Evergreen
Half yearly Newsletter of Kerala Forest Research Institute
(An Institution of Kerala State Council for Science, Technology & Environment)
KFRI

No. 64 October 2009 - March 2010

Observations on the *Snake Vines* of Nilgiris

Ceropegia L. (Asclepiadaceae), a pantropical Old World genus of about 200 species, exhibits tremendous diversity with respect to habit, habitat, flower architecture and ecological adaptations. *Ceropegia* is distributed to most of Africa, Madagascar, the Arabian Peninsula, the Indian subcontinent, and the Far East and Northern parts of Australia (Bruyns, 1997; Yadav & Kamble, 2008). Ansari (1984) in the revision of Indian *Ceropegia* recorded 44 species, of which 28 are known to be endemic to India. After this revision, some five novelties have been added to the list. Presently the genus is represented in India by about 50 species of which 38 occur in the Western Ghats (Yadav & Kamble, 2008; Yadav & Shendage, 2010). Many species of *Ceropegia* are narrow endemics and are placed under different IUCN Red-List categories (Nayar & Sastry, 1987, 1988 and 1989). Most of the endemic species of *Ceropegia*, being restricted only to special habitat and narrow ecological niche, are highly vulnerable and deserve special attention for conservation. Reasons for their decline are many. Destruction and alteration of habitats, pollution and introduction of invasive alien weeds, etc. are few examples.

The flowers of *Ceropegia* are very peculiar among the angiosperms. The corolla is tubular and basely inflated with five petals, most often fused at the tips, forming an umbrella-like hood, a cage or appendage-like antennae with great diversity in design, size, shape, coloring patterns, corona structures and mechanisms for illumination of essential organs (Dyer, 1983). Because of the curious shape of corolla, *Ceropegia* are also known by local names such as snake vine, lantern flower, parasol flower, parachute flower, bushman's pipe, string of hearts, wine-glass vine, sary vine, necklace vine, etc. An interesting feature of *Ceropegia* is that the corolla tubes are lined with small hairs that point downward to form a temporary trap for small flies hence widely known in the nick name *'fly trap flowers'*. Once the fly enters flowers, the downwardly directed hairs prevent its escape. During the struggle to escape, the pollinia of the *Ceropegia* get attached to the fly's body.

A total of nine species of *Ceropegia* were collected from Nilgiris. Majority of them are distributed in Wayanad, north-west corner of the Nilgiris. The collection includes an undescribed, elegant species named as *Ceropegia manoharii* Sujanapal, Salim, Anil & Sasidh. sp. nov. The new species is restricted to Chembra Hill ranges of Wayanad. All the other species are endemic to the Peninsular India-Sri Lanka Mega-diversity centre, a hotspot of biodiversity. Species such as *Ceropegia ciliata* and *Ceropegia decaisneana* are restricted to Western Ghats. While assessing the threatened status, it was virtually impossible to assess the total population, especially in the case of sparsely distributed species. Further most of the *Ceropegias* can be identified only when in flowers. All the *Ceropegias* in this region are monsoon plants and phenology is more or less uniform. Slight seasonal variation was observed among the species based on the rainfall pattern and locality.

Ceropegia decaisneana Wight

Ceropegia candelabrum L. var. *candelabrum*

Edible species

Root tubers are developed in *Ceropegias* either as single large potato like tuber or fascicled tuberous roots. An enquiry with tribes as well as other local people of Wayanad, revealed that the tubers of *C. hirsuta* and leaves of *C. decaisneana* are widely consumed by local communities. Though *C. decaisneana* doesn't form a potato like tuber, the leaves are used as '*Paalaancheera*' (milk tasted Amaranth). Probably the knowledge was transferred from tribal groups. Now it is a delicious item during the fasting period such as '*Eidh*'.

Butterfly relationship

It was observed that caterpillars of striped tiger (*Danaus genutia*) heavily feed on the three species of *Ceropegia*, including the new species *C. manoharii*, which was transplanted to lower elevation area from its original habitat. The other species they feed on are *C. elegans* and *C. twaitesii*.

New species of *Ceropegia*

Ceropegia manoharii Sujanapal, Salim, Anil & Sasidh. sp. nov. (in. ed.)

Field note: Twining broad fleshy leaved species with few flowered cyme, mostly with one flower. Root tubers fasciculated. Flowers large, elegant, corolla tube greyish with brown striations. Upper half of the corona is green coloured.

Local status: Rare

Habitat: High altitude grasslands

Geographical distribution: So far known only from the Chembra hill ranges of Wayanad

Rare and Threatened species

1. ***Ceropegia ciliata*** Wight

   Field note: Twining narrow leaved annual herb with many flowered cymes. Leaves are hairy. Tuber is rounded or flattened. Flowers pale yellow or greenish-yellow, stem and peduncle with brownish blotches.

   Local status: Rare

   Habitat: High altitude grasslands and rocky areas

   Geographical distribution: Southern Western Ghats

2. ***Ceropegia decaisneana*** Wight

   Field note: Twining broad leaved species with few flowered cymes. Tubers fasciculated. Flowers long beaked, beak yellowish, corolla tube yellowish with brownish blotches.

   Local status: Rare

   Habitat: Semi-evergreen and moisture rich areas in moist deciduous forests

   Geographical distribution: Western Ghats

Ornamental species

1. ***Ceropegia elegans*** Wall.

   Field note: Twining broad leaved annual herb with few flowered cyme. Root tuberous. Leaves are coriaceous. Corona lobe with long ciliae, tube greyish with brown blotches.

   Local status: Rare

   Habitat: Open areas in semievergreen and evergreen forests

   Geographical distribution: Peninsular India and Sri Lanka

   Remarks: This specimen is highly variable in morphology from typical *C. elegans*. Floral morphology is similar to *C. walkeriae* (synonymised under *C. elegans*) and cilia are similar to *C. elegans*. A through investigation is necessary for elucidating the *C. elegans* complex.

2. ***Ceropegia hirsuta*** Wight & Arn.

   Field note: Twining broad leaved annual herb with few flowered cyme, hairy. Root tuberous, tuber obliquely globose, leaves hairy. Corona broad and yellowish or apple-

Ceropegia candelabrum L. var. *biflora* (L.)

Ceropegia manoharii

Ceropegia juncea Roxb.

Ceropegia elegans Wall.

Ceropegia hirsuta Wight & Arn.

green coloured, tube is light beige coloured and mottled olive-brown or purple upwards.
Local status: Rare
Habitat: Open areas in semi-evergreen and evergreen forests
Geographical distribution: India

3. ***Ceropegia juncea*** Roxb.
Field note: Twining, scale leaved, succulent species with many flowered cyme, root non-tuberous, stem is thick, greenish, fleshy and photosynthetic. It is the only Indian species which has thick fleshy twinning stem with Crassulean Acid Metabolism (CAM) [Supate *et al.*, 1990]. A promising species for cultivation
Local status: Rare
Habitat: Deciduous forests
Geographical distribution: Peninsular India and Sri Lanka
4. ***Ceropegia thwaitesii*** Hook.
Field note: Twining broad fleshy leaved species with few flowered cyme, mostly single. Root tuberous. Corona greenish yellow with brown blotches, tube narrow, yellowish-green with brown striation.
*Local status:*Rare
Habitat: High altitutde grasslands
Geographical distribution: Peninsular India and Sri Lanka
5. ***Ceropegia candelabrum*** L. var. ***biflora*** (L.) M.Y. Ansari
Field note: Twining broad leaved annual herb with many flowered cyme. Root tuberous, leaves membranous. The flowers are long beaked and show small variations in colour and blotching pattern.

Ceropegia elegans Wall with fruit

Local status: Rare
Habitat: Deciduous forests and open lands
Geographical distribution: India and Sri Lanka

6. ***Ceropegia candelabrum*** L. var. ***candelabrum***
Field note: Twining broad leaved annual herb with many flowered cyme. Root tuberous, leaves membranous. The flowers show variations in corolla size, colour and blotching pattern. It is the most common species in lower elevation area.
Local status: Common
Habitat: Deciduous forests and open lands
Geographical distribution: India and Sri Lanka

References

Ansari, M.Y. 1984. Asclepiadaceae: Genus-*Ceropegia*. In: Fascicles of Flora of India 16: 1-34.

Bruyns, P.V. 1997. A note on *Ceropegia* L. (Asclepiadaceae) of Silent Valley, Kerala, India. *Rheedea* 7: 107-114.

Chaterjee, D. 1962. Floristic pattern in Indian vegetation. Proc. Summer School of Botany, Darjeeling 1960-32-42.

Chatterjee, S. 1995. Global 'Hot Spots' of Biodiversity. *Curr. Sci.* 68 (12): 1178-1179.

Dyer, R.A. 1983. *Ceropegia*, *Brachystelma* and *Riocreuxia* in Southern Africa. Rotterdam, Balkema.

Nayar, M.P. and A.R.K. Sastry. (eds.). 1987-89. Red Data Book of Indian Plants. Vol. I-III. Botanical Survey of India. Calcutta.

Supate, A.R., D.K. Gaikwad, S.R. Yadav and P.D. Chavan. 1990. Crassulacean acid Metabolism features occur in leafy forms of *Ceropegia* also. *Photosynthetica* 24: 53 - 55.

Yadav, S.R. and Mayur Y. Kamble, 2008. Threatened *Ceropegias* of the Western Ghats and Strategies for their Conservation in: Special Habitats and Threatened Plants of India, Wildlife Institute of India, Dehradun. pp123-134

Yadav, S.R. and S.M. Shendage. 2010. *Ceropegia bhatii*, a new species of Apocynaceae: Ceropegieae from Karnataka, India. *Kew Bulletin* 65: 107–110.

P. Sujanapal, P.M. Salim[1], N. Anil Kumar[1] and N. Sasidharan
Silviculture Department and NWFP Department
[1]MS Swaminathan Research Foundation, Puthoorvayal, Kalpetta – 673 121.

