KFRI EVERGREEN

Half Yearly Newsletter of the Kerala Forest Research Institute, Peechi

No. 55 & 56 September 2005-March 2006

Cluster Development of Bamboo Artisans and Farmers to Improve Their Livelihood

One of the recent initiatives of Government of India is the development of bamboo sector. In this connection the Planning Commission had brought out an integrated action plan in 2003. The action plan envisaged laying down a foundation of a modern bamboo economy with input from science and technology, people's participation, industrial application and strong linkage with market capable of meeting global competition.

Kerala state has three strongholds for development of the bamboo sector. 1. Suitable agro-climatic conditions to grow most of the priority species selected by experts for cultivation at national level 2. Skilled craft persons, especially women to use bamboo for small-scale industries such as handicrafts, house hold items etc., 3. Modern industries like Hindustan Newsprint Ltd. and Kerala State Bamboo Corporation for large-scale industrial utilization of bamboo.

A view of the homesteads in Thenkurussi Panchayath rich in thorny bamboo (Bambusa bambos)

Kerala Forest Research Institute with its expertise developed through research on bamboo and through implementation of bamboo network projects in Kerala, Tamil Nadu, Karnataka and North-eastern states initiated a programme to set up a model cluster of bamboo artisans and farmers during 2005. The objectives of the one-year project implemented in a mission mode were:

1. Livelihood improvement of artisans and farmers by enhancement of their per capita income through technology transfer for manufacture of new products and productivity improvement of existing bamboo clumps.
2. Enhancement of bamboo resources in the Panchayath area through additional planting of suitable commercial species.

For implementation of the project, Thenkurussi Panchayath, Palakkad District was selected as bamboo is grown in homesteads of this Panchayath and there were four colonies of traditional bamboo artisans viz. Sambavars (Kavaras).

Limitations of artisans/farmers

Before starting the project, an assessment of the status of artisans in the Panchayath was conducted. Although the traditional artisans were familiar with extraction and processing of bamboo and possessed good skill in weaving and craft, the marketability of the traditional products such as baskets, mats and agricultural implements reduced drastically due to the change in land use pattern and introduction of similar products made of plastic. In

Issue Highlights

addition, the shortage and hike in cost of raw material resulted in a much low daily income between Rs. 20 and 30, which was insufficient to sustain their families. Due to these problems the younger generation of the traditional artisans had already shifted to other jobs in plantation and construction sector.

It was felt that support from experts with upgraded tools, technology, product design manufacture of premium products and improved marketing and supply of raw material are necessary for rejuvenating bamboo craft and to improve the livelihood of artisans and farmers.

The farmers having bamboo in homesteads were not aware of the scientific management of bamboo clumps and availability of different species with multiple uses for cultivation. Hence, most of them were growing *Bambusa bambos* and extraction was by clear felling of clumps based on their financial requirements. Technical know-how on the proper management of clumps by maturity marking, pruning, fertilizer application and harvesting methods are required for sustainable management of bamboo to get a regular annual income. Also they need to be provided with suitable species (thorny or non-thorny) based on their needs and area available in their home gardens for growing bamboos.

PROJECT IMPLEMENTATION

The project was implemented as two different activities : artisan cluster development (ACD) and bamboo resource development (BRD).

Artisan cluster development

Project Launching Workshop

The artisans from all the four colonies viz., Vakathara, Kurumankadu, Poolakunnu, Kunnakkad consisting of 70 families were invited for a meeting in April 2005. Information about different bamboo species and the latest developments in the bamboo sector were provided to the artisans. KFRI received support of officials of Panchayath and Kerala Bamboo Workers Union and District Industries Centre, Palakkad for this workshop. Of the 75 artisans attended the workshop, 27 were selected for training in bamboo craft for 30 days based on their interest and capability.

Training and design workshops on bamboo weaving and craft

In collaboration with URAVU, (an NGO on bamboo craft from Wyanad), curriculum and resource persons for conducting one-month training programme (June 8 - July 7, 2005) was finalized. Three resource persons each from URAVU (Sri. Antony, Sri. Arun and Sri. Lenin) and KFRI (Dr. K. K. Seethalakshmi, Dr. S. Sankar and Dr. R. C. Pandalai) conducted the training programme. The training commenced with a general introduction on bamboo and bamboo industries and its socio-economics and ecological relevance followed by practical sessions consisting three modules. During this training and demonstration of the tool kit developed by Industrial Design Centre, IIT, Bombay, hand-on experience on bamboo cutting, joining, finishing, treatment and seasoning, along with product development, production group setting, production management and marketing methods were given to artisans. Certificates were issued to the participants on successful completion of training. The trainees were able to develop 40 products and sell in market during the project period, which included furniture (woven moodahs, stands), decorative items (flower baskets, table mats, fruit baskets, scale flowers, star, table lamps, lamp shades, trays) and household items (puttu kutti, pappadam kuthi, chapathi basket, waste paper/ laundry basket, thawa, Hanger, Tea trays etc.,).

In collaboration with Mr. Susanth, National Institute of Design, Ahmedabad, a design workshop was organized during 8 to 11th December 2005. The artisans were taught to make products like Christmas star, fruit basket, office basket, tablemat, lampshades and seminar folders.

Exposure to artisans through visits and participation in melas

The artisans were taken to URAVU to expose them to a developed craft unit and to familiarize them with advance tools and technology and marketing. Selected members were taken to a *Poorbasree Exhibition* at

Artisans selected for training along with Officials of enkurussi Panchayath and Resource Person from KFRI.

An artisan on her way for selling traditional bamboo products

Thiruvananthapuram to expose them to the bamboo and cane products from the North-eastern region. In the demonstration workshop they could see how some of the items are made.

The artisans participated in the IRDP Mela during Onam festival season. About 28 products were presented by them. Also they participated in Bamboo Fest organized once in year by Kerala Bureau of Industrial Promotion with 40 items including traditional and new products made.

Organization of the Bamboo Consortium

With KFRI's intervention twenty trained artisans were organized into a group which was registered as Thenkurussi Bamboo Consortium, under Central Literary, Science and Charitable Society Registration Act on 26 May 2005 (No. C. A. 208/05). The byelaws for Bamboo Consortium were prepared. An Executive Committee consisting of President Secretary and Treasurer was constituted for running the Consortium. KFRI assisted the Consortium to open a bank account, in procuring permission to use the existing building constructed by the Panchayath, necessary additional infra-structure like electric connection. Partial assistance was also provided with a minimum daily wage of Rs.50/ day along with raw materials and consumables for a period of six months from July to December 2005 to develop a production unit under the Consortium.

Follow up

After the project period was over in December 2005, the Consortium obtained a bank loan as seed capital and they functioned in the same way as KFRI supported. The repayment of the loan was done promptly. The daily income of the artisans doubled from that of the beginning of the project and their confidence also improved. As on today, the President of Thenkurussi Bamboo Consortium is a member of the Kerala Bamboo Mission, which provided an opportunity to them to project their requirements to higher authorities/ policy makers.

Bamboo Resource Development (BRD)

The farmers having bamboo in homestead were invited for a meeting with the help of President of *Padasekhara Samithi* (Association of agriculture land owners) and information on the potential of bamboo as a crop was provided to them by KFRI experts. For productivity improvement of the bamboo clumps in the homestead, the scientific way of extraction of bamboo by removing mature culms every year and the method for marking the age (maturity marking) either by marking the year of formation of coloured rings were taught to the farmers. Details of fertilizer application were also provided to them.

For enhancement of bamboo resources through additional planting of suitable

Some of the novel bamboo products

An artisan with new products

species in the area, *Ochlandra travancorica* one of the species with long internodes, suitable for weaving was introduced in the area. About 185 seedlings were distributed to the artisans to be planted in their homestead. In addition, 1000 seedlings of two common species *Bambusa bambos* and *Dendrocalamus strictus* were distributed to farmers.

IMPACT OF THE PROJECT

- The implementation of the project helped to create awareness among the traditional bamboo artisans about the potential of bamboo craft, new developments in the sector and to rejuvenate their interest on value addition of their products.
- The Bamboo Consortium organized during the project period enabled the artisans to work in a co-ordinated manner and manage production and sale of the products.
- The artisans were trained in production of a variety of products including furniture, decorative and house-hold items.
- Participation in melas and fests facilitated during the project period helped the artisans to understand the level of their products in market and interact with artisans from other units.
- In general, the project helped to rejuvenate bamboo craft in Thenkurussi Panchayath.

FUTURE PLAN

Developing one bamboo cluster at Thenkurussi Panchayath is only a beginning of bamboo sector development by KFRI in the state. For organizing the whole bamboo sector in the state to make the artisans and farmers self reliant with improved livelihood, more clusters need to be developed through intensive training and common facility/ production centres established.

The availability of processed bamboo raw material after preservative treatment i.e. partial mechanization of bamboo processing in a common facility centre (CFC) will reduce the workload of artisans and cost of transport of raw material. For this at least one CFC is required in each district. This Centre should also have the facility to procure raw material from farmers when they produce bamboo in homesteads.

KFRI has already initiated the second phase of this project with the above objectives to develop 10 more clusters and a coordinating centre within a period of three years.

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Dendroclimatology - A Newly Emerging Science

As an offshoot of *dendroecology*, is a newly emerging science - *dendroclimatology* , which deals with determination and prediction of effects of climate change on tree growth and wood properties. The term *dendroclimatology* is derived from the fact that trees serve as indicators of climate change by displaying their growth patterns and tree ring structure as direct responses to the changes in climatic conditions. The predicted climate models based on the sensitivity of tree growth to climate change in various types of forests appear to have potential for carbon sequestration scenario. This will also provide a basis to assess environmental and socio-economic impact of different tree-growth scenarios and to allow the development of strategies for sustainability in future forest management.

Earliest studies on periodic tree growth in the tropics extend back to the work of Brandis in 1850s in India followed by Coster (1927) on the periodicity of diameter growth of 200 tree species of Southeast Asia. A dendrochronological approach was first applied by Berlage in 1931 on teak in Java. While more promising results were obtained in tropical tree species of Brazil, India and Thailand, many dendrochronologists continued the studies in Indonesian teak .

Recent evidences of tree sensitivity to climate change from Kerala

Some of our studies in KFRI on tree-ring analysis in teak indicated considerable climatic influence on tree growth particularly rainfall implying that such studies have potential not only for reconstruction of climatic changes over the past period but also for assessing the growth dynamics and wood yield patterns in the Western Ghat region in India (Bhat 1998;2001; Priya and Bhat 1998, 1999). This is particularly evident from the research data generated during the two consecutive annual growth cycles of teak in the years 1994 and 1995.

Effect of rainfall on growth periodicity in teak

The Effect of the local environmental factor especially the mean annual rainfall on cambial activity and wood formation was clear from the observations made in 13-year-old trees in Walayar (where the mean annual rain fall was less than half of Nilambur and Peechi locations), which exhibited shorter period of growth activity than the trees of the same age in Nilambur and Peechi. In the year 1994, cambial activity commenced in Nilambur and Walayar in March itself as a response to the first rains (Fig. 1) while in 1995, the dormancy was broken only in April, after the onset of pre-monsoon showers (Fig 2). In Peechi, the cambium became active and wood formation started only after receiving the first showers in April in both the years observed.

The late onset of tree dormancy after the active period of wood formation in the autumn influences the quality of wood as evident from higher proportion of latewood in the growth ring (Fig. 3). This is reflected in the trees grown in Peechi where there was earlier onset of dormancy than the same aged trees in Nilambur. The mean proportion of latewood built up in the trees in Peechi was 76 % as against 90% in Nilambur in the year 1995. Similarly the trees in Walayar region had a lower latewood percentage than the

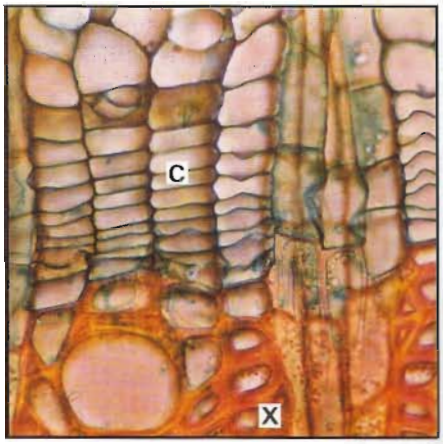

Fig. 1. Reactivation of cambium with thinner radial cell walls and swollen cells in teak correlating with pre-monsoon showers in March 1994 in Nilambur (C – cambium; X – Secondary xylem)

same aged trees in Peechi ,which is again the result of an earlier onset of cambial dormancy in the former. The 7-and 13-year-old trees in Nilambur exhibited faster growth than their counterparts in Walayar as evident from the maximum width of their annual rings (Table 1).

