households in the study area. Use of biogas in households can be promoted, wherever possible, to reduce not only the dependence on PTR for fuelwood but also grazing of cattle within the Reserve.

A shift in fuel-mix in households is expected in the near future due to increased use of alternative fuels as well as adoption of fuel-efficient wood-burning stoves keeping the *useful heat* requirement the same. This will lead to considerable reduction in the requirement of forest fuelwood. Therefore, the negative impact of fuelwood collection in PTR can be minimised by substitution and saving of forest fuelwood. If a shift from fuelwood to alternative fuels is not possible in the near future, efforts should be made to popularise and increase the use of improved stoves, particularly in households dependent on forest fuelwood.

RELEASING SHORTLY

Bio diversity Documentation for Kerala: REPTILES. The handbook contains information on 159 species of reptiles known from Kerala. In this compilation the species within each genus are arranged in alphabetical order. Details on the type, locality, habit and habitats, distribution in and outside Kerala, Status and important reference are given under each species



NEW RESEARCH PROJECTS INITIATED

KFRI 384/2003: Optimization of harvesting and post harvest technology to economize bamboo resource utilization (Bhat, K.V., Varma, R.V., 2003 February-2006 January, MoEF).

KFRI 386/2003: Capacity building of tribal community in managing NWFP resources: monitoring of empowerment and sustainability in Nilambur (Mammen Chundamannil, Anitha, V., 2003 April- 2006 March, PEA [E], GoK)

KFRI 387/2003: Economic valuation of eco-tourism development of a recreational site in the natural forests of southern WesternGhat. (Anitha V., Muraleedharan, P.K., 2003-April-2006-March, PEA [E], GoK)

KFRI 388/2003: Microbial pathogens associated with forest insects of Kerala part of Western Ghats with reference to host parasite relationship and ex-situ conservation. (Varma, R.V., Sudheendrakumar, V.V., Sankaran, K.V., 2003-April-2006-March, MoEF)

KFRI 389/2003: Development of protocols for processing and testing of forest seeds (Chacko, K.C., 2003 April-2006 March, KFRI Plan Grants)

KFRI 390/2003: Development of microbial inoculants for aerobic composting (Balasundaran, M., Maria Florence, E.J. 2003 April-2005 March, KFRI Plan Grants)

KFRI 391/2003: Macropropagation of two commercial bamboos *Bamusa balcooa* and *Dendrrocalamus strictus* (Seethalakshmi, K.K., Raveedran, V.P., 2003 April-2005 March, KFRI Plan Grants)

KFRI 392/2003:Micropropagation of three selected species of bamboo (Muralidharan E.M., Pandalai R.C., 2003 April-2006 March, KFRI Plan Grants)

KFRI 394/2003: Protocol for evaluation of residual nutrients in the soil (Balagopalan, M., Rugmini, P., 2003 April-2005 - March, KFRI Plan Grants)

KFRI 395/2003: Standardization of technology for edible bamboos in Kerala (Kumar M, 2003 April-2005 March, KFRI Plan Grants

KFRI 396/2003: Standardization of nursery and plantation techniques of mahogany with particular reference to soil, nutrition and shoot borer incidence(Thomas T.P., Mohandas, K., Rugmini, P., 2003 April-2008 March, KFRI Plan Grants)

KFRI 397/2003: Standardization of potting media for balanced nutrition of teak seedlings in root trainers (Sujatha, M.P., Maria Florence, E.J., 2003 April-2005 March, KFRI Plan Grants)

KFRI 398/2003: Mass productivity of HpNPV, a biopesticide for teak defoliator management (Sudheendrakumar, V.V., Varma, R.V., Sajeev, T.V., 2003 April-2006 March, KFRI Plan Grants)

KFRI 399/2003:Demonstrating the effect of controlling the teak defoliator on volume increment in teak in the permanent plots established at Nilambur (Varma, R.V., Sudheendrakumar V.V., 2003 April-2006 March, KFRI Plan Grants)

Extension activities

Provided details on cultivation of medicinal plants in rubber plantations of Kerala to Rubber Board, Kottayam; details on different aspects of *Cleistanthus collinus* and *Hydnocarpus pentandra* given to Kerala Agriculture University; Given information on allied species of *Zingiber officinale* which produce similar secondary metabolites like ginger to Rajiv Gandhi Centre for Biotechnology, Trivandrum; Supplied information on Appoppanthadi to Government of UAE. (Dr. K.K.N. Nair of Botany Division).