Malabar giant squirrel *Ratufa indica maxima* damages coconuts in Kerala

The Malabar giant squirrel *Ratufa indica maxima* (Schreber, 1784) is restricted to the Asian tropics. It is a large-bodied squirrel, mostly solitary and territorial with arboreal, diurnal and herbivorous habits and is widely distributed in peninsular India. It is one of the largest tree squirrels in the world with individuals reaching up to 2 kg body weight. It is listed under Schedule II of Indian Wildlife Protection Act (1972) and is in Appendix II of CITES (2005). The species is more widely distributed than the only other large squirrel found in southern India, the grizzled giant squirrel *Ratufa macroura* (Pennant, 1769). Earlier reports mention that the Malabar giant squirrel feeds on fruits of *Xylia xylocarpa, Zizyphus oenoplia, Radermachera xylocarpa, Bombax sp., Terminalia crenulata, Lagerstroemia microcarpa, Schleichera oleosa, Cordia wallichii, Dillenia pentagyna* and *Grewia tiliifolia*. Water content in the food item is already identified as a significant positive predictor of relative food item consumption in this species. Apart from these, presence of more digestible nutrients, such as non-structural carbohydrates were also identified as significant positive predictors in the selection of food.

The feeding of Malabar giant squirrel on coconuts (*Cocos nucifera*) was studied in Thrissur District, Kerala, South India, as a part of the large study on human-wildlife conflict in the District. Twelve Forest Ranges within three Forest Divisions and two Wildlife Sanctuaries constituted the study area. The consumption of coconut was quantified by taking plots of 10 m x 10 m size in the fringe areas of the three Forest Ranges, where this behavior was observed. Six plots having 20 coconut trees were studied in the Machad Range, where as three plots having 6 coconut trees in Palappilly Range and three plots having 10 coconut trees were observed in Peechi Range. Data were collected from April to November 2009. Intensive study areas were Kakkinikkad in Machad Range, Echippara in Palappilly Range and Olakara in Peechi Range (Fig. 1).

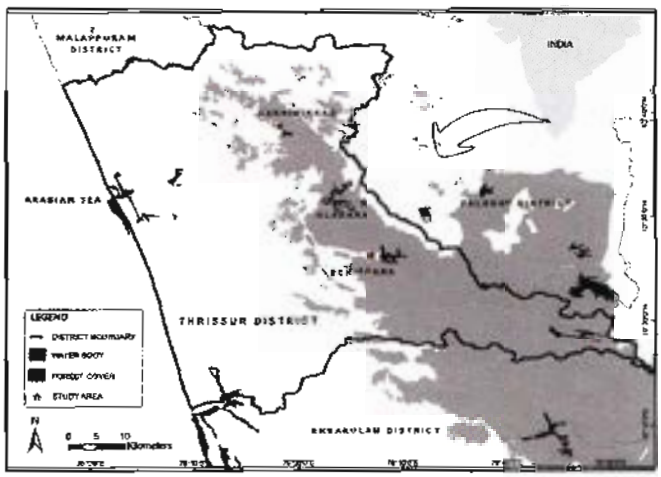


Figure 1. Kakkinikkad in Machad Range, Echippara in Palappilly Range and Olakara in Peechi Range

Malabar giant squirrel was recorded from all the Forest Divisions and Wildlife Sanctuaries of the Thrissur District. Consumption of coconuts occurred when the trees were adjacent to the boundary of forest. The practice of private land owners cultivating coconut trees near the forest encourages this type of feeding. Feeding on tender coconuts adversely affects the farmers and this behavior is restricted to Machad, Palappilly and Peechi Forest Ranges in the District. Maximum destruction of coconut was recorded in the Machad Forest Range followed by Peechi (Table 1). The mode of consumption of coconut was by making a hole into the endocarp after removing

Table 1. Number of coconuts consumed by Malabar giant squirrel in the study area.

Months	Machad Forest Range		Palappilly Forest Range		Peechi Forest Range		Mean nuts destroyed/ tree
	Number of nuts destroyed (n=20)	Nuts destroyed per tree	Number of nuts destroyed (n=6)	Nuts destroyed per tree	Number of nuts destroyed (n=10)	Nuts destroyed per tree	
April 2009	29	1.45	2	0.33	-	-	0.89
June 2009	56	2.80	0	0.00	-	-	1.40
July 2009	77	3.85	6	1.00	-	-	2.43
August 2009	55	2.75	7	1.17	-	-	1.96
September 2009	32	1.60	4	0.67	-	-	1.14
October 2009	26	1.30	0	0.00	30	3.00	1.43
November 2009	74	3.70	7	1.17	27	2.70	2.52
- Data not recorded				Mean			1.68

Pulpwood requirement of Kerala

Attempts were made to study the pulpwood requirement of the State using data obtained from Hindustan Newsprint Ltd. (HNL). HNL is the only processing unit for pulpwood in the State of Kerala. Hence, all data related to utilization of pulpwood were obtained from that firm. The time series data gathered consisted of the following.

i Annual supply of different kinds of raw material from government and other sources including KFDC for the period from 1982-83 to 2008-09.

ii. Consumption of raw materials for the period from 1983-84 to 2008-09.

iii. Production of newsprint from the year 1983-84 to 2008-09.

Supply refers to the material received during the extraction season 1st September to 31st May in each year and production and consumption figures are for the corresponding financial year. From 1983-84 to 1999-2000, the forest raw material figures were in Bone Dry Metric Tonne (BDMT) i.e., in 0 per cent moisture content basis. From 2000-2001 onwards, figures were in net weight. The net weight figures were converted to dry weight by multiplying with 0.65. The supply figures except that for bamboo were in 50 per cent moisture content, which were converted to dry weight by multiplying with 0.50. The net weight figures for bamboo were converted to dry weight by multiplying with 0.65.

Pattern of consumption of pulpwood and newsprint production

The pattern of total consumption of pulpwood and corresponding production of newsprint from HNL for the period 1983-84 to 2008-09 is depicted in Figure 1. There was a gradual increase in the consumption of pulpwood over the years which naturally reflected on the production of newsprint as well. At any time of the period under reference, the industry was facing a lag except during 1996-97 when a dip could be seen.

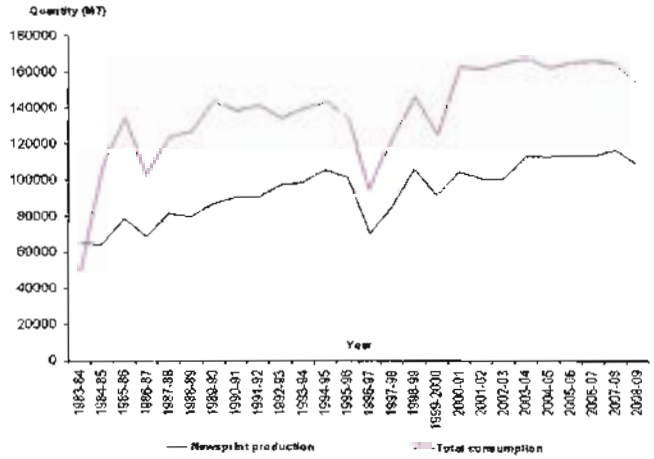


Figure 1. Total consumption of pulpwood and newsprint production

HNL uses different types of raw material such as wood, bamboo, reed and waste paper. The wood consists mainly of eucalypt, acacia and mangium. Figure 2 allows us to see the contribution of each type of raw material to the total consumption in terms of percentage over time. This chart thus illustrates the annual change in the consumption pattern in respect of different types of raw material.

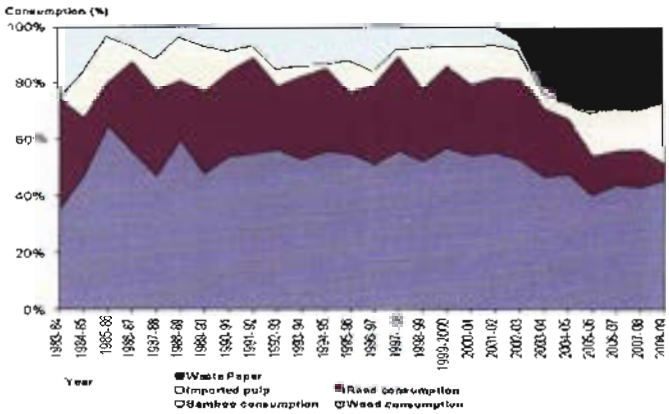


Figure 2. Consumption of different types of raw materials

the mesocarp. The opening will have a circumference in the range of 25-35 cm (Mean = 31 cm). It took the endosperm with its fore-limb and consumed the coconut water after inserting the head through the hole. The squirrel usually takes about an hour for consuming a single coconut. Ten minutes were utilized for removing the mesocarp and endocarp and the remaining time for widening the endocarp and ingestion. As the endocarp of the pre-ripened coconut is comparatively soft, the animal could easily use its incisors to open the hard nut.

Malabar giant squirrel is highly sensitive to the external sounds while consuming coconuts. Watch and ward is a good remedy to prevent the entry of this species into the coconut farms. Another successful solution is to remove the branches of the trees near the boundary. Consumption and damage of coconut by Malabar giant squirrel has not been reported earlier.

Suresh K. Govind and E. A. Jayson
Wildlife Biology Department

Nearly 40 to 50 per cent of the total consumption consisted of wood. The next important material was reed but over the years, the percentage contribution came down drastically. Instead, bamboo was getting increasingly utilized. The use of imported pulp, although was prevailing in the earlier period, came down to almost nil by 2003. Since that period, waste paper was getting increasingly used amounting to almost 25 per cent of the total consumption by 2008.