Our attempt to correlate the tree ring formation with the rainfall of the corresponding year - 1976 in Nilambur indicated the possibility of rain fall prediction from the type of false growth rings formed in juvenile trees. The ring structure showed that trees must have commenced active growth after a period of dormancy, in the month of April, after receiving the first summer showers. Heavy rains in April must have rendered the formation of wide vessels in the earlywood zone. But the month of May witnessed unusually less rains which must have decreased the pace or led to partial cessation of growth. This was evident in the earlywood zone of the growth increment in the form of thick walled fibres characteristic of latewood. Later with the advent of heavy rains in June, active growth must have resumed once again, leading to the formation of wide vessels, characteristic of early wood which was depicted in the form of a false ring in the annual growth increment.

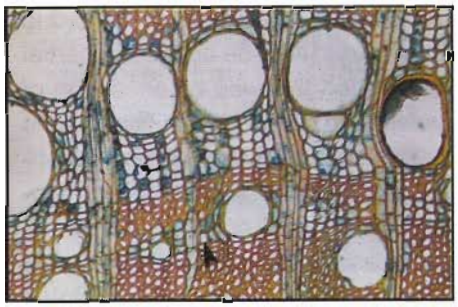

Fig. 3. Effect of post-monsoon shower in latewood zone of teak producing false rings and affecting tree ring structure and wood quality

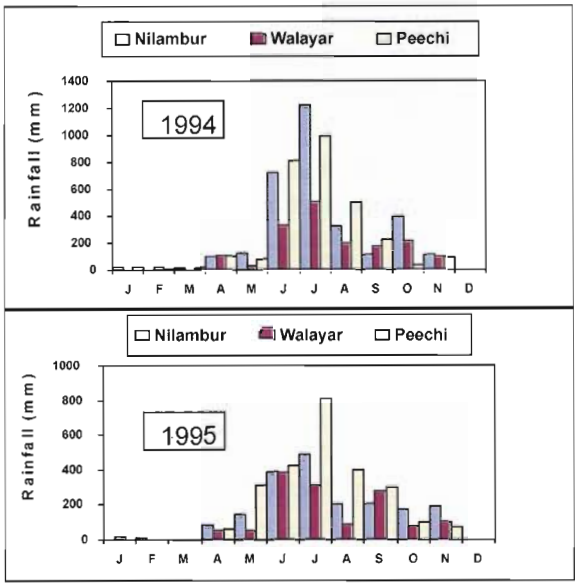

Fig 2. Monthly rain fall in Nilambur, Walayar and Peechi in the years 1994 and 1995

Table 1: Mean ring width with earlywood and latewood proportions of trees, as indicators of climate change, from different locations

Location	Nilambur					Peechi	Walayar
Tree age	7	13	20	40	147	13	7
Ring width (mm)	4.55	4.24	0.95	1.33	0.99	1.88	1.47
Earlywood width (mm)	0.38	0.43	0.49	0.74	0.30	0.45	0.33
Earlywood %	8	10	52	56	30	24	22
Latewood width (mm)	4.17	3.81	0.46	0.59	0.69	.43	1.14
Latewood %	9290	48	44	70	76	78	

Double and multiple rings formed in some trees must be due to the partial resumption followed by cessation of growth with respect to the fluctuations in rainfall during May. From our observations, it is clear that the intervention of a dry spell during active growing season, followed by favourable conditions is capable of producing a false ring, provided it is intense enough to cease or reduce the pace of growth for some time prior to the resumption of active growth. To confirm this, nine discs of 12-year old trees planted in 1981 were analysed. With the exception of four annual increments, all the trees exhibited false rings in any one of their annual rings. Maximum number of trees had false rings in the early- wood zone of their third annual ring, which was again correlated with the rainfall of the corresponding year (1983). In this year, there was no rainfall during April, when active growth resumed normally in the trees. After producing a few layers of early wood, growth must have slowed down or ceased partially due to lack of rains, ultimately leading to the production of thick walled fibres. At the onset of rains in May, active growth must have resumed with the production of a zone characteristic of early wood which was evident as a false ring close to the early wood zone of the corresponding annual increment.

Effect of Drought

From the observations made on seedlings, it was noticed that any changes affecting their growing conditions had pronounced bearing on their active growth, obviously producing a false ring. Fluctuations in the rainfall, field transplantation of the seedlings, irregular irrigation treatments etc. resulting in partial or complete loss of leaves were found to produce false rings in seedlings. Thus they were more susceptible to the changes in the environment than mature trees, which is obvious from the higher frequency of false ring formation in the former. It was observed that induction of drought during active growing season produced false rings in the seedlings (Fig. 4). During the treatment period, growth was brought to a stand still, with the formation of thick walled fibres as characteristic of late wood. When watering was resumed, large vessels and parenchyma characteristics of the early wood were noticed, appearing as a false ring in the annual growth increment (Fig. 5).

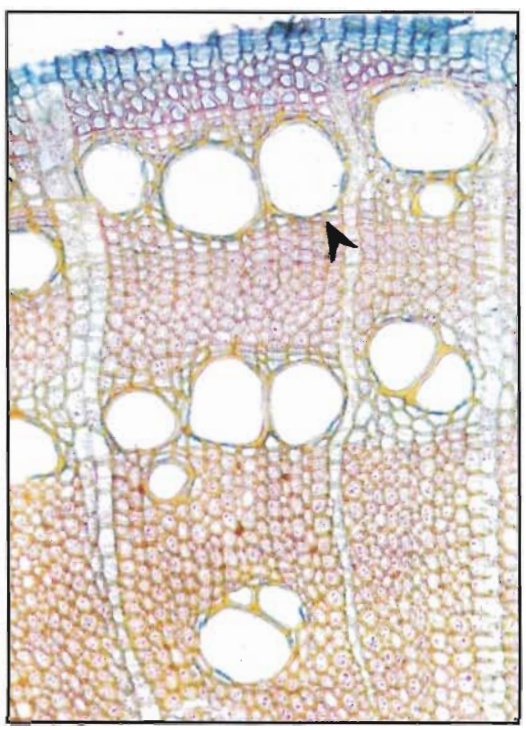

Fig. 4 False ring formation due to growth interruption as a response to induced drought in teak seedling

Fig. 5. Drought causes false rings in active growing season (in early wood zone)

Thus, our tree ring studies indicate that teak has tremendous role in dendroclimatology to predict the effects of climate change on tree growth dyanamics as well as the effects of wood production practices on climate change. Dr. Cherubini of Swiss Federal Research Institute, says, it is possible to predict which trees will survive the next drought and which will die in Italy.

Future research

Our future research endeavours in dendroclimatology should aim at accomplishing the following tasks:

1. Sensitivity of tree growth to climate change in tropical teak bearing deciduous forests
2. Influence of climate change particularly the rain fall patterns of south-west monsoon on tree growth periodicity and wood increment patterns of the past and future to facilitate the growth modeling.
3. Standardisation of dendrochronological methods to provide proof of annual/semiannual or irregular growth periodicity of teak and associated species , viz. *Albizia lebbeck*, *Grewia tiliifolia*, *Gmelina arborea*, *Lagerstroemia microcarpa*, *Pterocarpus marsupium*, *Terminalia alata and Xylia xylocarpa*.
4. Developing linear aggregate

climate models based on the long-term tree growth dynamics traced through tree-ring analysis of teak and selected/associated tree species.

5. Assessment of the environmental and socioeconomic impact of tree growth scenarios for developing future strategies of sustainable forest management (SFM).

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Ecological Notes on *Nageia wallichiana* (Presl) O.ktze. habitats in Goodrical Reserved Forests, Kerala.

Nageia wallichiana tree

Western Ghats form one of the 18 mega-centers of biodiversity in the World and Southern W. Ghats is richer in terms of number of species as well as rare, endangered and threatened (RET) taxa. As per the IUCN specifications, out of the over 4,000 plants native to Kerala, 22 species belong to the near-threatened category, 26 endangered, 38 vulnerable, and 63 endangered. Autecological details of these rare species such as, the natural range of distribution, population structure, habitat preference, ecological amplitude, mechanism of regeneration, etc. are needed for formulating conservation strategies. Unfortunately, such details are not available for a number of them.

Nageia wallichiana (Presl) O. Ktze. (Syn.: *Podocarpus wallichiana* Presl) is the only living gymnospermous tree found in the evergreen forests of the Kerala part of Western Ghats. The tree belongs to the family Podocarpaceace. The available information on the species is scant.

N. wallichiana is seen only from an area around four hectares in the West Coast Tropical Forests of Goodrikkal Reserved Forests (9° 10' - 9° 30' N lat. and 76° 55' - 77° 17' S long.) situated south of the Palghat gap in Kollam (Quilon) District. The area is humid with temperature ranging from 15 to 31° C and the forest was selection-felled during 1986. Ragahavan Nair notes that the species was probably extracted in the past under the name of *Mesua ferrea*.

A phytosociological analysis of the stand containing *N. wallichiana* showed that *Palaquium ellipticum* (Dalz.) Engl. *Cullenia exarillata* Robyns, *Meiogyne pannosa* (Dalz.) Sinclair, *Mesua ferrea* L., etc., are the dominant tree species. Floristic studies revealed 294 individuals (> 30.1 cm gbh) belonging to 43 species in a 0.5 ha area. Out of these, 54.4% of Individuals belonged to the endemic category, 7.5% rare, 1.4% endangered and 1.0% vulnerable. An average of nine individuals of *N. wallichiana* were observed in 0.5 ha.

Looking at the tree regeneration population in the area, there were 2,373 individuals in a 0.15 ha sample and be

A Twig with male cone

longed to 56 species; 44.1% of the population was of endemic species, 5.2% rare, 6.0% of endangered, and 5.6% of vulnerable species. The size structure of the population was as follows: 12.8% saplings (10.1-30 cm gbh) and 87.2% seedlings (<10 cm gbh); *N. wallichiana* was found represented by 327 individuals in the regeneration.

The local people in some parts of Kerala consider *N. wallichiana* as sacred. The belief goes that the biblical character Noah built his ark with this tree and escaped the flood. As a matter of fact, some times the seedlings of the species are smuggled out from the forest. Appropriate measures for the protection of the species are to be taken.

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A Computer-Aided Identification Package (TreeID) for the Trees of Kerala

Identification of trees in tropical forests has always been a challenge. The enormous height of the trees, inconspicuous flowers, short flowering period, etc. make the task more difficult. Botanists traditionally follow the Linnaean style of delimiting taxa based on floral characters and often ignore field and vegetative characters, which are more helpful in the field identification. Identification of trees at sight is often required by Foresters, Wildlife biologists etc. One of the weaknesses of plant taxonomy has been the excess use of technical terms in the identification keys and description of species, which makes the conventional floras more useful only to Botanists. Computer aided multi-entry identification keys are very convenient than conventional dichotomous keys. The Computer-Aided Identification package (**TreeID**) is a Menu driven multi-entry program based exclusively on field and vegetative characters along with altitude and habitats.

The major characters used in the preparation of the Computer Aided Multi-entry key include **arrangement of leaves** (phyllotaxy) - opposite, subopposite, alternate, verticillate or clustered at the apex of branchlets; **leaf types-** simple, bilobed, 3 or more lobed, simple odd pinnate, simple even pinnate, bipinnate or tripinnate; **leaf apex types**- acute, acuminate, obtusely acute or acuminate, apiculate, mucronate, caudate, obtuse, retuse, rounded or emarginate; **leaf base types**- acute, attenuate, oblique, cordate, sagitate, auriculate, rounded, truncate and peltate; **leaf shapes (form)**- elliptic, oblong, ovate, obovate, oblanceolate, lanceolate, elliptic-lanceolate, linear-lanceolate, rhomboid, pandurate, orbicular etc.; **leaf margin**- entire, serrate, dentate, ciliate, wavy, revolute or undulate; **petiole -** pulvinate, appendaged, winged, glandular or with outgrowth at apex. **Venation-** basally 3-5 ribbed or pennineryed; **glands-** often found in the nerve axils, base or throughout the surface of leaves. Thus from a leafy twig as many as 70 characters can be observed. Other characters used for keying out species are: bark colour, blaze colour, exudation, habitats, etc. For identifying a tree, as many characters as possible may be selected from the main menu. . For identification of mature trees, the characters such as bark, blaze, size and shape of leaves in the identification program may be observed.

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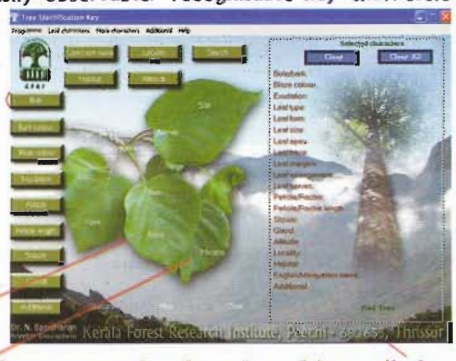
TreeID

Tree Identification Key for Kerala

TreeID is designed to identify the trees of Kerala by selecting a few easily observable/ recognisable key characters through a multi-entry, menu driven program.