Provided details on nine species of bamboos occurring in Andaman Islands, to SANE, a NGO; provided details of dye yielding lichens of South India, to Prof. Elsemma Joseph, Departmentf of Botany, Arts & Science College, Calicut and information on the species of bamboos occurring in South India, to Dr. Pattanaik, Jorhat (Dr.Muktesh kumar, Botany Division).

Rendered help to the Kerala Forest Department for correcting the scientific names of plants mentioned in the working plan of Ranni Forest Division.(Dr. N. Sasidharan, Non Wood Forest Products Division).

Investigated disease problem of saplings of Calamus spp in Kanhjangad and disease problems in miscellaneous species in the Forest Central Nurseries in Nilambur and Kannavam and remedial measures suggested (Dr. C. Mohan and Dr. M. Balasundaran, Forest Pathology Division)

Analysed the biofertilizer samples sent by the Divisional Forest Officer, Kannur for its quality such as pH, microbial populations, etc. and the result was communicated to DFO, Kannur (Dr. M. Balasundaran, Forest Pathology Division)

CAMPUS NEWS

Seminar/Workshop attended

Dr. R V Varma attended the Workshop on Resistance and Silvicultural Control of the Shoot Borer Feeding on Meliaceae in the Asia Pacific Region, Bangkok, 4-8 October, 2002.

Dr. E.J. Maria Florence attended the International Conference on *Eucalyptus* Productivity at Hobart, Australia during 6-10 November, 2002 and presented a poster paper entitled "Clonal propagation of eucalyptus in Kerala, India for disease resistance and higher productivity".

Dr. M. Balasundaran and Dr. E.P. Indira attended the training/planning workshop on Molecular Marker Development for Teak Genetic Diversity Studies during 28 September - 6 October 2002 at Dept. of Agri. Biotechnology, Kasertsat University, Thailand, organized as part of European Union-funded research project on Developing Know how for the Improvement and Sustainable Management of Teak Genetic Resources.

Dr. C. Mohanan attended the two-day Training Programme on Biotechnology and Biofertilizers at FACT, Cochin during September 2002

Dr. V.V. Sudheendrakumar presented a paper "Baculovirus as a biocontrol agent against forest pests" in the Discussion Meeting on Applied Chemical Ecology- Implications of Induced Resistance and Transgenics in Insect Plant Interactions organized by Dr. T.N. Ananthakrishnan on 30 October 2002 at Chennai.

Dr. V.V. Sudheendrakumar also presented a paper "Current use of microbial pesticides against forest pests" in the .ICAR-CABI workshop on Biopesticide Application, 9-13 December 2002 held in Bangalore.

Dr. N. Sasidharan presented a paper entitled "Tree Taxonomy: Problems and Prospects" in the Seminar on Aspects and Prospects of Working Taxonomy, STEC, Thiruvanathapuram, 2-3 December, 2002.

Dr. E.A. Jayson attended. The Workshop on the "Wetlands of South India" organised by the Salim Ali Centre for Ornithology and Natural Resources, Coimbatore on 22 December, 2002.

Dr. C. Mohanan attended the one week training programme on "Intellectual Property Rights in Biotechnology" at the National Law School of India at Bangalore, organized by Department of Biotechnology, Govt. of India during December 2002.

P.K.Chandrasekhara Pillai attended the National Seminar on 'Management of Degraded Forests for Productivity Enhancement and Carbon Sink Expansion', TFRI, Jabalpur. 15 – 16 January, 2003.

Dr.A.R.R.Manon attened the National Workshop on Remote Sensing for Local Level Planning, CESS, Trivandrum, 23 December, 2002.

Dr. K.K.N. Nair, Dr. Muktesh Kumar and Dr. M. Balasundaran participated and Dr. N. Sasidharan presented a paper entitled "Rare, endangered and threatened tree species in Kerala- A Review" in the Workshop on Conservation and Research Needs of the Rare, Endangered and Threatened (RET) tree species in Kerala Part of Western Ghats, Trivandrum , 14 February, 2003.

Dr.E.A. Jayson attended the 28th conference of the Ethological Society of India, 7-8 February, 2003, Mundanthurai, Tirunelveli, Tamil Nadu.

Dr. K. Kumaraswamy participated in the National Workshop on 'Natural Resource Management: Changing Scenarios and Shifting Paradigms' Kerala Agricultural University, Thrissur, 21-24 February, 2003.