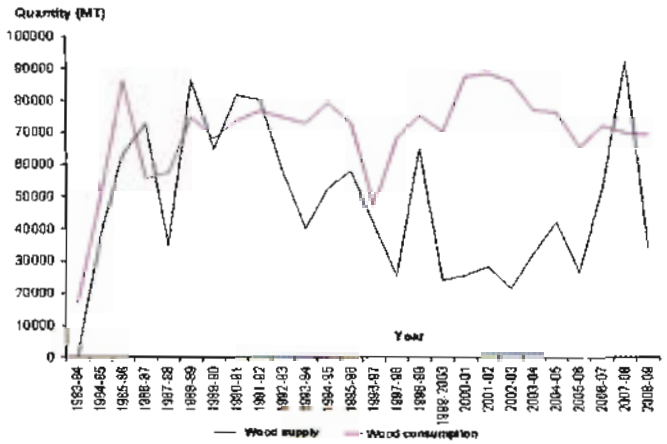


Figure 3. Supply and consumption of pulpwood

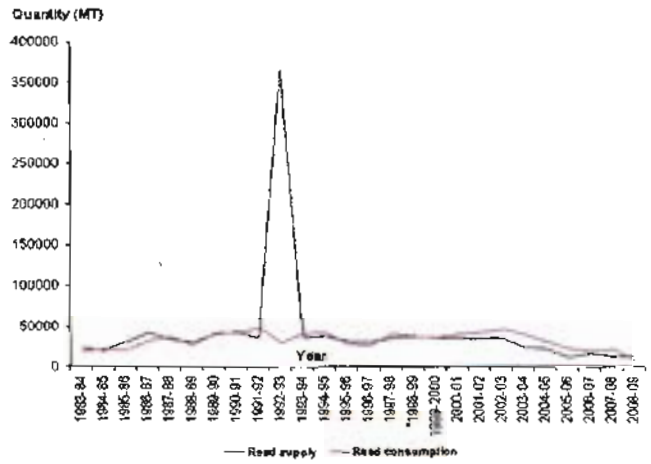


Figure 4. Supply and consumption of reed

Figures 3 and 4 give a more detailed pattern with respect to raw material supply from government sources. The wood supply from 1986-87 to 1991-92 from government sources, including eucalypt, acacia, mangium and other wood matched with the consumption but in the later years, there was a gap (Figure 3).

Figure 4 shows the pattern of consumption of reed which maintained an almost stable level. During the period 1992-94, there was an excess supply of reed which went to the factory's buffer stock for the later years.

Figure 5 depicts the mode of consumption and supply of bamboo. There was no supply of bamboo from government sources till 1999-2000 and the requirement had to be met by procurement from private sources during that period.

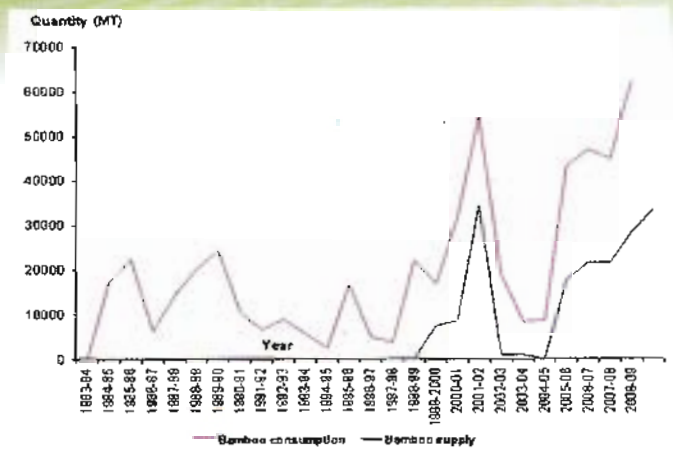


Figure 5. Supply and consumption of bamboo

Forecasting of pulpwood consumption in Kerala

For the analysis, consumption data for the period 1983-84 to 2008-09 were used. Forecasting of pulpwood consumption was carried out using Autoregressive Integrated Moving Average (ARIMA) model introduced by Box and Jenkins in 1960s. There are three basic components to an ARIMA model: autoregression (AR), differencing or integration (I), and moving average (MA). This procedure consists of three steps which are identification, estimation, and diagnosis. An ARIMA model is typically expressed as ARIMA (p, d, q) where p is the order of autoregression, d is the order of differencing (or integration), and q is the order of moving average involved. Given a time series $\{Y_t = 1 \le t \le n\}$, mathematically, ARIMA model is written as

$$(1-B)^d Y_t = \mu + \frac{\theta(B)}{\phi(B)} a_t$$

where t indexes time

μ is the mean term

B is the backshift operator; that is, $BX_t = X_{t-1}$

$\phi(B)$ is the autoregressive operator, represented as a polynomial in the back shift operator:

$$\phi(B) = 1 - \phi_1(B) - \ldots - \phi_p(B)^p$$

$\theta(B)$ is the moving-average operator, represented as a polynomial in the back shift operator:

$$\theta(B) = 1 - \theta_1(B) - \ldots - \theta_p(B)^p$$

a_t is the independent disturbance, also called the random error.

To determine the order of differencing d, the time series must be checked for nonstationarity. If nonstationarity is indicated, differencing or other transformations must be performed prior to further analysis. The required order of differencing determines d. To determine the AR and MA orders p and q, inspection of the Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) of the series (or differenced series, if called for) is performed. It can be shown that, in theory, the number of significant ACF spikes at lags greater than zero equals the order of the moving average component, q. In a similar way, the number of significant PACF spikes at lag orders greater

than zero indicates the order of the autoregressive component, *p*. Model comparisons are usually based on Akaike Information Criterion (AIC) or Bayesian Information Criterion (BIC).

The analysis was carried out using SPSSPC software. Following the above methods, ARIMA (2, 1, 0) was identified as the most suitable model. Statistical significance of the estimated coefficients was tested by using *t*-test. The estimated parameters for the model are given in Table 1.

Table 1. Estimated parameters of the model

Parameters		Estimates	Std Error	*t*	P
Non-Seasonal	AR1	-0.425	0.217	-1.957	0.063
Lags	AR2	-0.457*	0.185	-2.463	0.022
Constant		3218.403	2191.948	1.468	0.156

*Significant at P= 0.05

The adequacy of the ARIMA (2, 1, 0) model was checked using the plots of ACF and PACF of the error series created by ARIMA. No correlations exceeded the 95 per cent confidence limit and also the Box-Ljung statistic for the ACF function was not statistically significant at any lag.

The projections made for the six years after 2008-09 showed further increase in total consumption of raw materials in HNL (Figure 6). This should happen provided the general production/ processing environment does not undergo any drastic changes. However, this was not the case as the discussion with the Management Unit of the factory revealed that the unit is currently in a production crisis due to competition from other newsprint manufacturing units in the country. Earlier, there was a restriction that the newsprint consumers within the State have to buy the newsprint from HNL. With the removal of that restriction, the buyers got a wide choice. The high production cost of HNL was preventing them from lowering the price of their products. With the result, the products were remaining in the factory lying unsold. In turn, the unit was unable to utilize the raw material that was piling up. Currently, an intervention from the Government is called for.

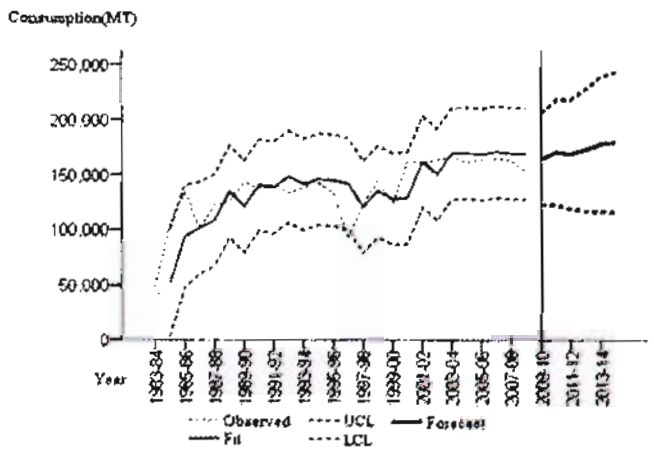


Figure 6. Predicted consumption figures for HNL based on time series analysis

Forecasting of newsprint production from HNL

In this case, production data for the period 1983-84 to 2008-09 were used. Forecasts were generated using ARIMA model as described earlier. The analysis was carried out using SPSSPC software. Here also ARIMA (2, 1, 0) was identified as the most suitable model. Statistical significance of the estimated coefficients was tested by using *t*-test. The estimated parameters for the model are given in Table 2

Table 2. Estimated parameters of the model

Parameters		Estimates	Std Error	*t*	P
Non-Seasonal	AR1	-0.483*	0.201	-2.404	0.025
Lags	AR2	-0.370	0.200	-1.849	0.078
Constant		1858.000	1078.000	1.724	0.099

*Significant at P=0.05

The adequacy of the ARIMA (2, 1, 0) model was checked using the plots of ACF and PACF of the error series created by ARIMA. No correlations exceeded the 95 per cent confidence limit and also the Box-Ljung statistic for the ACF function was not statistically significant at any lag.

The projections made for the next six years after 2008-09 showed further increase in the production of newsprint (Figure 7). However, this is not in accordance with the current crisis faced by the management, the reasons for which were discussed earlier in this report.