Main menu

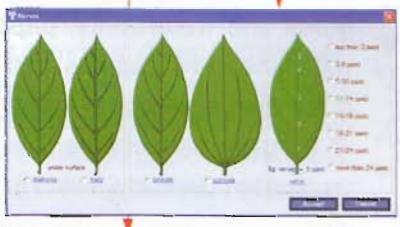
The key characters for identification of trees are arranged in the main menu under different icons such as bole, leaf form, leaf margin, etc.

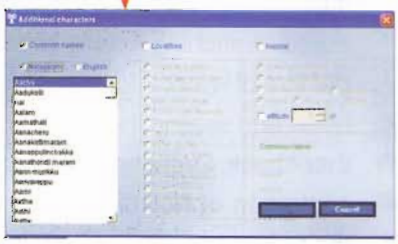
One can choose any character by just clicking on the icon.

Character selection

When an icon is selected all characters under the selected icons (bole, leaf form, leaf margin, etc.) will be displayed (example: leaf base) and most matching character can be selected by a single click.

Select as many as characters from the main menu while identifying trees (leaf, habitat, bole, bark colour, exudation, nerves and common names, etc.).



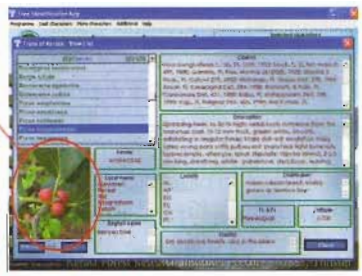


Selection Table: The selected characters will be displayed on the Selection Table placed at the right side of the main menu. One can check all the entered characters from the Section Table. If any selected character is found doubtful, it can be removed by using clear button and for removing all selected characters with clear all button in the Selection Table.

After completion of selection, find the matching species by clicking the Find Tree icon.

Scientific names of all trees matching the selected characters will be displayed in the result window. If the list of trees in the Result Window are more, return to main menu and select a few more characters and repeat the find process. The list in the result window will be reduced and finally to the tree to be identified. Images (enlarged views are available by clicking on the image) of the trees will be appear in the result window. When there are more images for a tree, view other images using Next Icon and Previous Icon.

If the list of trees in result window are more than one, compare the images of the trees in result window and find out the matching tree.



Available data: The correct scientific names, basionyms/synonyms, author citation with full reference, family, detailed description, habitat, English and local names, geographical distribution, phenology and altitude are provided for each species.

In addition, a distribution map of the species in Kerala showing the representing district(s) and protected area(s) is also provided.

Search facility (in main window) is provided for family/genus/specific-epithet (also using any comparable 'phrase') of trees.

Glossary (in main window) for easy recognition of characters and scientific terms, a detailed glossary is also provided.

ACTARA 25WG (Thiamethoxam) as an effective termiticide

Control of termites has always been a challenging job. When very effective and highly persistent organochlorine insecticides like aldrin, chlordane, heptachlor were available, the job was a bit simple because of the assured positive results. When these deadly insecticides were banned in the late 1990s, termites would have been the happiest because they could survive without much of fear. But the human perception of termites as 'pests', encouraged him to look for alternatives. In the post organochlorine era, the organophosphate-Chlorpyrifos was the main choice and is being widely used as a termiticide formulations specific to control termites attacking buildings are also available.

When it is a question of finding out the deleterious effects of a pesticide, we come to know only through agencies outside the country. Our strategy is to use something until somebody tells us not to use it. It is a sad reality that though our level of environmental awareness is excellent, we have no system to monitor the ill effects of pesticides and take corrective measures at the right time and inform the concerned. The pesticide atrocities that we hear is mainly due to the lack of regulations. In the year 2000, the Environmental protection Agency (EPA) in the U .S.,while reviewing the pesticide safety aspects indicated that chlorpyrifos as termiticide will be banned in a stepwise manner. Thus like the organochlorines, chlorpyrifos will also come under the hit list and will be withdrawn from the market sooner or later. Thus looking for another alternative to control termites has become a necessity. When we look at the practical side of the problem, always there is a demand for control of termites attacking forestry and agricultural crops and also woodworks in buildings.

Based on the literature survey and interactions with other scientists in the field, the scope of thiamethoxam (a nitomethylene derived compound considered as second generation neonicotinoid) as a termiticide was brought to notice and we decided to evaluate it against termites. This chemical is reported to have antifeedant effect against termites and also to have a little more persistence than chlorpyrifos.

A two-year field trial to control termites attacking eucalypt seedlings showed that Actara 25 WG (Thiomethoxam) was effective in preventing termites from attacking during the initial establishment phase and compared well with chlorpyrifos. Based on the results of the field trials, dipping the root trainer raised seedlings in a solution of Actara 25 WG @ 1 g per l litre of water (0.25 g % a.i. solution) gave good protection. Even a lower dose of 0.5 g per 1 lit of water was effective, but on practical considerations, a higher dose was recommended.

It may also be stated that in addition to the above, Actara 25 WG was also tested against termites attacking lawn grass and woodworks, paper etc., within the KFRI campus. In the case of the lawn, a solution of Actara 25 WG @ 0.5 g per 1litre of water, gave good protection . Similarly, inside the buildings where termite infestations were noted, drenching Actara 25WG @ 1g per litre of water into the crevices and holes and sealing them prevented further attack. Drenching the same concentration of Actara 25 WG around the building was also tried to prevent entry of termites from outside which requires further confirmation.

What is required now is to use thiomethoxan as a termiticide in different situations and generate more information as possible on the efficacy of the product as a termiticide. The main advantages of Actara are, that it has only low mammalian toxicity, and it is not phtotoxic, based on pot trials.

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The Razor-wire Fence: Will it halt the elephant in its tracks?

The standoff between the wild elephant and the farmer is a recurring problem in settlements adjacent to forests and one that has evaded a lasting solution. In Kerala, the burgeoning population and its pressures have resulted in settlements that intrude into the elephant habitat. The beleaguered animal and the harassed human are thus juxtaposed in a seemingly no-win situation. Agriculture is invariably the mainstay of such communities. The crops are an attraction to the elephant particularly when the dwindling habitat makes normal food scarce. The natural foraging behaviour of the animal involves constant movement along elephant corridors. When humans unwittingly intrude into this space it leaves little room for peaceful coexistence. There is little choice for humans but to find ways and means to protect life and property. Several means are in vogue for keeping the pachyderms away but the general view is that none are satisfactory when the costs, long term maintenance and performance is considered.

Solar electric fencing is perhaps the best option available. It is indeed a strong deterrent when fully functional. Maintenance is required to ensure circuit continuity in all of the cables strung across pillars. Elephants are known to damage such fencing and it is presumed that they learn to use objects like branches to push down the pillars and snap the cables. Stray cases of electrocution have also been reported probably involving modification from the standard and safe practice. In any case installation and maintenance of the solar powered fence is expensive over long stretches.

The other common method of keeping away wildlife is to excavate a trench around the area to be protected. The trench is not only expensive in its initial cost but requires maintenance to keep it functional. Elephants can breach the trenches at the weak points where walls have buckled or the soil eroded. It also minimises the movement of humans and domestic animals and requires gates, bridges for permitting such passage. It also takes away a significant area of land from more productive use.

It is in this background that a possible solution is suggested to overcome the problems described and yet offering a cost effective barrier to movement of elephants and similar large animals into areas that need protection.

Advantages: Razor Wire Fence

The razor wire is an alternative to the regular barbed wire used commonly for fences. One usually associates the razor wire fences with international borders, military and industrial installations rather than with farmer's fields. Yet the razor wire might offer a formidable barrier with the following advantages:

1. Difficult to breach: The razor wire 'concertina' (coils) is a GI wire with sharp blades in pairs attached like in barbed wires. The coils, depending on the diameter and the height at which it is installed, will not permit large animals or humans slipping through. The flexibility of the fence as well as deterrence offered by the razor is expected to be sufficient for making an elephant proof fencing.

2. Ease of installation: The concertina has the advantage of retaining the shape even if left free standing on the ground. It can also be mounted on horizontal stay wires strung on pillars to leave a gap from the soil.

Gaps below the coils can be kept at a suitable height to permit smaller animals or even humans to pass while keeping the elephants away

3. Maintenance free: Unlike solar electric fences the razor wire fence is maintenance free and not energy intensive.

Disadvantages

1. Rusting: GI wires are prone to rust if the galvanization is of poor quality. GI barbed wire fences in common use today do not last more than a decade. But if quality is ensured or antirust treatment or paints used during the installation GI wires as well as razor wires can be long lasting.

2. Injury to the elephants: The possibility exists of the sharp razor blades inflicting serious wounds to the animal or human that tries to break through. But it is expected that animals will perceive the danger and learn to avoid the fence. It is also possible to dull the razor edge but still retaining the capability to deter the animals.

The concept of the razor wire fence is definitely not aesthetically pleasing and may evoke an image of an imposing and hostile warlike scenario in a otherwise natural forest setting. But as any farmer whose orchard or house has been trampled by a passing band of pachyderms will vouchsafe, it is his life or livelihood that is at stake.

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FT-NIR installed in the Forest Utilization Division of KFRI

Traditional methods employed for measuring important wood properties are time consuming, expensive and often destructive, i.e., the tree has to be cut down. Near Infra Red (NIR) spectroscopy has been extensively used for rapid estimation of a number of parameters that traditionally have been time consuming and difficult to measure. It is a rapid technique which can replace many types of chemical analysis. It has been widely used in the pharmaceutical industry, as well as for diverse application in food and beverages industry for quality control. For example,

NIR has been used to predict tablet composition if the tablet samples are adulterated with other compounds. Lately in the field of forestry/wood science, it has been introduced for the analysis of lignin in a variety of tree species to determine the pulpwood quality and to analyze extractive content, hemicellulose, cellulose and silica content. Now, the use of NIR has been extended to assess non-chemical characteristics of solid wood samples such as multivariate modeling of density and mechanical properties as well as determination of wood durability/decay resistance.

NIR spectra consist mainly of overtone and combination bands of the fundamental stretching vibrations of C-O, O-H, C-H and N-H functional groups and contain chemical and physical information about a sample. The most useful region of the NIR spectrum is 1200-2500 nm. For wavelengths below 1200 nm, the weak absorption bands make reflectance measurements difficult, and for those above 2500 nm the bands become too strong. In the NIR spectrum, when the infrared radiation passed through a sample, some of which is absorbed by the sample and some of it is passed through (transmitted). The resulting spectrum represents the molecular absorption and transmission, creating a molecular fingerprint of the sample. Like a fingerprint no two unique molecular structures produce the same infrared spectrum. Because each different material is a unique combination of atoms, no two compounds produce the exact same infrared spectrum. This can result in a positive identification (qualitative analysis) of every different kind of material. In addition, the size of the peak in the spectrum is a direct indicative of the amount of material present. With modern algorithms like 'Chemometrics' (multivariate calibration models in analytical chemistry), near infrared is an excellent tool for quantitative analysis.

Fourier Transform-Near Infra Red (FT-NIR) Spectroscopy is relatively a new field for material analysis in the laboratory. The FT-NIR employs a very simple optical device called an Interferometer which measures all frequencies simultaneously. Thus, fast measurements are possible. The measured interferogram signal can be decoded using a well-known mathematical technique called Fourier Transformation. This transformation is performed by the computer which then presents the user with the desired final spectral information for analysis and interpretation. Thus, FT-NIR is unique in many ways:

It is a non-destructive technique

- It provides a precise measurement method which requires no external calibration.
- It can increase speed, collecting scans every second
- It can identify unknown materials
- It can determine the amount of components in a mixture
- It is mechanically very simple.

Under the CSIR sponsored project, KFRI has installed the most advanced model of FT-NIR instrument from Bruker, Germany in Wood Science and Technology Discipline. It is being used

in analyzing a large number of wood samples for simultaneous prediction of extractive content, lignin, hemicellulose, cellulose and silica content etc., in non-destructive way by comparing the spectral data with multivariate calibration models. In the instrument, there is provision for analysing liquid as well as solid samples by using the liquid and solid fibre optic probes. For liquid, the transmittance mode is used and for solids the diffuse reflectance mode. The whole analysis is software controlled using the OPUS QUANT /LAB software. The advantage is that, once the calibration models are developed, large number of samples can be analysed at a time avoiding the cumbersome job otherwise experienced in analysing a set of samples by the conventional method.

The NIR spectroscopy offers a low cost, rapid and non-destructive alternative to traditional methods of laboratory analysis. It can be well employed in the analysis of soil organic carbon, foliar analysis of nitrogen, protein estimation of vegetables, fruits and many food items, in the quality control laboratories of pharma and paper industries and many others.