Publications

Anitha, V., Muraleedharan, P.K. and Binilkumar, A.S. 2003. Natural resources depletion in Protected Areas: socioeconomic linkages. *Indian Journal of Social Development*, (3) 1: 44-59.

Bhat K.M. and Maria Florence, E.J. 2003. Natural decay resistance of juvenile teak wood grown in high input plantations. *Holzforschung*, 57: 39-41.

Indira, E.P. and Anto, P.V. 2002. Karyotype analysis *in Calamus palustris* Griff. *Journal of Bamboo and Rattan* 1 (3): 199-203.

Jayson, E.A. and Mathew, D.N. 2002. Structure and osition of two bird communities of in the southern Western Ghats. *J. Bombay nat. Hist. Soc.* 99(1): 8-25.

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Mendham, D.S., Sankaran, K.V., O'Connell, A.M., and Grove, T.S. 2002. *Eucalyptus globulus* harvest residue management effects on soil carbon and microbial biomass at 1 and 5 years after plantation establishment. *Soil Biology and Biochemistry* 34: 1903-1912.

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Sankaran, K.V. 2002. Black wattle problem emerges in Indian forests. *Biocontrol News and Information*, 23: 5.

Sasidharan, N., Sujanapal, P. and Jomy Augustine, 2002. Reappearance of *Syzygium myhendrae* (Beddome ex Brandis) Gamble and Ellipanthus tomentosus Kurz in the Southern Western Ghats. *Journal of Economic and Taxonomic. Botany*, 26 (3): 516-519.

Sujatha, M.P., Jose, A.I. and Sankar, S. 2003 Leaf litter decomposition and nutrient release in reed bamboo (*Ochlandra travancorica*). *Journal of bamboo and rattan* 2(1): 65-78.

Swaran, P.R. and Varma, R. V. 2003. Laboratory evaluation of the entomopathogenic fungus *Metarhizium anisopliae* var. *major* against the subterranean termite, *Odontotermes guptai* Roonwal and Bose. *Journal of Biological control*. 17(2): 147-151.

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Santhosh Kumar, R., Raju, P., Bhat, K.V. and Varma, R.V. 2003. A sample method for judging maturity of bamboos. *INBAR Newsletter* 10(2): 12.

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Aerobic composting. Information Bulletin 16

Sampling and processing of forest soil for analyses. Information Bulletin 17

In Press

Bio diversity Documentation for Kerala: INSECTS. The handbook contains information on 4027 species of insects recorded from Kerala. IThe document is organised in systematic sequance at higher taxonamic levels and the species are listed alphabetically. Under each species, it's distribution in Kerala along with ecological data and litarature citation are given. Pages: Approximate 280

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This CD contains full text of 200 research reports published during 1978-2000. It is very user friendly and has been provided with author and subject indexes and other search facility to facilitate easy retrieval of information. The CD will be a good source of information to forest officials, scientists, students, teachers etc.

Cost Rs. 1000/ US$ 100

Releasing shortly

KFRI CD : Forest Resources of Kerala - Database

The database was developed by collecting data from several secondary sources and by communicating with various agencies. The sources include the publications of the Kerala Forest Department, Ministry of Environment and Forest, Department of Statistics and Economics, Directorate of Census, Communications with State Forest Departments, the research reports published by the Kerala Forest Research Institute and the articles published in journals. The data on many of the aspects are of time-series type covering the period 1980 to 2000. The major themes covered in the database are Forest Administration, Forest area, Forest Plantations, Forest Products, Wildlife, Forest Weather, Forest Fire and Revenue and Expenditure of the Kerala Forest Department. The required data from the software can be retrieved in two or three clicks. The system also contains a glossary. It is proposed to refine and update the software periodically. For copies write to The Librarian, Kerala Forest Research Institute, Peechi - 680 653, Kerala

Matters of General Interest

Dr. R. V. Varma, Scientist in charge, Entomology served as an expert to review an ACIAR funded project on 'Insect resistance and Silvicultural control of the shoot borer, *Hypsipyla robusta* feeding on *Meliaceae'* in 8 South East Asian countries.