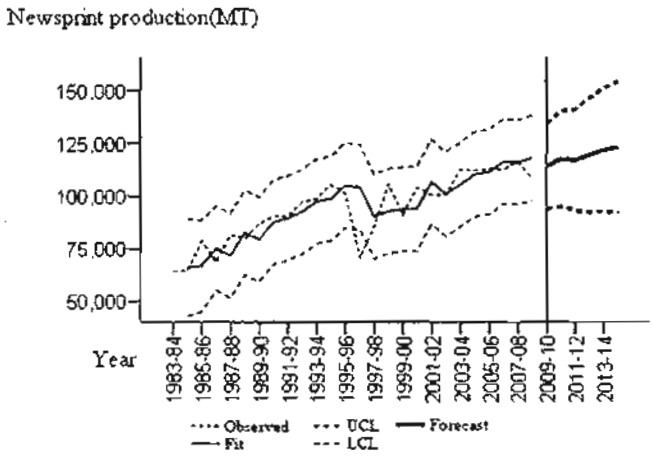


Figure 7. Predicted newsprint production figures for HNL based on time series analysis

K. Jayaraman
Forest Management Information System Division

KFRI Research Reports

Use of Bioprotectant against fungal deterioration of rubber wood

KFRI Research Report No 327. (Maria Florence, E. J. and Balasundaran, M., June 2009)

Rubber wood is one of the widely used timbers in wood-based industries in Kerala. One problem of utilization of rubber wood is its susceptibility to moulds, sapstain and decay fungi, and insect borers. Among various fungi, *Botryodiplodia theobromae* Pat. is the dominant fungus causing sapstain on rubber wood. Among the several microorganisms screened, a bacterium, *Bacillus subtilis* B2 and an actinomycete *Streptomyces* sp. SA18 were identified as possible bioprotectants against sapstain caused by *B. theobromae*. The inhibition of *B. theobromae* by the *Streptomyces* sp. SA18 was by producing chitinase enzyme and thereby degradation of the fungal cell wall chitin. The antibiotic, Iturin A produced by *B. subtilis* B2 was also inhibiting the fungal growth. When compared to actinomycete, the bacterium was more effective against the sapstain fungus in the field. Open stacking reduced the fungal infection than close stacking.

Integrating cultural and biological diversity into the conservation of Agastyamala Biosphere Reserve.

KFRI Research Report No. 331 (Anitha, V. and Chandrasekhara, U.M., 2010).

There is definite linkage between cultural identity and biodiversity. It is evident that the traditional societies like Kanis of Agastyamala Biosphere Reserve perceive the biodiversity based on their indigenous knowledge and they respect the nature and elements of environment around them though they use the same for their well being and livelihood. Whereas the non traditional societies perceive the nature and forest resources only as useful and useless commodities. Due to such non respecting perception they are responsible for destruction of forest tracts in exploitative manner. The forest being replaced by rubber plantations is a common sight throughout the Peppara and Neyyar areas. Therefore it can be said comfortably that non tribal cultures do not provide space for the natural processes responsible for maintaining diversity nor they have certain traditions like sacred groves or sacred landscapes that are contributing to biodiversity conservation. The main findings are given below.

Kani Tribal Women

Kanis perception of the forests and ABR has been on the principle of sacredness. The knowledge of biodiversity and cultural practices associated with age old conservation practices are vanishing very fast in Agastyamala Biosphere Reserve as in the cases of all protected area management and forest/tribal development scenarios. There is need of detailed studies, documentation and in depth research work before implementing any special biodiversity conservation and management programme. Awareness generation among various people's group including Kanis is mandatory before implementation of any new participatory conservation approach. There is need for an integrated approach for establishing balance between environmental protection and development needs to manage and protect the delicate landscapes like Agastyamala Biosphere Reserve.

Typical Kani Hut

Water use by *Eucalyptus grandis* in comparison with rice fields and grass lands located in the downhill area of Mannavan Shola in the Western Ghats of Kerala.

KFRI Research Report No. 332 (Jose Kallarackal, 2010).

Eucalypts have been alleged to be consuming excessive amount of water, sometimes their roots even reaching the ground water table in several parts of the world. However, there are several reports mentioning the merits of this tree species in afforestation. In 2004, based on a complaint from the residents of Marayur and Pius Nagar in Idukki District of Kerala, the Chief Minister of Kerala ordered a thorough study on the problem of eucalypt plantations raised in the uphill areas of Marayur causing drought situations in the downhill areas.

Relatively large areas in Kanthalloor, which form the uphill areas of Marayur, have been converted into plantations of *Eucalyptus grandis*. A eucalypt plantation and grassland in this area were chosen for experimental work. This involved the measurement of transpiration in the eucalypt trees using sap flow method. Besides, other ecophysiological parameters such as leaf area index and leaf water potential were measured in the plantation. Along with the water use measurements in eucalypts, the evapotranspiration from adjacent grassland was also measured for comparative purposes. Evapotranspiration from rice fields originally envisaged in this project could not be measured, as rice cultivation was not available in the uphill locations. Simultaneous with the above measurements, hourly weather data from the above location was monitored using an automated weather station. The stream flow of the river was also monitored at six strategic locations during different seasons to see the changes in the flow of the river as it passed through the different land use systems in this large catchment.

The results from the study showed that eucalypts show transpiration values very similar (1.32) to studies made elsewhere in the world, during the post monsoon season when the soil is saturated with water. However, during the dry period (pre monsoon), the transpiration values were much higher than the usually reported values (7.70 mm). The roots of the tree were found to reach more than 10 meters deep in the soil, indicating extraction of water from deep layers. The evapotranspiration from the grassland was much less than eucalypt plantation. When the stream flow was analysed, it was found that the stream flowing through the area had its main source in an underground spring, starting at much higher elevation. The stream flow was not considerably reduced as it passed down the eucalypt plantations in question. The above results lead us to a conclusion that the drought-like situation in Marayur is not due to the presence of eucalypt plantation because the water flow in the river does not seem to be seriously affected by the eucalypt transpiration. In spite of this, we recommend that the eucalypt plantation should not be expanded to the existing grasslands, as grasslands are very good water conservation areas, especially in a geographical area where the rainfall is very seasonal.

Studies on genetic diversity of teak using AFLP markers.

KFRI Research Report No. 339. 29p. (Balasundaran, M., Indira, E.P. and Nazeem, P.A., 2010)

One hundred and eighty genotypes from 9 teak populations of natural forests of the Western Ghats were evaluated for genetic diversity. The teak populations selected for the study belonged to forest divisions of Konni, Peechi-Vazhani Wildlife Sanctuary, Parambikulam Wildlife Sanctuary, Nilambur South, and Wayanad Wildlife Sanctuary from Kerala State, natural forests of Shimoga, Virnoli and Barchi of Karnataka State and one population from Indira Gandhi Wildlife Sanctuary from Tamil Nadu State. Out of 64 AFLP primer combinations screened, ten best primer combinations were used for the study.

Of the nine natural populations, Konni and Wayanad populations had the highest genetic diversity as measured from per cent of polymorphic loci and gene diversity index. Gene diversity (h) varied from 0.139 (Barchi) to 0.244 (Konni and Wayanad). Kerala and Tamil Nadu populations showed higher genetic diversity than Karnataka populations. The gene diversity indices of the nine populations showed higher genetic diversity values for populations from protected forests than populations from territorial forests. Cluster analysis done using genetic similarity coefficients between the populations showed grouping of nine populations into two main clusters; the Karnataka populations forming a single cluster. The Kerala populations and Indira Gandhi Wildlife Sanctuary from Tamil Nadu formed a separate cluster. The Nilambur natural forest population stood out separately but joined the cluster of Kerala populations indicating uniqueness of Nilambur populations among the natural teak of Kerala. The genetic diversity of the SPAs varied from 0.169 (Konni SPA) to 0.203 (Wayanad SPA). The percentage of polymorphic loci ranged from 74.42 (Parambikulam SPA) to 84.06 (Konni SPA). The genetic similarity coefficients and clustering of 80 genotypes in the NTSYSpc-generated dendrogram indicated a pattern in accordance with the origin and geographic location of SPAs but with small discrepancies.

All the 20 samples from each of Konni and Parambikulam SPAs clustered into respective groups clearly justifying their respective geographic origin. However, five genotypes from Nilambur namely N2, N3, N9, N12 and N14 and one Wayanad genotype W5 intruded into the Konni cluster besides the 20 genotypes of Konni origin. This indicated that these trees might have their origin in Konni and they might have reached

Nilambur and Wayanad plantation as stumps for planting or there could be mixing of Konni seeds into Nilambur and Wayanad seed lots.

Ecology and behaviour of forest owls in the Western Ghats and developing habitat model for their conservation

KFRI Research Report No. 343 (Jayson, E.A and Sivaram, M., 2009)

Distribution, status and habitat use of forest owls in the southern Western Ghats of India was studied from February 2005 to January 2008. The objectives were to make an inventory of forest owls in the study area, to find out the factors that influence the owl distribution and abundance and to characterise the microhabitat use of owls. Intensive surveys were carried out in 276 census points, using dusk watch, initial quiet listening, call playback and spotlighting. One hundred and thirty seven points were surveyed from Kerala and 139 points from Tamil Nadu State. Thirteen species of owls were recorded from the southern Western Ghats of Kerala and Tamil Nadu. Out of the sixteen species of owls distributed in Kerala part of the Western Ghats, eleven species are found in the forests and others in the cultivation and in open country. Two species are migratory and 14 species are resident. Thirteen species of owls were recorded from the Kerala State and a new report of the short eared owl (*Asio otus*), a migrant species, was obtained from the Peechi-Vazhani Wildlife Sanctuary. The Ceylon bay owl, an endemic species, was newly reported from the Idukki and Neyyar Wildlife Sanctuaries. Southern distributional limit of seven species of owls was reported for the first time from the Western Ghats. New reports of several owl species in various protected areas are also obtained in this study.

Distribution pattern of owls was characterised using vegetation types, topographic variables, disturbance level and protection status of the areas. Highest encounter rate of owls was recorded from the Nelliampathy-Parambikulam-Vazhachal-Anamalai hill complex. Species of owls were grouped into two, namely large owls and lesser owls based on the size. Lesser owls namely jungle owlet, Indian scops owl, oriental scops owl and brown hawk owl were recorded from all the protected areas than the large owls (forest eagle owl, brown fish owl, mottled wood owl, brown wood owl and Indian eagle owl). Jungle owlet was the predominant lesser owl and the Indian eagle owl was the dominant in the large owl category. Highest species richness was recorded from the Indira Gandhi Wildlife Sanctuary. The encounter rate of lesser owls was higher in the protected areas; whereas that of larger owls was significantly higher in the reserve forests.