K. M. Bhat and P. K. Thulasidas

Wood Science & Technology
Forest Utilisation Division

APFISN Workshop on Early Warning Systems for Forest Invasive Species - A Report

A workshop on Early warning systems for forest invasive species was held at KFRI during 21-24 February 2006. It was arranged as an activity of the Asia-Pacific Forest Invasive Species Network (APFISN) in collaboration with Asia-Pacific Forestry Commission (APFC), USDA Forest Service, Food and Agriculture Organization of the United Nations (FAO), Asia-Pacific Association of Forest Research Institutions (APAFRI) and KFRI. The APFISN is a cooperative alliance of the 32 member countries of the APFC and it focuses on inter-country cooperation that helps to detect, prevent, monitor, eradicate and/or control forest invasive species in the Asia-Pacific Region. The main objectives of the Early Warning workshop were: 1) to become familiar with key early warning strategies for forest invasive species; 2) identify key challenges to implementing early warning systems for forest invasive species and possible solutions to address these challenges; 3) develop working relationships and contacts with colleagues from other countries on invasive species and 4) develop an action plan to address early warning of invasive species on a regional scale. The workshop was attended by 48 participants from 13 countries. Representatives of APAFRI and FAO also participated in the workshop.

There were 4 Technical Sessions viz., Overview of Early Warning Systems (Technical Session 1), Identifying Potential Threats (TS 2), Early Detection of Invasive Forest Species (TS 3) and Assessing Potential Impacts of Forest Invasive Species (TS 4). The papers presented at the technical sessions on the first day (21 Feb.) dealt with 'early warning of forest health threats, risk profiles and databases for invasive species, assessing potential pathways for FIS and identification of ecosystems at risk'. On the second day (22 Feb.), the topics covered included 'development of hazard site surveillance programs, systematic detection surveys, evaluation of potential extent and severity, regulatory and quarantine assessments, national regulatory framework for preventing invasive species in India and development of species awareness program. The experts who presented papers on various topics included Dr. Ross Wylie (Australia), Mr. Borys Tkacz and Mr. Frank Sapio (USA), Drs. Wu Jian and Sun Jianghua (China), Drs. P. S. Ramakrishnan, P. K. Muraleedharan, R. J. Rabindra and Ravi Khetarpal (India), Dr. Chris Baddeley (New Zealand) and Dr. S. T. Murphy (UK).

A Panel Discussion held on 23 February was lead by Dr. S. T. Murphy and Mr. A.K. Goyal (India). The panelists were Prof. P. S. Ramakrishnan, Mr. Frank Sapio, Dr. Ross Wylie, Dr. Chris Baddeley, Dr. Sun Jianghua and Mr. Pham Quang Thu (Vietnam). The workshop developed an action plan for early warning of FIS on a regional scale.

The workshop was closed at 3.30 pm following 'closing remarks' by Dr. Sim Heok Choh.

Summary of the recommendations

How to net work?

- The Executive Committee (EC) of APFISN (to be constituted) may decide on the organizational structure of the network and the modality of in-country networking in consultation with the national coordinators (NC). A TOR on the duties and responsibilities of EC, NC and network coordinator (NEC) may be developed and approved at the Pre-session workshop at the 21st session of APFC to be held in Dehra Dun, India. A time frame needs to be fixed for any activity proposed by the network
- Mechanisms for sharing of IPR, patents (and trade restrictive items) between countries shall be addressed at a later stage

Areas to network

Information sharing

China has agreed to undertake work on a database on invasive species. The NEC may help upgrading the website at frequent intervals.

Publication arrangements may proceed as decided at the APFISN task force meeting held in Beijing in September 2005.

General public awareness

Public awareness on invasive species and the threats they pose could be brought to the attention of the general public through media (TV, Newspapers), brochures (with specific examples from partners of the network), bulletins (some need to be prepared in local languages), extension workers in villages, by adding to course curricula in schools/colleges/universities, publicity at ports of entry, making and exhibiting documentaries for different category of stake holders, by involving NGO's and citizens and getting feedback. NC and NEC may work jointly to achieve this.

Outreach programs need to be country/area specific and should also address to biodiversity rich zones.

Linkages among quarantine-agriculture-forestry

In many countries in the region, linkages between quarantine activities concerning agriculture and forestry are lacking. This problem needs to be taken up at a regional level, involving APPPC. NEC may initiate action on this in consultation with NC's.

Taxonomy

NC's, jointly with NEC, should identify experts (taxonomists, weed biologists, plant pathologists, entomologists) in each country in the region. The experts could be requested to identify groups of invasive pests and weeds in each country as an initial activity. Taxonomists may attempt to develop digital or referral specimen collections (of invasive species) irrespective of whether conventional/ molecular. Digital images could be linked to the network website for wider circulation in the region and elsewhere. An in-country networking of experts may be developed by the NC to facilitate these activities. Networking across the region may be helped by the NEC.

Diagnostic protocols

Further discussion between EC, NC, NEC and experts in the area is necessary to decide on diagnostic protocols.

Specific IAS problems at country level

Prioritizing the IAS

NC and NEC should facilitate collection of information on:

1. introduced and established IAS;
2. recently introduced IAS; and
3. those with potential to be introduced (a priority item for action) in each country in the region.

If necessary, involvement of local communities (traditional knowledge) should be ensured to collect the information. National coordinators could arrange involvement of local communities and seek funding locally and globally to take up the activity.

NC's, in association with quarantine personnel, port authorities and all other Government machinery concerned, need to ensure detection/ fumigation of all "at risk" imported items such as timber, non-timber products etc. Strict adherence to this practice may avoid many incursions.

Regulatory harmonization

NC's in association with NEC should prepare a list of quarantine pests of concern to each country in the region.

Collaborative research projects

NC's and NEC in consultation with the EC may develop collaborative research programs (bilateral/ trilateral) to address specific problems of invasive species in a country/ region. Pilot projects on biocontrol methods and risk assessment should be initiated on a priority basis.

Promote exchange of biocontrol agents/promising germplasm

Pro-active action is required to facilitate exchange of biocontrol agents/promising germplasm. In most countries, Government permission would be required for import/ export of germplasm and biocontrol agents. NC's may interact with the concerned officials in each country and develop action plans in consultation with EC and NEC.

Capacity building

NC's, in consultation with scientists, foresters, quarantine officials, port authorities and others dealing with IAS problems should identify where capacity building is necessary in each country. Sometimes, an institutional mechanism may be helpful in the easy identification of needs. Once this is done, the network may help capacity building through facilitating exchange programs, training and by conducting workshops. Identification of needs should take priority and a matrix needs to be developed based on this.

Use of sophisticated technologies

Use of GIS, remote sensing and helicopters may help identification of spread of invasions. Many countries in the region may not be in a position to adopt these technologies. Network may consider steps to help such countries.

Issues

Funds available

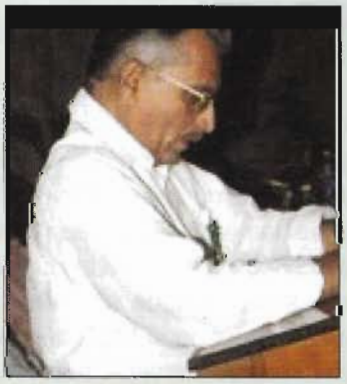
A continuous source of funding needs to be located for all network activities. NEC in consultation with EC of the network, FAO, APFC, USDA and other national/ international bodies should identify sources.

Expertise available

As discussed earlier, a matrix on available expertise in the region needs to be established and this expertise may be utilized for further goals and objectives of the network.

Dr. K.V.Sankaran
Forest Protection Division

Workshop on Site management of exotic forest plantations in Southern India: Prospects for improving productivity- A Report



Shri. Therambil Ramakrishnan Hon'ble Speaker, Kerala Legislative Assembly inaugurating the Workshop

An international workshop on "Site Management of Exotic Forest Plantations in Southern India: Prospects for Improving Productivity" was held at Kerala Forest Research Institute during 8-10 November 2005. The workshop was organized by KFRI in collaboration with CSIRO Forestry and Forest Products Australia. The workshop was inaugurated by Shri. Therambil Ramakrishnan, Hon'ble Speaker, Kerala and Legislative Assembly in a function held at KFRI auditorium on 8 November 2005. The inaugural function was presided over by Shri. K. Balachandran Thampi, IFS, Additional Principal Chief Conservator of Forests, Kerala. Dr. E.K.S. Nambiar, Chief Research Scientist and Director (Science), CSIRO Forestry and Forest Products and Ensis, Australia gave a key note address on the topic 'Sustainable plantation forestry for economic development'. Dr. Tony O' Connell, Senior Principal Scientist (Rtd.), CSIRO, Australia gave an introduction to the KFRI-CSIRO-ACIAR project on improving productivity of eucalypt plantations through site management.

A total of 47 participants representing pulp wood industries, State Forest Departments, Forest Development Corporations from the States of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Uttaranchal participated in the workshop. Participants also included scientists of Kerala Forest Research Institute, Ensis, Australia, Forest Research and Training Institute, Karnataka, Forest Reearch and Training Institute, Tamil Nadu and Institute of Forest Genetics and Tree Breeding, Tamil Nadu. There were 4 technical sessions. Technical Session 1 included presentation of a case study of improving productivity of eucalypt plantations in Kerala based on the results of the KFRI-Ensis-ACIAR, Australia collaborative project on eucalypts. Status papers on impact of site management practices on improvement of productivity of exotic plantations in the States of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Uttarachal were presented in the other three sessions. A field trip for participants to experimental plantations of eucalypts at Surianelli and Vattavada was arranged on 10 November 2005.

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KFRI RESEARCH REPORTS

Timber quality of teak from home garden forestry. KFRI Research Report No. 262 *(Bhat, K. M., Thulasidas, P. K. and Maria Florence, E. J .M., 2004).*

Trees grown outside forests especially homesteads play an increasing role in the industrial supply of timber in Kerala. The present study evaluates the timber quality of 35-year-old teak grown in homesteads representing wet and dry localities of Kerala in comparison with that grown in forest plantation of Nilambur (of the same age group), which is widely reputed as Malabar teak.

Grading of 88 logs (of 35-year-old trees) from wet and dry localities reveals that teak timber from homesteads qualifies only for Grade II or III specified in Indian Standard (IS 4895). Grade I timber was not available from either of the two homesteads. The 35-year-old home garden trees from wet site produced timber of average DBH 39.6 cm indicating their potential of producing the log diameter similar to that of Site Quality I (SQ I) prescribed in the All India Yield Table (1970). In contrast, teak from dry site produced smaller dimensional timber of average DBH 24 cm, which qualifies only to SQ II/III with the major share of logs comprising pole sizes. Pole sized logs were less frequent in wet sites than in dry localities. Therefore, the sawn wood out turn from wet site was significantly higher than dry and plantation sites. The log form was poor with eccentric growth possessing bends and frequent knots probably due to lack of standard silvicultural regime like spacing/thinning in home garden forestry.

The heartwood proportion at BH level was 71%, 64% and 73% in wet, dry and forest plantation sites respectively. Although stem diameter of the trees differed significantly, the heartwood percentage did not show significant variation with tree size and locality of the planted site. This means that homesteads of wet site areas produce larger diameter logs without adversely affecting the heartwood yield compared to dry localities and plantation sites.

The quantitative measurement of colour, as per the international standard, indicates that wood from wet sites of homesteads is paler with less yellowness and colour saturation. No significant differences were observed between the samples of different localities with regard to brightness and redness. The results suggest that the paler colour of wet site teak wood is one of the causative factors of lower timber price of home garden teak. The total extractive content was significantly lower in wet than in dry site. The paler colour of wet site sample was attributed to lower extractive content. The decorative black streaks of dry site wood sample were probably due to the presence of higher (16%) and more well defined zones of extractive distribution. The heartwood of plantation specimen also often displayed a similar pattern (13%) with uniform golden brown colour.

No significant differences were noticed in wood basic density, moisture content and volumetric shrinkage values among the homesteads of wet and dry localities as well as the forest plantation site in Nilambur. Excepting slightly higher longitudinal compressive stress of dry site home garden teak, no significant variation was encountered in timber stiffness (modulus of elasticity) and bending strength among the samples of homesteads and forest plantation. This implies that teak wood grown in homesteads has almost the same dimensional stability and strength as the plantation grown teak of forest sites.

The accelerated laboratory tests revealed that significant differences existed in natural decay resistance between wet and dry localities. While the two brown rot fungi caused more severe weight loss in wet site samples than in dry and plantations sites, the three white rot fungi did not show significant differences among the sites. In general, Polyporus palustris *was the most aggressive fungus followed by Gloeophyllum trabeum, both belonging to the group of brown rot fungi. The higher susceptibility of wet site home garden teak was attributed to the lower extractive content of the wood.*

With a mean value of 2.2 cm, bark was thicker in trees grown in wet locality than in dry (0.8 cm) and plantation (1.1 cm) sites. While thicker bark from wet locality displayed higher moisture content (228%) and lower basic density (263 kg/m^3), thinner bark from dry locality was heaviest with a mean basic density of 640 kg/m^3. Bark from plantation was intermediate with 400 kg/m^3 of basic density and 172% of moisture content on dry weight basis.

The study concludes that teak wood grown in homesteads differs from forest plantation grown timber in certain properties such as log form, extent of natural defects, appearance/wood colour and grain as well as natural durability depending on the dry or wet locality although wood density and strength properties are almost similar. These differences in timber quality may influence the price factor of teak wood coming from homesteads especially of wet localities.