Raakhee Vijayaraghavan, MSc., Biotechnology student from Periyar University completed her MSc. Thesis on the topic, "Genotype characterization in *Acacia magium* Willd. Using RAPD analysis" under the supervision of Dr.M. Balasundaran

Ms. Prathiba, P. M.Sc ., Biotechnology student from K.S. Rangasamy College of Arts and Science, Tiruchengode, Periyar University, Salem completed M.Sc. thesis on the topic Vertical transmission of Hyblaea puera NPV in the host H. puera (Cramer) under the supervision of Dr.V.V. Sudheendrakumar

Dr. Muktesh Kumar, Scientist, Botany was nominated as one of the authorized reviewer for the editorial scrutiny of papers submitted under the section Morphological Systematics and Tropical Biology for the American Journal of Botany, Academic Press, USA.

Dr. A.R.R.Menon served as an examiner for MEM examination of M.G. University, Kottayam in September 2003.

Dr. A.R.R.Menon as a Board Member, M.Sc. Plantation Science of Calicut University attended board meeting on 3 February 2003 to scrutinise and finalise the question papers

Dr.N. Sasidharan participated in the State Medicinal Plant Board meeting at Trivandrum on 2 January 2003.

Training programme for Foresters and Forest Guards of Munnar Wildlife Division on Strengthening Sustainability of PA System. 16-18 December 2002 (Convener: Dr. P.S. Easa).

Workshop on Conservation and Research Needs of the Rare, Endangered and Threatened Tree Species of the Western Ghats of Kerala at Truvananthapuram. 14 February 2003 (Convener: Dr. Jose Kallarackal)

KERALA SCIENCE CONGRESS

The Government of Kerala is committed to the cause of promotion of Science and Technology for human welfare. Kerala was the first to constitute a State Committee on Science & Technology in 1972 and to adopt a Policy Resolution on Science & Technology in 1977 after the National Committee on Science & Technology was formed. The Government have set up a number of autonomous Research Centres in areas of study relevant to Kerala. Further, the State is also a pioneer in the field of funding Research and Development in Science and Technology.

The Kerala State Council for Science, Technology and Environment (KSCSTE) has been established to promote research in Science & Techology for speeding up the socioeconomic development and enhancing the quality of life and environment in Kerala. Six R & D Centres, viz. Centre for Earth Science Studies, Thiruvananthapuram, Centre for Water Resources Development and Management, Kunnamangalam, Kerala Forest Research Institute, Peechi, National Transportation Planning and Research Centre, Thiruvananthapuram, Rajiv Gandhi Centre for Biotechnology, Thiruvananthapuram, and Tropical Botanic Garden and Research Institute, Palode, are functioning under the umbrella of KSCSTE.

The Council holds Science Congress every year dedicating its efforts for the revitalization of R & D in the State, shifting the focus towards solution of developmental problems of Kerala. The Kerala Science Congress (KSC) is organized to encourage the effective participation of fresh talents and inculcate scientific temper to promote scientific research in the State.

GENERAL OBJECTIVES

- An effective interaction among academicians, researchers, professionals and decision makers from the State and outside.
- Review the present status of R & D efforts in Kerala and to critically examine the outputs.
- Encourage in-depth studies on the focal theme.
- Identify integrated and coordinated research programmes with a view to optimally utilize resources.
- Formulate strategies for betterment and utilization of scientific and technical manpower.
- Encourage talented young scientists of Kerala for their contribution to Science and Technology.

KERALA SCIENCE CONGRESS – A FORUM FOR INTERACTION

The Kerala Science Congress will have presentation sessions in which selected general papers in the identified subject categories and Young Scientists Best Paper Award through contest papers will be presented.

There will also be a plenary session with invited talks, keynote address, etc. on subjects related to the focal theme. Besides, the Kerala Science Congress will bring together eminent scientists from outside Kerala and also Kerala scientists working abroad and in national R & D institutions for interacting with the scientists within Kerala. The administrators and planners will also interact during and outside the sessions on the significance of the work carried out by the scientists.

Thus, the Congress will prove to be an excellent ground for academic interaction.

VENUE AND DATE

Venue of the XVII Kerala Science Congress is the Kerala Forest Research Institute, Peechi located in central Kerala in the midst of tropical forests with a scenic beauty. The nearest city is Thrissur (18 km), the cultural capital of Kerala.