Habitat use of owls was studied by estimating habitat parameters at the field level and landscape level. Twelve variables were measured at field level and twenty two parameters at landscape level. Point centered quarter method was employed to sample the vegetation structure and tree diversity. The values of landscape parameters were estimated from the digital maps using GIS tools. Habitat use of jungle owlet, brown hawk owl, Indian scops owl, oriental scops owl, brown fish owl, Indian eagle owl, and forest eagle owl was given in detail. Response of owls to inter and intra specific calls were also described. In the last chapter, the predictive performance of the two presence/absence modelling approaches namely binary logistic regression model and decision tree model was assessed. The model developed after assessing the distribution of owl species in the various vegetation types and topography can be utilized for locating their habitats in the dense forest terrains of the Western Ghats and to narrow down the search to probable locations. The habitats of seven species of owls namely jungle owlet, brown hawk, Indian scops, oriental scops, Ceylon bay, Indian eagle and brown fish owl have been mapped. Owl species of the southern Western Ghats are not facing any serious threats, though they are found few in numbers. Most of the species need mature forest with long and tall trees and old forest growth for survival. The expansion of plantations into natural forests

Jungle owlet (*Glaucidium radiatum*)

Indian scops owl (*Otus bakkamoeana*)

Spotted owlet (*Athene brama*)

Indian eagle owl (*Bubo bengalensis)*

could put pressure on the owl population and mining activities for granite are destroying the habitat of the Indian eagle owl and brown fish owl in the eastern slopes of the Western Ghats in Tamil Nadu.

The Conservation of Mangroves in Kerala: Economic and Ecological Linkages

KFRI Research Report No. 353 (Muraleedharan, P.K., Swarupanandan, K. and Anitha, V., 2009)

Biodiversity rich mangrove ecosystems are fast declining the world over. They provide many ecological, environmental and socioeconomic benefits to mankind. Presently, in Kerala, the extent of undisturbed mangroves is reduced to just 150 hectares mostly distributed in Ernakulam, Kannur and Kozhikode districts, but potential area comes to around 1670 hectares. The vegetation has diminished in its extent drastically and has acquired a threatened status in Kerala. The threats to the mangrove ecosystems could be broadly grouped into both natural as well as anthropogenic. More than 80 per cent of the mangrove lands in Kerala (potential and existing) are under private ownership and the remaining areas which are left with the government agencies are very meager. The mangroves in the State are threatened with unprecedented destruction, which includes commercial exploitation of raw materials, land reclamation for agriculture, aquaculture and housing. There have been significant changes in the traditional and present uses of resources within the mangrove system, which have implications on its depletion.

The respondent perception on the benefits derived from mangroves highlighted forestry products and seafood as the most important direct benefits. This is indicative of the fact that respondents give more weightage to the direct economic benefits of the ecosystem. On social and environmental problems associated with mangroves health problems, low agricultural productivity and water pollution were highlighted. The traditional mangrove ecosystem was by and large, self contained following subsistence production, but now it is closely related to the market. The changing land use has drastically affected the mangrove ecosystem. The high returns from high tech aquaculture especially shrimp farming has led to rather quick transformation of the mangrove lands. Many people sold out their mangrove lands to big investors not realizing its environmental and social values. Decline in area under mangrove ecosystem continues in an unprecedented manner due to increase of population, industrialization and implementation of developmental activities. Mangrove afforestation initiative is yet to make a successful leap in the State. Socially, afforestation programme would be benefiting people living in coastal areas in terms of protection, environmental services and support for livelihood.

Taxonomy of Microlepidoptera

KFRI Research Report No. 361 (George Mathew, 2010)

Intensive survey of Microheterocera was made from different parts of Southern Western Ghats Viz., Silent Valley, Mukkali, Muthanga, Sulthan Bathery, Amarambalam, Meenmutty, Vellimuttam, Nilambur, Peechi, Vazhani, Sholayar, Rajamalai, Ranni, Thenmala, Arienkavu, Rosemala, Kattlapara, Achenkovil, Neyyar, Peppara. Sampling of insects was done by light trapping using a lighted sheet. Altogether, 67 species of Microheterocera belonging to the families Psychidae, Tineidae (Tineoidae) Oecophoridae, Ethmiidae, Lecithoceridae, Gelechiidae, Blastonasidae, Cosmopterigidae (Gelechioidae); Plutellidae, Yponomeutidae, Lyonetiidae, Glyphiterigidae and Heliodinidae (Yponomeutidae) have been recorded in this study. A major share of moths collected in the study belonged to Gelechiidae, Tineidae, Oecophoridae and Cosmopterigidae. The faunal elements were interesting in that they contained several

Tinea pellionella Linnaeus (Tineidae)

Monopis monachella Hubner (Tineidae)

new records for the region- six species as new records for Kerala; 44 species as new records for southern India and two species as new records for India. Studies on the morphology of various species with special reference to head appendages, wing and external genitalia have shown that characteristics of the labial palpi, wing venation and parts of external genitalia such as uncus, saccus gnathos, juxta, tegumen of the male as well as corpus, bursae, ductus bursae and signum of the female have diagnostic value in species identification.

Key for the various species using wing venationl and external genitalial characters was prepared for easy segregation of species studied here. In addition, an inventory of species recorded in this study along with details of collection, localities, distribution and also given.

Extension Projects

Pre-project workshop on decision support system for forest sector of Kerala

KFRI Extension Research Report No.162 (Jayaraman, K. 2009)

A pre-project workshop was conducted with the objective of developing a project proposal on Decision Support System for forest management in Kerala. The workshop was held at KFRI on the 4th of March 2010 and was attended by the officials of the Kerala Forest Department and scientists from the Institute. The workshop started with a briefing about the objectives followed by lectures on work already done with respect to creation of a statistical database for forest sector of Kerala, information available through remote sensing and use of GIS in forest management. Later, discussions were held on the process of decision making in forestry in the State. Several decision making techniques were illustrated and two project outlines were also presented for discussion. The workshop resulted in identifying the project theme and associated details required for developing a full-fledged project proposal on Decision Support System for forest management in the State.

Extension Reports

C.N. Krishnan Kutty, P.K. Thulasidas, K.V. Bhat. Renovation of the Punalur suspension bridge in 2003: Assessment of financial loss of Government of Kerala due to non-use of the specified Kambakam (*Hopea parviflora)* wood. KFRI Extension Report No. 30,10 p

K.K.N. Nair and George Mathew, 2010. Biodiversity Documentation of Ernakulam District, Kerala State. KFRI Extension Report No. 33(1), 95 p.

K.K.N. Nair and George Mathew, 2010. Biodiversity Documentation of Thiruvananthapuram District, Kerala State. KFRI Extension Report No. 33(2), 124 p.

K.K.N. Nair and George Mathew, 2010. Biodiversity Documentation of Kollam District, Kerala State. KFRI Extension Report No. 33(3), 114 p.

K.K.N. Nair and George Mathew, 2010. Biodiversity Documentation of Alappuzha District, Kerala State. KFRI Extension Report No. 33(4), 84 p.

K.K.N. Nair and George Mathew, 2010. Biodiversity Documentation of Idukki District, Kerala State. KFRI Extension Report No. 33(5), 146 p.

K.K.N. Nair and George Mathew, Biodiversity Documentation of Malappuram District, Kerala State. KFRI Extension Report No. 33(6), 121 p.

K.K.N. Nair and George Mathew, 2010. Biodiversity Documentation of Kozhikode District, Kerala State. KFRI Extension Report No. 33(7), 99 p.

Among the other States in India, Kerala is a forerunner with regard to decentralized planning at district level. For effective implementation of the planning process, information availability of natural resources is a *sine qua non*. It is in this context the Kerala Forest Research Institute, Peechi was entrusted with the task of compiling various facets of biodiversity encountered in the forests of the State. Time being a major factor, certain omissions are only to be expected and this will be rectified in due course of time as more and more information are collected. However, it is expected that this document will serve as baseline information for further investigations in the field of Biodiversity.

NEW RESEARCH PROJECTS

KFRI 586/2009: Ensuring sustainable livelihood of tribals through skill development and employment generation: an action research programme in Wayanad Kerala (P.K. Muraleedharan, V. Anitha, November, 2009)

KFRI 587/2009: Preparation of Biodiversity Conservation Plan for Vazhachal High Value Biodiversity Area, KFDF (C. Renuka, November, 2009)

KFRI 588/2009: Preparation of Biodiversity Conservation Plan for Muthikulam High Value Biodiversity Area, KFDF (C. Renuka, November, 2009)

KFRI 589/2009: Need assessment and formulation of technical cooperation programme (TCP) project for forest invasive species (FIS) in South India, Sri Lanka and Maldives, FAO, Bangkok (K.V. Sankaran, January, 2010)

KFRI 590/2009: Preparation of Biodiversity Conservation Plan for Malayattur High Value Biodiversity Area, KFDF (C. Renuka, October, 2009)

KFRI 591/2010: Stock assessment and yield regulation for teak plantations in Kerala, KFDF (K. Jayaraman, March, 2010)

KFRI 593/2010: Storage practices in recalcitrant tropical forest seeds of Western Ghats, KFDF (P.K.C. Pillai, March 2010).

NEW EXTENSION PROJECTS

KFRI Ext.172/2009: One week compulsory training course on collection, compilation, validation and dissemination of forestry statistics (M. Sivaram, November, 2009)

KFRI Ext.173/2009: Modern trends in teak cultivation and management. (E. J. M. Florence, November- December 2009)

KFRI Ext.174/2009: Exploring the potential of afforestation programmes of Attappady Hills Area Development Society (AHADS) for obtaining Carbon credits – a feasibility study (S. Sankar, December 2009)

KFRI Ext.175/2009: Familiarization to bamboo cultivation and also Bamboo Training for farmers from Tiruchirappally (E.J.M. Florence, December 2009).