Propagation of rattans in the Western Ghats - a species trial. KFRI Research Report No. 269 *(Renuka, C., 2004).*

Species selection is very important when large scale plantations are planned or when some of the commercially important species from other regions are adopted and acclimatized for widening the resource base. Hence a species trial of rattans with four species from Karnataka and Goa part of the Western Ghats was conducted at two different elevations, at Kacchithodu at 300 m under Thrissur Forest Division and at Nelliampathy at 1000 m under Nemmara Forest Division. Species planted were *Calamus prasinus, C. nagbettai, C. stoloniferus* and *C. thwaitesii* (Goa Provenance). The former three species are reported from Karnataka region of the Western Ghats. Survival percentage and growth in height were monitored during the experimental period.

C. nagbetttai grew well at both elevations. Hence this species is recommended for raising large scale plantations at elevations up to 1000 m. It provides large diameter canes (about 3 cm in diameter) and is suitable for furniture frame work.

The Kerala Forest Development Corporation had planted three species, *C. thwaitesii* (Kerala Provenance), *C. pseudotenuis* and *C. rivalis* at four different altitudes, 650, 1000, 1150 and 1550 m. Survival percentage and growth in height were monitored here also. The survival of *C .pseudotenuis* was more than 90 percent in all the areas except at Nemmara where it declined drastically for all the species. The main reason for the decline in the survival percentage was the exposure of roots due to rodents' activity and soil erosion.

Germplasm establishment of rattans. *KFRI Research Report No.270* (Renuka, C., 2004).

Rattans, once abundant in the tropical forests, have become a scarce resource today due to loss of habitat, overexploitation, inadequate replenishment and unscientific management. There is an urgent need to ensure the future for rattans by intensifying the *ex situ* and *in situ* conservation methods. Recent studies have shown that genetic variations exist between populations of rattans. Genetic conservation or germplasm aims at maintaining the entire gene pool of species and populations for many generations.

In this *ex situ* conservation project, seeds and seedlings of different species of rattans from various populations were collected from the Western and Eastern Ghats, north eastern states and from the Andaman and Nicobar Islands. Seeds of each population were kept separate and germinated. One – year - old seedlings were out planted in the selected areas. Linear plots were laid out with at least 25 plants from a population.

Two germplasm plots were established, at Nilambur in north Kerala , and at Achencoil in south Kerala. Two smaller live collection plots also were established, one at Vazhachal and the other at Peechi, both in central Kerala. There are 18 species at Achencoil, 22 at Nilambur, 29 at Peechi and 18 at Vazhachal. Exotic species collected were planted only in the KFRI campus at Peechi. There are six species collected from China, Lao PDR and Malaysia. For each species planted in the germplasm, the botanical name, local names, accession number, distribution, the provenance collected, the nature of the species, flowering and fruiting time, conservation status according to IUCN specifications and uses are given in this report.

Rehabilitation of degraded forests through landscape based participatory approach. *KFRI Research Report No.272 (Kallarackal, J, Chandrashekara, U. M., Vijayakumaran Nair, P., George Mathew, Ramachandran, K. .K., Chundamannil, M., Anitha, V., Induchoodan, N. C., Trivedi Babu, Srivastava, P. and Thomas, M.. L. 2005)*

This capacity building project aimed at evolving a model for rehabilitation of degraded forests through participatory action programme. The landscape ecology concept, a relatively new concept, has been adopted to achieve this goal. Training for this project implementation has been given to seven scientists and three forest officers in Australia using an AUSAID programme. Besides, several training sessions were held in India employing the expertise of several reputed scientists from overseas.

Deforestation and degradation of forest ecosystems in the tropics pose great threat to the conservation of a large number of endemic and endangered tree species and ecosystem as a whole. Kerala, located in the southwestern part of India, with its rich tropical forests, has 740 indigenous tree species, of which a good number are endemic. Most of the species have environmental or medicinal value. Hence the gene pool of all these species needs to be conserved in the natural forests. With a high density of population in Kerala, a large number of people live in the periphery of the forest, depending on its natural resources for sustenance, which makes conservation a challenging task. An attempt was made to evolve a suitable model for conserving forest ecosystem using Participatory Forest Management (PFM) based on landscape ecology concepts. The model suggested is based on two diverse forest habitats – a forest area inhabited by tribal communities and another forest area surrounded by the non-tribal communities.

Landscape level participatory approach to rehabilitate the degraded forest is very unique as it takes into account the physiographic, ecological and sociological characteristics of the land. Landscape varies according to these characteristics and the historical impact of man on it. Therefore, in this approach, the physical landscape and social considerations are integrated, resulting in a fusion of ecology and sociology.

The forest and the non-forest areas forming the entire degraded landscape were identified at two locations. The topographical features, vegetation and fauna within the landscape were analysed to establish the linkages between different landscape units. Physical, biological and anthropogenic causes of degradation were also identified.

Altogether, 135 species of insects were recorded from the forest ecosystem at Vellimuttom and 165 species from Vaniyampuzha. The homestead contained 104 species at the former location and 144 species at the latter. The insect species diversity (Shannon-Weiner index) of the forest patch at Vellimuttom was 3.298 and 4.863 in Vaniyampuzha. In the case of homesteads, the former registered a value of 2.867 and 3.796 in the latter. The faunal elements in both locations included several rare and endemic species.

A stakeholder analysis was conducted to determine the number of people depending on the forests and their resource availability within the landscape. Based on these landscape-ecological details, the restoration of degraded forests was attempted. In the non-tribal site, different tree species were planted as per the requirement of the stakeholders. Awareness campaign was quite effective in the tribal site. While restoring the forest sites, the stakeholder empowerment and aspirations were given high priority. Stakeholders were educated on the environmental benefits of the forests and trained to use the forests in a sustainable way. They were also trained for other means of employment. The problems and basic requirement of people in tribal and non-tribal areas were quite different.

The landscape-based approach was found useful in understanding the ecological, physiological, silvicultural and sociological requirements for restoration of degraded forests. The PFM approach is expected to conserve the forests in a sustainable manner as it empowers the people and gives them the feeling that the forests belong to them. Only when the conservation needs coincide with the interests of the local communities, can forests be effectively protected, especially when the forestlands are highly fragmented as in many tropical countries. The success of conservation will depend on circumventing the many social and ecological problems faced during this process.

Management of soils of teak plantations for sustainable productivity. *KFRI Research Report No.279.* (M. Balagopalan and P. Rugmini, 2005).

In Kerala, Teak (*Tectona grandis* Linn. f.) occupies an area of about 69,000 ha and constitute about 46.5 per cent of man made forests. There is wide variation in site quality classes in teak plantations. In order to study the physical and chemical properties of soils of teak plantations of different site quality classes in various age groups and also to evaluate the soil properties affecting the site quality, this project was undertaken.

Teak plantations belonging to three age groups, 5-25 yrs, 26-45 yrs and >45 yrs in the major teak growing Forest Divisions of Achencoil, Konni, Ranni, Thenmala, Nilambur (North & South) and Wynad (North & South) were selected. In each of the selected plantations, plots were marked along a randomly laid out transect running through the centre of the plantations. One plot was taken for every 10 ha with a maximum of 10 plots in any one plantation. Girth at breast height of all trees in the plots was taken. Trees having the largest height, smallest height and three trees in between the range were selected for measurement of height in each plot.

One soil pit was taken from each plot and samples collected from 0 - 20, 20 - 40 and 40 - 60 cm layers. Altogether 289 soil pits were taken. The samples were air dried, passed through 2 mm sieve and particles > 2 mm (gravel) were found out. Analyses were carried out for particle - size separates, bulk density (BD), particle density (PD), soil pH, organic carbon (OC), maximum water holding capacity (WHC), available N, P, K, Ca and Mg and $CaCO_3$. Discriminant analysis was done to identify the factors by which the soils under different site quality classes differred significantly under each age group.

It was found that in the age group 5-25 years, the soils were loamy and medium acidic in the different site quality classes I, II and III and there was no definite pattern for the soil properties. In the age group 25-45 years, the soils were sandy loam in the site quality I while in the site quality classes II, III and IV, the soils were loamy. The soils were medium acidic in all the site quality classes. There was considerable difference in site quality classes I, II, III and IV with respect to some of the soil properties viz. water holding capacity, organic carbon, available N, Ca and Mg and $CaCO_3$. The Available N, Ca and Mg and $CaCO_3$ were more in site quality I. Water holding capacity and organic carbon content was more in site quality IV.

In the age group > 45 years, the soils were loamy in site quality classes I, II, III and IV and medium acidic in site

quality classes I, II and III. In the site quality IV, the soils were slightly acidic. Organic carbon, available N, Ca and Mg contents showed considerable variation between the site quality classes. Organic carbon, available N, Ca and Mg contents were lowest in site quality I while available N and Ca were highest in site quality II. Organic carbon and available Mg were more in site quality classes IV and III, respectively.

It was observed that there was no general trend with respect to the variation in soil properties in relation to different site quality. Particle density, bulk density, available P and Ca in the age group 5-25 years and $CaCO_3$, organic carbon, available K and silt in the age group 25 - 45 years discriminated the soils under different site quality classes. In the age group > 45 years, $CaCO_3$, available P, Ca and Mg and particle density discriminated the soils under different site quality classes. In other words, in the age group 5- 25 years, soil physical properties and nutrients were the discriminating factors by which the soils belonging to various site quality classes differed significantly. Soil texture, alkalinity, nutrient and fertility status were the discriminating factors by which the soils under the four site quality classes differed significantly in the age group 25- 45 years. In the age group >45 years, soil alkalinity, nutrients and physical properties discriminated the soils belonging to various site quality classes.

On the basis of the study in teak plantations belonging to different site quality classes, it is recommended that steps have to be taken to minimize soil compaction and also to enhance the nutrient status of the soil by retaining the litter and the thinning residues in the soil and also by controlling forest fire. In addition to the above, retaining calcium in the soil at optimum level is required for management of soils of teak plantations for sustainable productivity.

Testing an alternative thinning schedule for teak plantations based on a simulation model (Phase II). *KFRI Research Report 217*, (Jayaraman, K. and Induchoodan, N. .C. 2005).

Through simulation studies with a yield prediction model for teak, Jayaraman (1998) had found that the presently followed thinning schedules based on All India Yield Table for teak are nonoptimal leading to understocked stands. As a corollary of the above finding, it came out that thinning could be delayed in fully stocked stands (as per All India Yield Table for teak) leading to higher yield without unduly sacrificing the diameter growth. A field experiment was planned to test the latter derivation. However, the ultimate objective of the experiment was not

recommend' or not to recommend" delayed thinning based on the results of the experiment. The experiment was only to find out for how long the thinning can be postponed in a fully stocked stand without appreciable reduction in diameter growth. In other words, the refutation of the hypothesis that the present thinning schedules are nonoptimal would only be indicative of the need for an alternative thinning schedule.

The experiment was conducted in fully stocked stands in two sites of different site quality classes in Nilambur. The stands were of age 12 years at Edakkod and 10 years at Valluassery. The trial was laid out in Randomized Complete Block Design with two treatments, viz., the standard as per the All India Yield Table for teak and the proposed schedule based on simulation studies. Under the proposed schedule, the first silvicultural thinning was skipped resulting in about 100 additional trees per ha compared to the plots under standard schedule. The plots were of size 50 m x 50 m with two replications occupying just above 1 ha in each site including border rows. Measurements on girth at breast-height, total height and crown width were made on the trees initially and subsequently at yearly intervals.

The results obtained at the end of four years indicated that the difference in diameter growth between the standard and proposed thinning schedules was statistically nonsignificant. So was the case with the expansion rate of crown width. The trees under the standard schedule carrying less number of trees gained more height due to increased space available during the experimental period. Physically, the reduction in diameter growth due to larger number of trees under the proposed schedule was 2.5 per cent in terms of relative growth rate. With a mean initial diameter of 16 cm of the experimental trees, this 2.5 per cent comes to 0.4 cm over 4 years, i.e., a reduction of 1 mm in diameter growth in an year. There is no claim that higher density will not reduce diameter growth. There will be reduction but not appreciable reduction. The results from the thinning trial were only indicative of the nonoptimality of the current thinning schedule in the sense that although higher density may result in slightly reduced diameter growth, the basal area and volume of the stand will be higher over long periods due to the higher number of trees in the stand. Leaving alone the results of the thinning trial, which was only for a short period, actual recommendations on thinning schedules were sought from the results of growth simulation studies conducted separately.

Attempts were made to develop a growth simulation model for teak so that the performance of stands under different management schemes can be easily studied using the model. The model was developed based on the data gathered from thirty-one permanent sample plots established in teak plantations during 1993-94 by KFRI clubbed with data from thirty additional plots laid out in 2000 and 2001 and

eight plots laid out as part of thinning trials at Nilambur. These plots belonged to selected age-site quality-stocking classes and were distributed throughout the state. The plots were re-measured during 1997, 2000 and 2005. The work of developing growth simulation models was undertaken in collaboration with Dr. Boris Zeide of the University of Arkansas, Monticello, U.S.A. Equations for predicting diameter and volume increments were developed based on Chapman-Richards function.