The Science Congress will be held during 29 - 31 January 2005

CORRESPONDENCE

All correspondence regarding the Congress may be addressed to:

Convener, XVII Kerala Science Congress
Kerala Forest Research Institute, Peechi,
Thrissur 680 653, Kerala

Phone: 0487-2699061-64; 2699037; Fax: 0487-2699249
E-mail: kfri@kfri.org. Website: http://www.kfri.org

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Editor
Dr. V.V. Sudheendrakumar

Associates
Dr. E.J. Maria Florence
Dr. K.V. Mohammed Kunhi
Dr. T.V. Sajeev
Shri. Subash Kuriakose

Evergreen, the **KFRI** Newsletter is currently brought out in March and September each year and is intended for free private distribution within the institution and the Kerala Forest Department. Free copies will also be sent upon request to other individuals or institutions connected with forestry activities. The views expressed in the Newsletter are those of the authors and do not necessarily reflect views of the Institute. All interested persons are invited to send comments and opinions. The newsletter committee reserves the right to choose among contributions and edit wherever necessary.

Address all communications to:
The Editor,
Evergreen
Kerala Forest Research Institute,
Peechi - 680 653, Thrissur, Kerala
India.
Ph.: 0487 - 2699037, 2699061-63
E.mail :
Web site : http://www.kfri.org

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Dr. N. Sasidharan participated in the workshop held at KFRI on management of plantations in protected areas in Kerala as a resource person during 16-17 December 2002; gave a talk on Non-Wood Forest Products of Kerala to the participants of the nature camp (Members of OISCA International) at Parambikulam Wildlife Sanctuary on 20 December 2002.

Dr. A.R.R. Menon gave a talk on *Scope of Eco-tourism in Aralam Wildlife Sanctuary* participating in the District Tourism Camp Workshop at Aralam Wildlife Sanctuary, Aralam during 18-19, January 2003 ; took class on Vegetation analysis and also Remote sensing at CUSAT, for UGC sponsored refresher course in Environmental Science on 26th Nov. 2002 ; served as a resource person for refresher course in Environmental Science at Calicut University and took class on Remote sensing on 30 November 2002 and took class at St. Thomas College, Thrissur and Christ college, Irinjalakuda on Remote Sensing on 13 and 30 January 2003 respectively.

Dr. E.A.Jayson took class on "Identification of indirect evidence of mammals" to the forest staff from Idukki Wildlife Division on 20, September 2002 at Kerala Forest Research Institute, Peechi; delivered a lecture to the students of NSS College Manjeri on the "Birds of Kerala" at Nilambur Sub Centre during the Wildlife Week celebrations on 11, October 2002; gave a lecture on the "Man- wildlife conflict in Kerala" to the Nature Club members of the College of Veterinary and Animal Sciences, Mannuthy, Thrissur on 21, October 2002.

Dr. M. Balasundaran gave two lectures on Forest Biotechnology at UGC-Academic Staff College, University of Kerala, Trivandrum for the benefit of college/university lecturers participating in Refresher Course in Life Sciences on 9 December 2002.

Dr. A.R.R.Menon imparted training to KFD staff on 'Skill upgradation and personality development' at Parambikulam Wildlife Sanctuary on 18 Dec. 2002.

Shri. P.K. Chandrasekhara Pillai took class and demonstrated the nursery activities in connection with the 'Training in Nursery Management' for Kudumbashree unit of Pavartty Panchayat during 25-26 November 2002.

Dr. E.A. Jayson delivered a talk on "Crop damage by wild animal" at AIR, Devikulam station. On 27 February 2003.

KFRI TRAINING PROGRAMMES IN TROPICAL FORESTRY

KFRI offers specialized training courses in tropical forestry to meet the requirements of various stakeholders. It is also proposed to provide tailor-made training depending upon specific needs of the stakeholder

For more details contact:
Director
Kerala Forest Research Institute
Peechi- 680 653
Thrissur, Kerala, India
Tel: Office: + 91 487 2699037
Fax: + 91 487 2699249
Email:training@kfri.org
Web:www.kfri.org

Recent Release Hand books

George, K.F.; Sankara Pillai, K. 2002. Annotated bibliography on rattans of the world. Handbook No. 19.

Sarojam, N.. 2002. An annotated Bibliography on bamboos of the world. Handbook No. 20.

Sankara Pillai, K. 2002. Information resources for bamboo and cane development in Kerala Handbook No. 21.

Readership Survey

We intend to revise the mailing list based on the response of the readers. Kindly fill up the Readership Survey Form provided in this issue and send it to the following address:

The Editor
Evergreen
Kerala Forest Research Institute
Peechi-680 653. Thrissur