KFRI Ext.176/2009: Two-day training workshop on effect of weeds on productivity of forest plantations and natural forests and different cost-effective methods for their control (K.V. Sankaran, January 2010)

KFRI Ext.177/2009: Preparation of local volume tables for *Acacia auriculiformes* and *Mangium* plantations raised under Kerala Forestry Project (P. Rugmini, January 2010)

PUBLICATIONS

Papers in Journals

Jijeesh, C.M. and Seethalakshmi, K.K. 2010. Effect of node position and growth regulating substances on root induction of culm cuttings in four commercially important *Bambusa* species. *Green Farming* 3 (1): 23-28.

Muraleedharan, P.K., Krishnankutty, C.N. and Anitha, V. 2009. An assessment of bamboo resources in agrofroestry home gardens of Kerala, *Journal of Non-timber Forest Products*, 15(3): 141-145.

Raveendran, V.P., Seethalakshmi K. K. and Jijeesh C. M. 2010. Effect of season, position of node and growth regulating substances on adventitious root induction in an edible bamboo *Dendrocalamus brandisii* (Munro) Kurz. *Indian Forester* 136 (3): 331-343.

Raveendran, V.P., Seethalakshmi, K. K. and Jijeesh C. M. 2010. Effect of season, position of node and growth regulating substances on adventitious root induction in Giant Bamboo, *Dendrocalamus giganteus* (Wall) Munro. *Advances in Plant Sciences* 23 (1): 121-123.

Rugmini, P. and Jayaraman, K. 2009. Intrinsic units of growth for teak trees. *Trees*, 23: 51-58.

Sujanapal, P. and Sasidharan, N. 2010. *Zingiber anamalayanum* sp. nov. (Zingiberaceae) from India. *Nordic Journal of Botany* 28: 288-29.

Papers in Books/ Proceedings/ Newsletters

Babu, S., Jayson, E.A and Sivaram, M. 2010. Distribution and conservation status of owls in the Southern Western Ghats, India. *In:* Yesodharan, E. P. (ed.) Proceedings of 22nd Kerala Science Congress, 28-31 January, 2010, KFRI, Peechi pp 510-513.

Beena, V. B. and Seethalakshmi, K. K. 2010. Biochemical changes during and after flowering of *Dendrocalamus stocksii* and *Ochlandra travancorica In:* Yesodharan, E. P. (ed.) Proceedings of 22nd Kerala Science Congress, 28-31 January, 2010, KFRI, Peechi pp 862-863.

Chandrasekhara Pillai, P.K. 2010. Eucalypt plantations: An effective tool in resoration of forest ecosystem. *In:* Yesodharan, E. P. (ed.) Proceedings of the 22nd Kerala Science Congress, 28-31 January, 2010, KFRI, Peechi. pp 563-564.

Chandrasekhara Pillai, P.K. and Subin, S. 2010. Conservation of *Terminalia travancorensis*–a rare, endangered and

threatened (RET) tree species. *In:* Yesodharan, E.P. (ed.) Proceedings of the 22nd Kerala Science Congress, 28-31 January, 2010, KFRI, Peechi. 599-600.

Jijeesh C. M and Seethalakshmi. K. K. 2009. Potential role of bamboo plantations in afforestation/reforestation CDM (Clean Development Mechanism *Evergreen* 61/62: 8-10.

Indira, E.P. 2010. Management of pollen flow to increase seed productivity in teak. *Teaknet bulletin* 3 (2): 6-8.

Mathew, G. 2010. Butterflies- their significance and conservation (Malayalam). *Aranyam* 08: pp 6-8.

Muraleedharan, P.K. and Anitha, V. 2009. Handicraft industry in Kerala State of India: Problems and Prospects. Proceedings of VIII World Bamboo Congress, held at Bangkok during 2009. 7: 48-59.

Muraleedharan, P.K. and Anitha, V. 2009. Conservation and sustainable management of NTFPs through stakeholder participation. Paper presented in the workshop: Biodiversity Conservation with stakeholder Participation, Published by United States-India Educational Foundation, (USIEF).

Raveendran, V. P., Jijeesh C. M and Seethalakshmi, K. K. 2010. Effect of variation in clump density on the performance of reed bamboo (*Ochlandra travancorica* Benth.). *In*: Yesodharan, E.P. (ed) Proceedings of 22nd Kerala Science Congress, 28-31 January 2010, KFRI, Peechi. pp 597-598.

Sujesh, S.M. and Indira, E.P. 2010. An analysis of breeding system and reproductive constraints in *Dipterocarpus bourdillonii* Br., an endemic RET species of Western Ghats. *In:(Ed.)* Yesodharan, E.P. (ed) Proceedings of the 22nd Kerala Science Congress 2010, KFRI, Peechi. pp. 513-515.

Swarupanandan, K. and Muraleedharan, P.K. 2010. Conservation of mangroves in Kerala for coastal protection: policy options, Zoological of Survey, India: Mangroves in India: Biodiversity, Protection and Environmental Services. pp 561-574.

SEMINAR/ WORKSHOPS ATTENDED

Anitha, V. attended national Seminar on "Role of women in combating climate change" held at Sasthra Bhavan, Pattom, Trivandrum on January 7-8, 2010.

Chandrasekara Pillai, P.K. attended the 22nd Kerala Science Congress, 28-31 January, 2010, KFRI, Peechi.

George Mathew attended and presented a paper entitled Trade of invertebrate organisms and its implications in the Seminar on "Recent Issues in Wildlife Trade & Conservation" organised by the St. Aloysius College, Thrissur, Elthuruthu, 22nd January 2010.

Indira, E.P. attended National seminar on genetics, breeding and biotechnology organized by Interuniversity Centre for Plant Biotechnology and Gregor Mendel Foundation at University of Calicut and presented a paper entitled *Variability of seed related characters in Teak (Tectona grandis L.f.) from Western Ghats Region* on 11th and 12th December, 2009.

Jayaraman, K. attended International workshop on production and marketing of teakwood: Future scenarios, November, 23-25, 2009, KFRI, Peechi.

Jayson, E.A. attended and presented a paper entitled "Illegal trade in mammals" in the seminar on "Recent Issues in Wildlife Trade & Conservation" organized by the St. Aloysius College, Trichur, Elthuruthu on 22nd January 2010 and also attended a workshop organized by the Kerala Forest & Wildlife Department to develop protocols for assessing and monitoring biodiversity at National Institute of Oceanography, Ernakulam on 22nd February 2010.

Maria Florence, E.J. participated in the 'Karshakamela' and presented the paper on, Acacias: Its propagation, cultivation management and marketing, during 3-4 November 2009 at KFRI. She also attended Technical meeting on Descriptors of Eucalypts and Casuarinas at IFGTB on 23rd September 2009 and also participated in the Stakeholders workshop on Formulation of All India Coordinated Project (AICP) for genetic improvement of fast growing phyllodinious Acacias on 11th February 2010 at IFGTB. Presented the work done by KFRI on Acacias. She also participated in the International Workshop on Mountain Biodiversity during 13-15, March 2010 at Dehra Dun and presented a paper on "Microbial diversity of the sholas of Munnar and Wayanad, Kerala, India".

Muralidharan, P.K. participated and presented the paper, *Handicraft industry in Kerala State of India: problems and prospects,* in the VIII World Bamboo Congress held during 16-19, September 2009 at Bangkok.

Sasidharan, N. participated in the National seminar on *Botanic Gardens "Garden and People"* at TBGRI, Palode, Trivandrum during 26-28 November, 2009 and also participated in the seminar on Global warming and Wildlife conservation, organized by the Kerala Forest Dept. at Kochi on 6th October 2009 and presented the paper "*Plant Diversity of Kerala*". He also participated in the brainstorming session on medicinal plants for promoting cultivation, organized by the Kerala State Biodiversity Board and Horticulture Mission, Kerala at KFRI, Peechi.

Seethalakshmi, K.K. participated in the International workshop on Production and marketing of teakwood: Future scenarios. 23-25, November 2009, KFRI, Peechi.

Seethalakshmi, K. K. participated in 'Karshakamela' organized by Institute of Forest Genetics and Tree Breeding (IFGTB), Kerala Forest Research Institute (KFRI) and Wildlife Wing of Kerala Forest Department during 3-4 November 2009 at KFRI as a Resource Person and gave a lecture on "*Potential of Bamboo and Cultivation*" and participated in the meeting

organized by NREGS for protection of Bharathapuzha River band in Malappuram District on 3rd October 2010.

Sudheendrakumar, V.V. participated in the workshop on 'Energy security and management' held during 8-12, February, 2010 at NIAS, Bangalore.

Thulasidas, P.K. participated as an invited delegate to the seminar and workshop on" *Improved utilisation of tropical plantation timbers*", 23-25 March 2010, at Kuala Lumpur, Malaysia, organised by Forest Research Institute Malaysia with the support of ITTO, Japan.

EXTENSION ACTIVITIES

Mr. P. K. Chandrasekhara Pillai submitted a proposal for greening up the denuded areas of Tyford Estate at Memala and Rohit, Idukki District.

Dr. George Mathew investigated seedling mortality in acacia plantations at Trivandrum and Punalur and identified insects for Tata Tetley, Cochin; Agricultural Department, Andhra Pradesh; M. Sc. students (Marthoma College, Perumbavur; SN College, Alathur; Govt. College, Madappally) and was also referee for projects submitted for funding to MoEF, KSCSTE and DBT.

Dr. E.A. Jayson submitted a report after visiting the mangrove patch of Chakkamkandam, Guruvayoor on 14th January 2010.

Dr. N. Sasidharan identified trees and prepared labels for the trees in Bharath Petroleum Corporation, Kochi Refinery Township, Kochi as per the request of Cochin Refinery.