The model consisted of five modules dealing with the effects of site index, unrestrained growth, aging, density of teak and density of miscellaneous species on the growth of teak. The stand density measure used was based on modified Reineke's index, which allows formation of gaps in the stand with increasing stand age. Further, an impetus module (Zeide, 2004) was also included in the growth equation. The impetus module could indicate changes in growth associated with sudden changes in stand density due to thinning. The parameters of the equations were estimated using data from the permanent sample plots. Based on the estimated equations, a growth simulator was developed using SAS software and several simulation runs were made to find out the behaviour of stands under various density and site quality levels. Repeated simulation runs indicated that the optimal stand density in terms of modified Reineke's Index, for maximizing the cumulative volume over a rotation period is 475. As density is a function of number and diameter, the number of trees will have to be reduced progressively as trees grow in diameter, in order to keep the density level constant at 475. Expressed as a ratio of the density level yielding maximum current annual increment (830), the optimal relative density worked out to 0.57.

In the case of teak, density that maximizes cumulative volume serves only as a reference value for comparative purposes. Since price-size gradient is very steep for teak timber, an economic optimum was sought through maximizing the net present value of cash flows. After many trial runs with the simulator, it was found that starting with a relative density level of 0.3 at 5 years and gradually increasing to 0.47 by 50 years is more economical than maintaining a stationary value of 0.57.

Economic analysis with the simulator indicated that optimal rotation age for teak in Kerala is 50 years for all site quality classes. Also, analysis with the growth simulator revealed that understorey species in teak plantations exert a great influence on growth of main crop. By controlling miscellaneous growth, the mean diameter of teak trees at 50 years can be increased by 16 per cent and the mean annual increment in volume at the corresponding age by 25 per cent.

Monitoring biodiversity in Kerala part of Western Ghats. *KFRI Research Report 283* (George Mathew, Sharma, J.K. and Easa, P.S. 2006).

Biodiversity of selected landscapes at five different locations was studied with the active participation of college teachers and students. Cheruvathur Grama Panchayath; Muthur (Tirur municipality); Paliyamangalam, Ayilamudichi Hills, Nemmara; Karoor Grama Panchayath and Pramadom Grama Panchayath were the areas covered in this study. In each location, various landscape units such as rivers, natural forests, scrub vegetations, sacred groves and agricultural areas were covered and data pertaining to the flora and fauna collected. The biodiversity of each landscape unit was found to be very characteristic. Of the various habitats, the moist deciduous forests contained maximum number of species followed by sacred groves and remnants of natural vegetation existing in these areas. Of these, the sacred groves, although confined to relatively small areas, were rich in biodiversity particularly of birds. Similarly, in all locations, the rivers and streams showed good representation of native fish fauna. Rubber plantations and paddy fields were relatively poor in biodiversity. The study has shown that a major share of biodiversity is still conserved in sacred groves and relict vegetation that still exist in these areas.

Wood quality evaluation of ITC Bhadrachalam clones of eucalypts. *KFRI Consultancy Project Report* (Bhat, K.M., Kulkarni, H.D., Venkatesh, K.R., Santhakumar, P. and Shivaram, M. 2004).

Wood quality attributes are significantly influenced by various factors such as clone, age, site/soil type, spacing, irrigation, etc. Age seems to be the most crucial factor that determines the pulpwood quality up to the age of 9 years. Among the 98 clones tested, Clones 3, 4, 6 and 7 merit attention in short listing the clones as most potential ones for commercial multiplication because of their relatively modest wood density, longest and widest fibres with wider lumen and thicker fibre walls. However, Clone 4 has denser wood (>600 kg/m^3)and shorter fibres making it the least favoured among the four potential clones identified. Clones with denser wood showed the tendency of having shorter fibres. Two clones, viz. Clone 3 and Clone 7 are the most desirable ones for pulping in view of their relatively long fibres and desired wood basic density around 576-581 kg/m^3. Clone 7 yields more wood per tree (greater growth rate) than others.

NEW RESEARCH PROJECTS INITIATED

International

KFRI 495/2005: Promotion of weed biocontrol in Asia- the *Mikania micrantha* experience (Sankaran K.V.. July 2005-March 2006. Department for International Development (DFID). UK).

National

KFRI 492/2005: Studies on controlling teak defoliator outbreaks by seeding baculo virus, HpNPV in epicenter populations (Sudheendrakumar. V.V.. Sajeev, T.V., 2005 August-2008 July. Department of Biotechnology. GOI).

KFRI 494/2005 Multilocational field trials for selected bamboo species in Kerala (Raveendran, V. P.. August. 2005-July 2007. National Mission on Bamboo Applications (NMBA).

State

KFRI 470/2005: Developing appropriate technology for community level production of charcoal and activated carbon from coconut stem wood and shell for industrial use (Dhamodaran T. K. 2005 June-2008 May. Coconut Development Board, Kochi, Kerala).

KFRI 493/2005: Establishment of a Bamboo stand for conservation and sustainable utilization of Arayambu (*Pseudoxytenanthera bourdillonii* (Gamble) Naithani (Phase II) (Muktesh kumar M. S., August. 2005-July 2007. Kerala Forest Department).

KFRI 496/2005: Estimation of moisture content in bamboo culms for deriving the weight and price conversion factors (Krishnankutty, C.N., November 2005 - October 2006. Hindustan Newsprint Ltd. Kottayam).

KFRI 497/2006: Preliminary study for conservation and sustainable utilisation of Erankol, a rare and endemic bamboo of Western Ghats and Koorankolli (Muktesh Kumar, M. S., January 2006- December 2006 .Kerala Forest Department).

KFRI Plan fund

KFRI 471/2005: Regeneration study of selected Terminalias in Kerala (Chandrasekhara Pillai, P.K., 2005 April-2008 March).

KFRI 472/2005: Genetic diversity and conservation of teak (Indira, E. P., 2005 April-2008 March).

KFRI 473/2005: Recording of weather data at different centers of KFRI (Jose Kallarackal, 2005 April-2008 March).

KFRI 474/2005: Establishment of a clonal multiplication area for teak (Surendran, T., 2005 April-2008 March).

KFRI 475/05: Genetic diversity assessment of captive Asian elephant (*Elephas maximus*) population at Guruvayur elephant camp using microsatellite DNA markers (M. Balasundaran,, April 2005-September 2006).

KFRI 476/05: Improving sandal population in Marayur sandal reserves through assisted natural regeneration and planting improved seedlings and clones (M. Balasundaran, April 2005 - March 2008).

KFRI 477/2005: Studies on the growth performance of the rattan species under plantations (Renuka, C., April 2005 - March 2008).

KFRI 478/05: Documentation and conservation of small mammal diversity of the sacred groves of Kerala state, Peninsular India (P. Padmanabhan, April 2005-March 2008).

KFRI 479/2005: Identification of mammals based on hair structure, flesh, tissue and preparation of a manual (Ramachandran, K. K., April 2005 - March 2008).

KFRI 480/2005: Preparation of illustrated keys on the macrolichens of Kerala (Mukteshkumar, M.S., April 2005 - March 2008).

KFRI 481/2005: Status of critically endangered species, Malabar Civet *Viverra megaspila* civettina Blyth, 1862 in the South Western Ghats (Jayson, E. A., April 2005 - March 2008).

KFRI 482/2005: Ecology and economics of riverine ecosystems and possibilities of their improvement and management: A case study of the Thalipparamba River, Kannur Dt., Kerala (Swarupanandan, K., April 2005 - March 2008).

KFRI 483/2005: Enrichment of microbial culture collections at KFRI (Mohanan, C., April 2005 -March 2008).

KFRI/486: Qualitative and quantitative analysis of biologically active principles, Baicalein, Luteolin and Psorolin from *Oroxylum indicum, Premna integrifolia* and *Aegle marmelos* respectively and its allied species (Sasidharan, N., April 2005 – February 2008).

PUBLICATIONS

Research Papers in Journals

Anitha, V., Muraleedharan, P. K. and Binil Kumar. A. S. 2006. Human-related constraints in Protected Area Management: Manifestations and Causatives: *Economic and Political Weekly*, March 11, 2006.

Bhat, K. M., Thulasidas, P. K., Maria Florence, E. J. and Jayaraman, K. 2005. Wood durability of home garden teak against brown rot and white rot fungi. *Trees*, 19: 654-660.

Bhat, K. V., Varma, R. V., Pandalai, R. C., Santhosh Kumar and Raju Paduvil, 2005. Distribution of starch within the culms of *Bamboosa bamboos* (L) Voss. and its influence on borer damage. *J. American Bamboo Society* 19(1): 1-4.

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Jayaraman, K. and Zeide, B. 2005. The effect of autocorrelation on growth estimates. *Journal of Sustainable Forestry*. 20(4):37-49.

Jayasree, V. K., Sujatha, M. P Renuka, C. and P. Rugmini 2005 Root morphology and development in rattans.3. Root system development in *Calamus thwaitesii* Becc. and *Calamus rotang* L. in relation to the chemical properties of a degraded lateritic soil. *J. Bamboo and Rattan* 4 (2) : 183-191.

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Muraleedharan, P. K., Anitha, V. and Swarupanandan, K. 2005. Changes in resource use pattern and its linkages to forest degradation: A case study of Shola Forests in the Western Ghats, Kerala,(India), *Indian Journal of Social Development*, 2005.5(1):115-129.

Muraleedharan, P. K., Sreelakshmi, K. and Anitha, V. 2005. Marketing, livelihoods issues and depletion of non-wood forest products in Kerala, *Journal of Non-Timber Forest Products*, 11(4):241-246.

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Sudheendrakumar, V. V. 2005. Current status of microbial control of forest insect pests. In: R.J. Rabndra, S.S. Hussaini and B. Ramanujam (Eds.), *Microbial Pesticide Formulation and Application* (Proc. ICAR-CABI Workshop on Microbial Pesticide Formulation and Application, December 2002, PDBC, Bangalore).

EXTENSION ACTIVITIES

Dr. N. Sasidharan participated in the meeting of the State Level Committee, as a member, to screen and evaluate the project proposals for recommending to the National Medicinal Plant Board for financial assistance during 25-26 May 2005. He also attended the MFP Committee Meeting at Forest Head Quarters, Thiruvananthapuram on 9. March 2005

Dr. M. Balagopalan carried out soil analyses for plantations of teak, eucalypt and acacia from various locations under the Kerala Forest Department (Social Forestry Wing, Trichur, Ernakulam: Forest ranges of Kasaragod, Begur, Kannavam, Nilambur, Kalikkavu, Vazhikkadavu, Mannarkkad, Central Nurseries at Nilambur, Chettikkulam and Kulathupuzha, Karulai, Olavakkode, Ottappalam, Attappady, Walayar, Kodanad, Malayattoor, Trichur, vazhachal, Wadakkanchery, Machad, Mannarappara, Konni: Kerala Forest Development Corporation (Trichur and Munnar). Also carried out compost sample analyses at Central Nurseries at Nilambur, Chettikkulam and Kulathupuzha. He also analysed the compost made out of the sludge/slurry of Kerala Chemicals and Proteins Ltd, Ossein Division, Kartikudam, Koratty as part of quality checking of the product.

Drs. A. R. R. Menon, N. Sasidharan, M. Balagopalan, George Mathew, K. K. Ramachandran and E. A. Jayson prepared management plans for the newly constituted Shola National Parks at Munnar.

Dr. M. P. Sujatha took class on "soil fertility as a factor limiting growth of eucalypts in Kerala" in connection with the Field day on improving productivity of eucalypt plantations in Kerala on 10 June 2005 at Munnar.

CAMPUS NEWS

Seminars/Conferences/ Workshops organized

Dr Jose Kallarackal organized a Workshop on *Environmental/Ecological Sensitivity of Hill Stations in Kerala* on 10 October 2005 sponsored by KSCSTE

Dr. R. V. Varma as General Convener, organized the workshop on *Sustainable management of Belowground Diversity* from 21-23 June ,2005 at KFRI, which was attended by over 80 participants including delegates from abroad.(Forest Minister inaugurated the seminar.

Dr. K.V. Sankaran organized three workshops:

National Workshop on Bio-control of *Mikania* during 24-25 October 2005 at KFRI which was attended by 14 par-

ticipants including scientists and forest officials.

International workshop on 'Site Management of Exotic Forest Plantations in Southern India: Prospects for Improving Productivity' at KFRI during 8-10 November 2005. The workshop was attended by 47 participants.

International workshop on 'Early Warning Systems for Forest Invasive Species' under the auspices of Asia-Pacific Forest Invasive Species Network (APFISN) at KFRI during 21-24 February 2006. The workshop was attended by 48 participants from 13 countries.

Seminars/Conferences/ Workshops attended

Dr. M. Balagopalan attended *National Conference on Forest Biodiversity Resources: Exploitation, Conservation and Management* held at Centre for Biodiversity and Forest Studies, School of Energy, Environment and Natural Resources, Madurai Kamaraj University, Madurai during 21 – 22 March 2006 and presented two papers: "Decline in soil productivity associated with plantation forest ecosystem in Kerala authored by Geetha, T. and Balagopalan, M; "Ecosystem resurgence in relation to soils due to fire in the evergreen and dry deciduous forests in Kerala, India" authored by Balagopalan, M. and Rugmini, P.

Dr. M. Balagopalan attended the *National Workshop* on *Status and Future of Mixed Forest Plantations* held at Kerala Forest Research Institute, Peechi during 30 May – 01 June 2005 and presented a paper entitled "Mixed species plantations: Composition and growth as related to soil/site characteristics" authored by Balagopalan, M. and Reneela, P.

Dr. George Mathew participated in the *National Conference of Agrobiodiversity* held at Chennnai during February.12-15, 2006. and gave an invited talk "Plant and insect diversity patterns in cardamom plantations vis-à-vis natural forests: An assessment in the Nelliyampathy hills, Kerala, India".

Dr. George Mathew participated in the *Conference on Biodiversity of Insects: Challenging issues in Management and Conservation* held at Bharathiar University, Coimbatore. During 30 January.-3 February and gave an invited talk "Impact of forest disturbance on insect species diversity-A case study in Kerala part of Western Ghats".

Dr. E. A. Jayson participated in the *National Conference on Forest Biodiversity Resources Exploitation Conservation and Management* conducted at Centre for Biodiversity Studies, School of Energy Studies, Madurai Kamaraj University on 21-22 March, 2006 and presented a paper entitled " Diversity of birds in the tropical forests of Kerala, India authored by Jayson, E.A. and Sivaperuman, C.

Dr Jose Kallarackal participated in the following workshops/Seminars:

National Workshop on Status and Future of Mixed Forest Plantations in India held from 30 May to 1 June 2005 at KFRI, Peechi. Presented a paper entitled, "Environmental requirement of mixed plantations – learning from the natural forests".

International Workshop on Facilitating Forestry Mitigation Projects in India: Promoting Stakeholder Dialogue and Capacity Building organized by the ICFRE from 15 to 17 June 2005 in FRI, Dehra Dun.

A *Brainstorming Workshop on Women Empowerment through Biotechnology* on 1 July 2005 in DBT, New Delhi: Presented a paper on "Floriculture, Aerobic Composting and Perfumed Candle Making – Possibilities and Opportunities in Kerala".

Workshop on Site Management of Exotic Forest Plantations in Southern India: Prospects for Improving Productivity on 8 to 10 November 2005 at KFRI and presented a paper on "Water use of eucalypts in Kerala".

National Conference on Biodiversity Related International Conventions: Role of Indian Scientific Community on 8-10 March 2006 at INSA, New Delhi and chaired a session on Climate Change.

Dr. P. K. Muraleedharan participated in the *National Conference on Forest Biodiversity Resources: Exploitation, Conservation and Management* held during 21-22 March 2006 and presented the paper "Sustainable use of non-timber forest products and conservation of forest biodiversity through participatory management by stakeholders-Some preliminary observations" authored by Dr. P. K. Muraleedharan and Sreelakshmi, K.

Dr. U. N. Nandakumar participated in the *XII Silvicultural Conference* during February 1-3, 2006 at FRI, Dehra Dun and presented a paper "Managing forests for fuel wood, fodder, medicinal plants, timber and other NTFPs Biofuel through multitier forestry: A case study from Kerala".

Shri. P. Padmanabhan participated in *International Beekeeping Congress* organized by Century Foundation, Bangalore, 13- 18 November 2005. He also participated in National Group Meeting of All India Co-ordinated Project on Honeybee Research and Training, on 27-28 January 2006 organized by KAU, ICAR & Horticorp, Kerala

Dr. R. C. Pandalai attended the *XII Silvicultural Conference* during February 1-3, 2006 at FRI, Dehra Dun and presented a paper " Productivity improvement of eucalyptus plantations in Kerala through silvicultural treatments" by R. C. Pandala et al.

Dr. C. Renuka attended the *Biodiversity awareness workshop* organized by

Central tuber Crops Research Institute, Thiruvananthapuram during 10 – 12 January 2006

Dr. K. V. Sankaran participated in the *National Workshop on Conservation and Sustainable Management of Below Ground Biodiversity* held at KFRI during 21-23 June 2005 and presented a paper entitled "Diversity of arbuscular mycorhizal fungi in different land use systems in Kerala part of the Nilgiri Biosphere Reserve".

Dr. N. Sasidharan participated in the *National Seminar on Emerging Trends in Plant Taxonomy* During 20-21 October 2005 at Nagpur University. Nagpur. Presented a paper "The Genus *Medinilla* (Melastomataceae) in Peninsular India". He also participated in the *National Congress on Medicinal Plants* during 4-5 December 2005 at Thiruvananthapuram. Presented a poster "Production of Quality Planting Materials of Rare Medicinal Plants of Commercial Importance".

Dr. M. P. Sujatha attended the *Workshop on Conservation and Sustainable Management of Belowground Biodiversity*, June 21-23, 2005 at KFRI. She also attended the worksop on *Site Management of Exotic Forest Plantations in Southern India- Prospects for Improving Productivity*, November 8-10, 2005

Dr. J.K.Sharma attended the *XII Silvicultural Conference* during February 1-3, 2006 at FRI, Dehra Dun and Co-chaired a session on "Forest Fire".

V. V. Sudheendrakumar attended the *XII Silvicultural Conference* during February 1-3, 2006 at FRI, Dehra Dun and presented a paper "Current status of use of baculovirus for management of forest insect pests in India" by V. V. Sudheendrakumar et al.

Dr. K. Swarupanandan attended the *XII Silvicultural Conference* during February 1-3, 2006 at FRI, Dehra Dun and presented a paper "Forest fire research and management: an analysis of the problems and possibilities under the framework of the general succession theory- A Kerala experience".

Dr. R. V. Varma attended the *International Conference on Biodiversity of Insects: Challenging issues in management and Conservation* from 30 January to 3 February 2006.He chaired one session and Mr. Mujeeb Rahman presented a paper titled" Diversity and abundance of soil insects in different land use systems in the Kerala part of the NBR" by Mujeeb Rahman and R. V. Varma.

Matters of General interest

Training received

Dr Jose Kallarackal participated in the International GLOBE Training Programme conducted by the GLOBE, USA from 11 to 20 April 2005 held in Shimla, Himachal Pradesh.

Dr. M. Balgopalan received training on Modern Instrumental Methods of Analyses during 11-15 July 2005 at Sophisticated Test and Instrumentation Centre, Cochin University of Science and Technology, Kochi.

Training imparted

Dr. K. M. Bhat served as Resource Person on the topic: "Timber Certification" for the Refresher Training Course for Senior Indian Forest Service Officers, on Forest Management in Kerala: Sharing experiences. 4 December 2005.

Dr. E. A. Jayson gave a lecture on "Human - wildlife interaction" to the IFS officers from various states during November 2005 at KFRI, Peechi. He participated in Nilgiri Tahr Census as Joint coordinator during May 2005 at Eravikulam National Park . He also delivered two lectures to the Foresters and Guards of the Tamil Nadu Forest department on "Wildlife Census" at Tamil Nadu Forest Academy, Coimbatore in January 2006.

Dr. Jose Kallarackal delivered a special talk on Climate Change and CDM to the IFS trainees on 25 November 2005 at KFRI.

Dr. P. K. Muraleedharan served as a Resource Person of IFS Refresher Course organized by KFRI during 21-25 November, 2005 and took class on "Non-wood Forest Products in Kerala: Socio-economic and Ecological Linkages". He also handled a class on Bamboo Policy in INBAR-CIBART International Workshop on "Bamboo Propagation, Management and Harvesting: Methods, Policy and Strategies" held during 27 February- 05 March 2006, at KFRI

Dr. C. Renuka served as a Resource Person in the Refresher Course for IFS officers on "Forest Management in Kerala – Sharing of Some Experience" during 18 – 22 July 2005. A talk was given on the "Cultivation and management of rattans" .In the refresher training course for IFS officers on " Management of Tropical Forests – Issues and Challenges" during 21-25 November 2005 she gave a talk on 'Biodiversity documentation , assessment and evaluation'.

Dr. N. Sasidharan gave lectures on "Non-wood Forest Products of Kerala" and "Field Identification of Forest Trees" to the Forest Guard Trainees at Forest School, Walayar on 23 June.2005 and 15 October 2005.

Dr. K. V. Sankaran served as Course Coordinator for a training workshop for IFS Officers on "Effect of Weeds on Productivity of Forest Plantations and Natural Forests and Different Cost Effective Methods for Their Control" held at KFRI during 14-15 February 2006.

Dr. V. V. Sudheendrakumar took a class on "Teak Defoliator Management Using the Viral Biocide, HpNPV" for the participants of the training course on Cultivation and management of teak in KFRI during June 2005

Dr. M. P. Sujatha served as a Resource Person and took class on "Nutrient

management in teak nursery" in the training programme on Cultivation and Management of Teak organized by KFRI during May 29-June 8, 2005.

Dr. R. V. Varma took a class on Pest Management in Teak for the participants of the training course on Cultivation and management of teak in KFRI during June 2005.

Celebrations

National Science Day was celebrated on 28th February 2006 with various activities including lectures in Sasthraposhini Schools of Thrissur, Palakkad and Malappuram districts.

Open House Day was celebrated on 29th November 2005 with activities such as exhibitions, lectures, quiz programmes and visits to all the divisions and facilities.

World Environment Day was celebrated on 5th June of 2005 and 2006 with activities such as invited talk, quiz programme, tree planting and outreach activities including lectures in nearby schools.

Visitors to KFRI

During the period March 2005-February 2006, students and teachers from over 40 institutions visited KFRI. The visitors were mostly students and teachers from schools and colleges. The butterfly garden established in the KFRI campus is one of the important attractions.

M.Sc Student attachment Programme

Ms. P. Sreeja, M. Sc. Microbiology student, St. Mary's College, Thrissur successfully completed her project work entitled "Epiphytic and endophytic fungi of bamboo leaves in Kerala" under the guidance of Dr. K.V. Sankaran.

Ms. Rajani Raju, M.Tech Biotechnology student, Sathyabhama Deemed University, Chennai completed her project work on "Genetic Diversity of Teak (*Tectona grandis* L.)clones using RAPD markers under the guidance of Dr. M. Balasundaran.

Guest lecture/ Lecture classes

Dr. N. Sasidharan participated as a Resource Person in the Seminar – Rejuvenising Plant Taxonomy: Potentialities in Kerala, at Mar Athanesius College, Kothamangalam, on 28.November 2005. Gave a talk on Principles of Taxonomy and Herbarium Techniques

Dr. N. Sasidharan served as a Resource Person in the Seminar on "Conservation and Sustainable Utilisation of Medicinal Plants" at All Saints College, Trivandrum on 16 June 2005 and gave talk on the Plant diversity of Kerala.

Dr. P. K. Muraleedharan gave a lecture on "Thinking of Participatory Management of Non-wood Forest Products: Avenues and Options Ahead", in a Workshop Organised by KIRTADS, on 3 March 2006, at Kozhikode.

Dr. R. V. Varma gave an invited talk on Biodiversity of insects of forest plantations in the Workshop on "Biodiversity and Bioresources Conservation Awareness", organized by the National Biodiversity Authority at Spices Research Institute at Kozhikode on 21 January 2006

Radio talk

Dr. E.A. Jayson delivered a talk "Wildlife of Eravikulam National Park" in All India Radio, Devikulam on 27 June 2005 and another talk on "Wildlife trade and its impact on conservation of wild animals" in All India Radio, Thrissur on 10 November 2005.

Visits abroad

Dr. K. V. Sankaran visited CSIRO Forestry and Forest Products Institute, Perth, W. Australia during 24-31 July 2005 as part of the CSIRO- KFRI Collaborative project on Eucalyptus and worked to prepare scientific papers out of project data. He also visited FAO Regional Office for Asia and the Pacific, Bangkok during 28 November-9 December 2005 to discuss and finalize a program for conducting an APFISN workshop on 'Early Warning Systems for Forest Invasive Species' in Kerala.

Dr. M. P. Sujatha visited CSIRO Forestry and Forest Products Institute, Western Australia from 2nd May to 13th May 2005 to contribute to the analysis of results and writing of papers for the joint KFRI-CSIRO-ACIAR project (ACIAR FST/95/106) on improving and maintaining productivity of eucalypt plantations in India and Australia

Nominations

Dr. Jose Kallarackal has been nominated to the District Level Technical Advisory Committee of the District Planning Committee.

Dr. N. Sasidharan has been nominated as a Member of the State Medicinal Plant Board and also in the Executive Committee of the Board by Government of Kerala

Dr. N. Sasidharan has been nominated as an Expert Member of the Subcommittee on Endangered and Threatened Plants by the National Biodiversity Authority.

Dr. E. A. Jayson has been nominated to the "Southern Region Committee for Management Effectiveness Evaluation of the Protected Areas in India" by the Ministry of Environment, Govt. of India for a period of three years.