GUEST LECTURES/ CLASSES

Anitha, V. gave classes on, Forest economics: inter-linkages between environment and economics, for Ph.D. Students in KFRI as part of the Ph.D. course work on August 10th 2009 and also on Economic valuation of ecotourism development of a recreational site in the natural forests of southern Western Ghats.

Chandrasekhara Pillai, P. K. gave lectures on "Vegetative propagation and seedling development of *Saraca asoca*" on October 20, 2009. Took class on 'Seed handling and Nursery Practices' of *Saraca asoca* to different Forest Divisions of Kerala and also gave lectures on "Collection, compilation, validation and dissemination of forest Statistics" for Indian Forest Service Officers during 16-20, November, 2009.

Chandrasekhara Pillai, P. K. gave lectures on "Priority species, resource estimation, plantation development, post harvest technology and socio-economic livelihood potential of bamboos" supported by National Bamboo Mission (Bamboo Technical Support Group for South Zone) for the Field Functionaries during 17-22, August, 2009; September 14-19, 2009 and 26-31, October, 2009.

Jayson, E.A. offered classes at the Extension centre of KFRI, Peechi in September 2009 and also on 8th October, 2009. He also gave class on "Biodiversity conservation in SN College Maliankara, Moothakunnam on 24th February 2010. Dr. E. A. Jayson inaugurated Canopy Nature Club and gave classes on Biodiversity Conservation at MES college Aluva on 4th January 2010.

Sasidharan, N. gave lectures on, Field botany and medicinal plants, in the Refresher Training course to Forest Guards at Kerala Forest School, Arippa on 17.09.09.

Seethalakshmi, K.K. gave a guest lecture on, Potential of bamboo and scope for cultivation, under NSS programme on 22nd October, 2009 at Nirmala College, Muvattupuzha.

Sivaram, M. delivered a lecture on 'Forestry statistical database and data mining-A case study of Kerala State' in the Training Workshop on 'Collection, compilation, validation and dissemination of Forestry Statistics' for Indian Forest Service (IFS) Officers, 16-20 November 2009, Kerala Forest Research Institute, Peechi and on i) Distance sampling in forest ecology and ii) Biodiversity indices and habitat models in the Winter School on Biodiversity and Conservation organized by Madurai Kamaraj University and Networking Resource Centre in Biological Sciences at Madurai from 21st November to 11th December 2009.

Thulasidas, P. K. served as resource person and taken class on "Wood quality of teak from fast growing plantations and home-gardens" on 1st December 2009 as part of a Training course on Modern trends in teak cultivation and management organized by the Extension and Training Division during 26th November to 1st December 2009 for the benefit of Mr. Rodric Evers, Managing Director, Future Forests, Fiji.

TRAINING IMPARTED

Training courses coordinated

Dr. V. Anitha conducted training course to the field functionaries for the Bamboo Technical Support Groups for south zone on - 'Economic and livelihood potential of bamboo' (May/ August/September/October 2009).

Dr. M. Sivaram was the course coordinator of the training course on 'Collection, compilation, validation and dissemination of Forestry Statistics' for Indian Forest Service (IFS) Officers sponsored by the Ministry of Environment and Forests, 16-20 November 2009, Kerala Forest Research Institute, Peechi.

Dr. E.J. Maria Florence was the course coordinator of the training course, on Priority species, resource estimation, plantation development, post harvest technology and socio-economic livelihood potential of bamboos during 26 - 31

October 2009 sponsored by NBM and Bamboo Training for farmers from Thiruchirappilly during 7 - 9 December 2009. Dr. E.J. Maria Florence coordinated training on Modern trends in teak cultivation and management, during 26th November to December 1st sponsored by Future Forests, Fiji Island. She coordinated two-day training workshop on, Effect of weeds on productivity of forest plantations and natural forests and different cost effective methods for their control, during 14-15 January 2010 sponsored by MOEF.

Dr. E.J. Maria Florence coordinated, training course on Priority species, resource estimation, plantation development, post harvest technology and socio-economic livelihood potential of bamboos, during 18-23 January 2010 sponsored by NBM and also Training on, vegetation carbon pool field data collection, demonstration during 6-9 February 2010 sponsored by ISRO and also coordinated, collection and processing and seeds of nursery techniques of selected forestry medicinal plants, during 30th March 2010 sponsored by FRLHT.

Dr. N. Sasidharan organized training on vegetative propagation and seedling development of *Saraca asoca* for the officers of the Kerala Forest Department on 20th February 2009 at KFRI, Peechi.

MEETINGS ORGANIZED

Dr. E.A. Jayson attended meeting at Parambikulam Wildlife Sanctuary on the review of Salim Ali bird census on 12 -11-2009 and also attended Advisory committee meeting of Mangalavanam Bird Sanctuary at Ernakulam on 9th December, 2009. Dr. E.A. Jayson attended meeting at New Delhi as expert of Regional Committee of MEE of Tiger Reserve on 18th January 2010.

Mrs. Sani Lookose organized various educational programmes in Teak museum for students, teachers, nature club members and the general public under the project KFRI 490/2005 titled 'Organizing educational programmes at Teak museum'.

Wildlife week activities were organised during 1-7 October 2009 for nature club members, members of nature education centres and various student groups with prior registration. A written essay competition on 'Forest and Wildlife conservation' was organized on 3rd October for students. A total of 716 participants and 55 officials attended the Wildlife week activities.

Two week long Teak study camps were organized at the Nilambur Sub Centre during 9th to 21st January 2010 for teacher trainees and student groups with prior registration. A total of 602 participants and 59 teachers attended the camp. World Forestry Day programme was organised on March 21st 2010 for the members of NCEC (Nodal Continuing Education Centre) Manimooly, Edakkara, (Malappuram Dist.) with prior registration. 44 participants and 2 officials attended the programme.

MEMBERSHIP IN COMMITTEES

Dr. N. Sasidharan was nominated as a member of the Technical Support Group for National Mission on Medicinal plants of the State Horticultural Mission, Kerala

Dr. K.K. Seethalakshmi was a member, Consortium Advisory Committee of NAIP project on, development of spectral reflectance methods and low cost sensors for real time application of variable rate inputs in precision farming, ICAR project to Punjab Agricultural University, Ludhiana. She was also Member, Board of Studies in Botany, P.S.G.R. Krishnammal College, Peelmadu, Coimbatore and also Technology Angel for evaluating technology projects in the field of bamboo processing by Techno park Outreach Centre (T-TUC), Trivandrum.

Dr. K.M. Bhat Memorial Award 2010

The first Dr. K. M. Bhat Memorial Award 2010 was given to Dr. P. Sujanapal for his outstanding contribution to the biodiversity documentation of flowering plants of Kerala. The award carries a Gold Medal and a Certificate of Merit, which was given on 2nd January 2010 at function held in KFRI which coincided with the 1st death anniversary of Dr. K.M. Bhat. The Endowment Award was instituted by the family of late Dr. Bhat. This was followed by the Endowment Lecture by Dr. H.D. Kulkarni, General Manager (Plantations), ITC Paperboards and Specialty Papers Division, ITC Ltd, Badhrachalam, Andhra Pradesh.

22nd Kerala Science Congress held at KFRI

The 22nd Kerala Science Congress organized by the Kerala State Council for Science Technology & Environment was held at Kerala Forest Research Institute, Peechi during 29-31 January 2010. Dr. R. V. G. Menon, Chairman, 22nd Kerala Science Congress Committee welcomed all the participants. The Science Congress was inaugurated by Mr. V. S. Achuthanandan, Hon. Chief Minister of Kerala. The inaugural session was chaired by Dr. E. P. Yesodharan, Executive Vice President of KSCSTE. Mr. K. P. Rajendran, Hon. Minister for Revenue inaugurated the Exhibition organized in connection with Science Congress.

The focal theme of the 22nd Kerala Science Congress was "*Intellectual Property Rights and Development: A National Perspective*". Beside the special session on the focal theme, there were nine technical sessions dealing with nine broad subject areas, viz. 1. Agriculture, 2.Fishery and Veterinary Sciences, 3. Biotechnology, 4. Chemical Sciences & Technology, 5. Earth System & Geo-informatics, 6.

Engineering Science, 7. Information Technology & Computer Science, 8. Environmental Science, Forestry & Wildlife, 9. Health Science, 10. Life Science and 11. Physical Science. In addition, a Poster session was also arranged comprising all the above subjects. A total of 875 delegates participated in addition to 15 child Scientists. *Professor P. R. Pisharoty Memorial Lecture*, was delivered by Dr. Thanu Padmanabhan, Director, IUCAA, Pune University. The *Prof. P. T. Bhaskara Panickar Memorial Lecture* was delivered by Dr. M. Sanjappa, Director, Botanical Survey of India, Kolkata. *Dr. P.K. Gopala Krishnan Memorial Lecture* was delivered by Dr. K. Mohandas, Vice Chancellor, Kerala University of Medical and Allied Science. A total of 36 contestants presented papers for Young Scientist's Best Paper Awards.

Mr. S. Babu, KFRI receiving the young scientist award from Dr. E.P. Yesodharan

Special Session

A special session was held on the focal theme: "*Intellectual Property Rights and Development: A National Perspective*"

Participants- Children's Science Congress

on 29th January 2010 at 10.00 AM. The key note address was delivered on the focal theme by Prof. (Dr.) N. R. Madhava Menon, Member, Commission on Centre-State Relations, Govt. of India. A special theme address was delivered by Shri. P. H. Kurian, IAS Controller General of Patents, Designs and Trademarks, Government of India.

Three Technical Sessions were conducted namely:

1. IPR - A catalyst for industrial development.
2. Patents in IT, BT and Pharma – issues and challenges for the 21st century.
3. Policy frameworks of Government of Kerala for promoting IPR for total development.