Dr. M. Balasundaran has been nominated as Member, Board of Studies in Biotechnology and Member, Faculty of Science, Cochin University of Science and Technology.

Official- International Bodies

Dr. K.M. Bhat has been nominated as a Member of the Extended Executive Committee of the International Union of Forestry Research Organizations. He also holds the position of Deputy Coordinator of IUFRO Division 5- "Forest Products" and Deputy Coordinator of the Working party S5.06.02- "Utilization of plantation teak". Dr.V.V. Sudheendrakumar holds the position of Deputy Coordinator of the IUFRO Working Party S7-03-09- Protection of Forests in the tropics.

Central Instrumentation Facility in KFRI

A centralized instrumentation facility has been built up in KFRI for the benefit of researchers within and outside the Institute. As an activity of the laboratory, it is planned to offer training to researchers and students in the use and maintenance of sophisticated equipments and modern instrumental methods of analyses.

The laboratory at present has the following sophisticated equipments

- High Performance Liquid Chromatograph (HPLC) - Shimadzu Make
- Gas Chromatograph (GC) - Shimadzu Make·
- Particle Size Analyzer – Ankersmid Make

Apart from the above, the laboratory has the basic equipments like Analytical balance, Ultra pure water purification system, Double distillation unit etc., Steps have been taken to install Gas Chromatograph – Mass spectrometer (GC-MS). It is also proposed to purchase a Bottle top sample dispenser, Block digestion system, UV-visible spectrophotometer, CHNS Analyzer, Auto analyzer and Muffle furnace.

A View of Gas Chromatograph

M.Balagopalan
Instrumentation Division

Leaves of Mikania plant infested by the fungus. Puccinia spegazzinii

Workshop on Biocontrol of *Mikania*

A workshop on biocontrol of *Mikania micrantha* using the fungus *Puccinia spegazzinii* was held on 24 and 25 November 2005 at KFRI. The participants included scientists from CABI Bioscience, Ascot, UK (Drs. S.T. Murphy and Carol Ellison), Project Directorate of Biological Control, Bangalore (Drs. R.J. Rabindra and P.S. Kumar), National Bureau of Plant Genetic Resources, New Delhi (Dr. Usha Dev), Kerala Agricultural University (Drs. Koshy Abraham, C.T. Abraham, Pathummal Beevi and K.R. Laila and KFRI (Drs. J.K. Sharma and K.V. Sankaran). Officers of the Kerala Forest Department (Shri. Lakwinder Singh, IFS, Shri. Rajan Sehgal, IFS and Mr. Joju) also participated in the workshop. The workshop discussed various aspects of introducing the biocontrol agent *Puccinia spegazzinii* in forest plantations of Kerala to control mikania. A field trip was arranged for the participants on 25 November 2005 to the Vazhachal forest area where invasive weeds like *Mikania*, *Lantana* and *Chromolaena* pose serious threat to forest plantations and natural forests.

K.V. Sankaran
Forest Protection Division

NEW Ph.Ds

Dr. K. C. Chacko	Seedling development in teak in response to environmental and nutritional factors (FRI-DU, Dehra Dun)	Dr Jose Kallarackal
Dr.. C. P. Biji	Investigations on the nucleopolyhedrovirus of the teak defoliator, with special reference to quality improvement (FRI-DU, Dehra Dun)	Dr. V.V.Sudheendrakumar
Dr. P. R. Swaran	Management of termites in forest plantations FRI-DU, Dehra Dun)	Dr. R.V.Varma
Dr. C. Sivaperuman	Ecology of wetland birds on the Kole wetlands of Kerala FRI-DU, Dehra Dun)	Dr. E.A. Jayson
Dr. M. A. Sreenivasan	Natural distribution and control of *Mikania micrantha* in the Western Ghats (FRI-DU, Dehra Dun)	Dr. K.V. Sankaran.
Dr. C. Sunanda	Simultaneous calibration of allometric relations for even-aged teak stands using multilevel models (FRI-DU, Dehra Dun)	Dr.K. Jayaraman.
Dr. K.. Sreelakshmi	Resource Use conflict and stakeholder diversity in valuing the forest banefits: An assessment of diverse benefits of the forest ecosystem in Kerala (FRI-DU, Dehra Dun)	Dr. P.K.Muraleedharan
Dr. C. M. Brijesh	A study on the diversity of lepidoptera in shola forests of Munnar, Kerala (FRI-DU, Dehra Dun)	Dr. George Mathew.
Dr. V. B. Sreekumar	Systematics and phylogeny of the genus *Calamus* Linn. (Arecaceae) in the Western Ghats (University of Calicut)	Dr. C. Renuka.

Retirements on superannuation

Sri. K. Dorairaj, Driver and Sri. K. Vijayan, Driver retired from KFRI service on superannuation on 31-1-2005 and 31-1-2006 respectively. We wish them a very happy retired life.

Honours/Awards

Shri. P. Padmanabhan, Scientist, Forest Ecology and Biodiversity Conservation Division was honoured as a Pioneer Research Worker in "Apiculture Research and Popularisation of Bee Keeping in Kerala State" on Beekeeper's day & National Annual group meeting of all India Coordinated Project on Honeybee Research & Training (ICAR) on 27th January 2006, at Kanakakunnu Palace, Thiruvananthapuram.

Secretariat of FAO's Asia-Pacific Forest Invasive Species Network (APFISN) in KFRI

The Secretariat for Asia-Pacific Forest Invasive Species Network (APFISN) was established in KFRI. Dr. K.V. Sankaran, Scientist EII, Forest Protection Division has been nominated as the Coordinator of the Network (APFISN) by FAO. APFISN is a cooperative alliance of 30 member countries of the Asia-Pacific Forestry Commission constituted by FAO. The network focuses on inter-country cooperation that helps to detect, prevent, monitor, eradicate and/or control forest invasive species in the Asia- Pacific Region. As Coordinator, Dr. Sankaran has the responsibility of coordinating national strategies for dealing with forest invasive species in the 30 member countries in the Asia-Pacific region. He is also expected to work with national focal points of the APFISN, its Executive Committee and other national and international organizations to identify opportunities for pooling resources, staff exchanges and collaborative research in order to prevent entry of new FIS and/or to mitigate impact due to forest invasive species with in countries in the region.

Field Day conducted

A 'Field Day' involving eucalypt farmers, officials of the Kerala Forest Department, Kerala Forest Development Corporation and Hindustan Newsprint Ltd. was conducted by the Institute at Munnar on 10 June 2005. The objective of the field day was to enlighten the participants on how the productivity of eucalypt plantations in the state could be improved using certain simple silvicultural practices. The recommendations for improving productivity were based on the results of a long-term research programme conducted by KFRI in collaboration with CSIRO Forestry and Forest Products, Australia during 1997-2004..

The 'Field Day' was inaugurated by Sri. Surendrakumar, IFS, Conservator of Forests, High Range Circle, Kottayam. He also released the booklet entitled " Improving eucalypt plantation productivity in India" published by KFRI. Dr. K.C. Chacko, Programme Coordinator, Extension and Training Division, KFRI presided over the function. The inaugural session was followed by a Technical Session, which included presentations by KFRI scientists on various aspects of improving eucalypt productivity. The presentations covered the following topics: Nursery practices and site preparation for planting eucalypts (Dr. R.C. Pandalai); Soil fertility as a factor limiting productivity of eucalypts in Kerala (Dr. M.P. Sujatha); KFRI-CSIRO project on improving productivity of eucalypts- results and recommendations to improve productivity (Dr. K.V. Sankaran); Economics of improving productivity (Dr. C. N. Krishnankutty); Environmental problems of eucalypts- myths and reality (Dr. Jose Kallarackal).

The presentations were followed by a discussion session, which provided opportunity to the participants to interact with the scientists and clarify any points. The 'Field Day' came to a close at 2 pm. A total of 48 participants attended the 'Field Day'. The participants were taken for a field trip to the KFRI-CSIRO experimental plantation of *E. grandis* located at Surianelli in the afternoon.

K.V. Sankaran
Forest Protection Division

KFRI Exhibitions

KFRI conducts exhibitions regularly for the benefit of school children and the public. A summary of the KFRI exhibitions conducted during 2005-2006 period is given below:

Sl.NO	NAME OF THE EXHIBITION	PERIOD	NAME OF THE ORGANIZATION
1	Vignana Vismayam, Jubilee exhibition.	6.1.05-8.1.05	Govt. Higher Secondary School, Vazhakkad, Malappuram.
2	Ideal Mega Show Exhibition.	12.2.05 - 15.2.05	Ideal English School, Thavanoor, Malappuram.
3	Prithvi- Global Eco Meet Exhibition.	20.2.05-28.2.05	Swadesi Science Movement at Kanakakunnu Palace, Thiruvananthapuram.
4	Kisan Mela Exhibition.	14.5.05-21.5.05	Kisan Saba Conference Thekkegopuranada, Thrissur.
5	INDSEARCH Exhibition-Casino Hotel-Thiruvananthapuram.	28.7.05-29.7.05	KSIDC, Govt of Kerala. Thiruvananthapuram.
6	All India Exhibition on Science, Technology and Culture; Jubilee exhibition	7.11.05-11.11.05	St. Joseph College, Devagiri, Calicut.
7	Science and Technology Exhibition - SOEX 05	11.11.05-15.11.05	S.O.H.S. School, Arecode, Malappuram.
8	Medicinal Plant Congress Exhibition, Science, and Technology Hall-Thiruvananthapuram.	3.12.05-5.12.05	Oushadhi, Govt of Kerala.
9	Bamboo Fest Exhibition-Town Hall, Ernakulam	20.12.05-22.12.05	KBIP, Department of Industries, Govt. of Kerala.
10	Kerala Karshaka Mela Thodupuzha	23.12.05-1.1.06	Gandhiji Study Centre, Thodupuzha.
11	Indian Science Congress Exhibition.	3.1.06-7.1.06	93rd session of Indian science congress at Hyderabad.
12	Silver Jubilee Exhibition	15.1.06-25.1.06	MES KEYVEEYAM college, Valanchery, Malppuram.
13	Kerala Science Congress Exhibition	29.1.06-31.1.06	Centre for Earth Science Studies, Aakulam, Thiruvananthapuram.
14	Thrissur Pooram Exhibition, 2006	18.4.06-22.05.06	Pooram Committee of Parammmekavu and Thiruvambadi Devaswoms. Thrissur.

Training Programmes conducted

Sl. No.	Date	KFRI Project No.	Title	Sponsor	Duration of Course (days)	No. of Participants
1.	13 - 18 March 2005	Ext. 54/05	Study tour for forest officials, members of VSS and NGO from AP to Kerala	APFA	6	26
2.	11 - 25 April 2005	Ext. 58/05	Tissue culture for forest trees and medicinal plants	M/s Dynamic Techno Medicals Pvt. Ltd. Aluva	15	1
3.	29 May - 8 June 2005	KFRI TC 016 Ext. 62/05	Cultivation and management of teak	APFA	11	3
4.	18 - 22 July 2005	Ext. 68/05	Forest management in Kerala - sharing of some experiences	MoEF	5	19
5.	17 - 22 October 2005	Ext. 71/05	Study tour of forest officials from Andhra Pradesh to various places of forestry relevance in Kerala	APFA	6	8
6.	24 - 29 October 2005	Ext.75/05	Study tour of VSS and forest officials from Andhra Pradesh to various places of forestry relevance in Kerala	APFA	6	34
7.	21 - 25 November 2005	Ext. 72/05	Management of tropical forests - issues and challenges	MoEF	5	17
8.	1 - 2 December 2005	Ext. 74/05	Environmental Impact Assessment: Need and Methods for Assessment	MoEF	2	9
9.	14 - 15 February 2006	Ext. 76/05	Effect of weeds on productivity of forest plantations and natural forests and different cost effective methods for their control	MoEF	2	23
10.	26 February - 5 March 2006	Ext. 80/06	INBAR International Training Workshop on Bamboo Propagation,Plantation Establishment and Management, Harvesting, Post-harvesting and Policy Issues	INBAR	8	17

EVERGREEN
A Newsletter of the
Kerala Forest Research Institute
(An Institution of Kerala State Council for Science, Technology and Environment)
Peechi, Thrissur, Kerala, India

ISSN 0254-6426

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Evergreen, the KFRI Newsletter is brought out in March and September is intended for free private distribution to individuals and institutions connected with forestry activities. The views expressed in the newsletter are those of the authors and do not necessarily reflect the views of the Institute. All readers are invited to send their comments and opinions. The Newsletter committee reserves the right to choose among the contributions and edit wherever necessary .

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KFRI Training schedule 2007

March 1-10
Molecular and Biotechnological Techniques in Tree Improvement

March 14-23
Tissue Culture Techniques for Forest and Medicinal Plants

April 23-27
Tropical Forest Study Tour

May 3-12
Estimating Animal Abundance in Forests

May 21-25
Tropical Forest Study Tour

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