In the programme on showcasing of Institutions three Institutions namely Kerala School of Mathematics, Hindustan News Print Ltd and Department of Biotechnology participated. An exhibition on research activities of R&D Centers, Geographical Indications, products, etc were also open to public.

Children's Science Congress

A Children's Science Congress was organized with the participation of 15 child scientists, who presented their respective projects selected at the national level. The valedictory session was held on 31st January. Dr. K.V. Sankaran, Director, KFRI welcomed the audience & Professor C.G. Ramachandran Nair, former Chairman STEC offered the valedictory address. Dr. R. V. G. Menon presented a report on the 22nd Kerala Science Congress and recommendations of the different sessions. The session was chaired by Dr. E. P. Yesodharan, Executive Vice President of KSCSTE, who gave away Young Scientist Awards and the Best Poster Awards.

Mr. S. Sabu, Senior Research Fellow of KFRI got the Young Scientist award in the session 08. Environmental Science, Forestry & Wildlife for his paper "*Distribution and conservation status of owls in the southern Western Ghats*".

International workshop on Production and Marketing of Teakwood: Future Scenarios

An international workshop on Production and Marketing of Teakwood: Future Scenarios was held during 23-25 November 2009 at the KFRI Campus. The main objective of the workshop was to make the various stakeholders aware of the current situation with respect to teak production and marketing at a global level, and to build on the opportunities available from these developments. The workshop was organized by TEAKNET in collaboration with the Kerala Forest Research Institute. Financial support for the workshop was provided by FAO of the United Nations, Asia Pacific Association of Forestry Research Institutions (APAFRI).

The workshop was attended by a total of 66 participants from different countries including India. Several eminent scientists and experts in various fields of tropical timber development programmes were invited from around the world to deliver keynote and plenary papers in addition to the country reports from the representatives of the major teak growing countries. The participants represented a cross section of the major sets of stakeholders like growers, traders, researchers and policy makers.

The technical sessions that followed centered in general on the following topics,

- Supply of and demand for teakwood
- Market intelligence on teak price
- Grading of teakwood
- Timber certification
- Production technology
- Future perspectives for TEAKNET

The recommendations of the workshop were the following.

i. TEAKNET determines its role and scope in improving the teak sector so that the sector can:
   - Increase the production of teakwood so as to meet the rising demand for the same by expanding teak cultivation to new areas, promoting growing of teak in community homesteads and private plantations;
   - Better market teakwood through improved strategies like the development of market intelligence on teakwood availability and price;

ii. TEAKNET selects a limited number of objectives (targets) for early attention chosen on the basis that the objectives:
   - Have the highest impact for the lowest input;
   - Can be realized within budget;
   - Have the highest probability of being achieved;

iii. TEAKNET undertakes a campaign to increase its budget.

Ph. D. AWARDED

Pramod N. Nair

Mr. Pramod N. Nair was awarded doctorate degree by the Forest Research Institute (FRI) University, Dehra Dun, in June 2009 for his work on **"Assessment of the impact of human disturbance on genetic diversity in teak through DNA marker studies",** under the guidance of Dr. E.P. Indira, Scientist F, Forest Genetics & Tree Breeding Department, KFRI, Peechi. The present study was taken up to assess the impact of human disturbance in teak populations with respect to genetic parameters including gene diversity. Seven paired populations (undisturbed and disturbed) of natural teak were selected in Kerala, Orissa, Madhya Pradesh and Gujarat. Nuclear gene markers and microsatellite markers (co-dominant DNA markers) were used to estimate the allelic richness, allele frequency, number of rare alleles, expected and observed heterozygosity and gene diversity in these teak populations. The markers showed high polymorphism and a total of 26 alleles were obtained. Ten rare alleles were seen out of which six were found missing in disturbed populations. But all the alleles present in the disturbed populations were seen in the undisturbed populations also. There was a reduction of 11 to 40 per cent in the mean number of alleles in disturbed populations than their undisturbed pair populations. The study also revealed a decrease of 2 to 26 per cent in gene diversity and 5 to 19 per cent in heterozygosity in disturbed populations compared to their paired undisturbed populations. The gene diversity was highest in the undisturbed population at Konni division (0.703) and the lowest in the disturbed population at Khurda division (0.24) of Orissa. The decrease in mean number of alleles, loss and decrease of rare alleles, a reduction in heterozygosity and gene diversity in the disturbed populations would affect the fitness of those populations. With respect to the study on short-term dynamics using four microsatellites, altogether 32 alleles were obtained, out of which eight were rare alleles. The results also showed 2 to 26 per cent reduction in gene diversity in disturbed populations in most of the pair populations. The observed heterozygosity (Ho) also was lower in disturbed populations. High within population diversity was seen in all the populations including plantation. The study clearly indicated that human disturbance leads to genetic erosion in terms of allelic richness, loss of rare alleles, gene diversity and heterozygosity.

Raju Paduvil

Mr. Raju Paduvil was awarded doctorate degree by the Forest Research Institute (FRI) University, Dehra Dun, in October 2009 for his work on **"Post-harvest damage by *Dinoderus* beetles in bamboos and its management."** under the guidance of Dr. R.V. Varma, Programme Coordinator, Forest Protection Division, KFRI, Peechi. The study on *Post-harvest damage by Dinoderus beetles in bamboos and its management* was aimed at understanding the intensity of damage and mode of attack on stored bamboos based on a survey and also to develop some eco-friendly methods to protect bamboos under storage. Data on borer infestation in selected bamboo depots, huts and articles made out of bamboos were recorded. Monthly assessment of borer infestation showed that mean per cent of attack for one year in Alathur depot was 26.20 per cent and in Cherppulasseri depot 21.62 per cent. Eight species under the family Bostrychidae, Lyctidae, Curculionidae and Plattipodidae were recorded. *Dinoderus minutus* Fab. *D. ocellaris* Steph. *Heterobostrychus aequalis* Waterhouse, *Sinoxylon anale* Lesne, *Minthea rugicolis* Walker, *Lictus africanus* Lesne, *Crossotarssus saundersi* Chapuis and *Myocalandra exarata* Boheman were the species identified.

Among the recorded pests, *D. minutus* was the most common which caused maximum damage to stored bamboos. During the dry period 752 beetles were retrieved from *B. bambos* and 764 beetles from *D. strictus* and in wet period 60 beetles from *B. bambos* and 206 beetles from *D. strictus* were recovered. Mean population obtained for dry period was 42.39 and that for wet period 7.60 per cent. Analysis of variance showed non significant difference between dark and bright phases of the moon with respect to borer attack. During initial stages of flowering, borer attack was very severe and a total of 550 beetles were retrieved whereas culms harvested after seed setting escaped attack. Average starch content in the bamboos during initial stages of flowering was quite high (21.7 %) compared to seed setting stage (1.80 %). It was found that water submersion caused depletion of starch from the culms due to the activity of saprophytic micro organisms. A biological formulation was prepared and evaluated for its effectiveness against bamboo borers and it was found to be quite effective.

List of students who were awarded Ph. D. Degree based on the work carried out at KFRI

Sl. No.	Name of the student	Supervising Guide/ Co-Guide (Discipline)	Title of Thesis	Year	University
1.	Mahiba Helen, S.	Dr. V.V. Sudheendrakumar	Studies on bio-ecology of nucleopolyhedrovirus of the teak defoliator and evaluation of formulated products	2005	FRI-U
2.	Sujanapal, P.	Dr. N. Sasidharan	Vascular flora of Parambikulam Wildlife Sanctuary	2006	Calicut University
3.	Geetha, T.	Dr. M. Balagopalan	Impact of teak and eucalypt monoculture on soils in the plains of Kerala, India	2008	CUSAT

Extension activities during October 2009- March 2010

Wood Identification and Testing

Sl. No	Date	Client
by Dr. K. V. Bhat		
1.	7.10.09	Mr. T. C. Devassy, Deputy Range Officer, Ponganamkadu Forest Station, Kurichikkara P.O., Thrissur
by Dr. P. K. Thulasidas		
2.	13.10.09	Mr. C. Mohanakumar, Government Contractor & Civil Consultants, J. J. Cottage, 90 – UPS Lane, Ambalathara, Poonthura P. O., Thiruvananthapuram - 26
3.	20.10.09	M/s. Sree Balaji Timbers119, Meenkarai Road, Zamin Uthukuli P.O., Pollachi – 642 004, Tamil Nadu
4.	21.10.09	The Assistant Engineer, C.P.W.D, Calicut Central Sub – Division No.1 Room No.2/17 & 2/18, Faculty Block, IIM Campus, Kunnamangalam, Kozhikode
5.	23.10.09	Mr. K. Kunhikrishnan, Chief Administrative Officer, IIM Kozhikode Campus P.O., Kozhikode 673 570
6.	9.11.09	The Director, Quilon Social Service Society, Fathima Road, Kollam - 691 013
7.	9.11.09	Smt. Sreekala, C.34/1673 – D, B.T.R. Road, Edappally P.O., Kochi - 682 024
8.	26.11.09	The Asst.Exe.Engineer, TRP Site, Moothakkara, Kollam
9.	30.11.09	The Assistant Engineer, Trivandrum Central Sub Division III, C.P.W.D. CRPF Campus, Trivandrum
10.	24.12.09	Mr. Sajan Thomas, Kurishinkal House, Edakochi, Kochi 682 006, Ernakulam Dt.
11.	30.12.09	M/s. Sree Balaji Timbers, 119 Meenkarai Road, Zamin Uthukuli P.O., Pollachi – 642 004, Tamil Nadu

Monthly Rainfall data (mm) for the last 12 years at Field Research Station, Velupadam*

Months	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
JANUARY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.15	0.00	0.60	0.00	0.00
FEBRUARY	0.00	66.30	34.40	20.70	0.00	114.30	0.00	0.00	0.00	0.00	10.50	0.00
MARCH	0.00	0.00	0.00	0.00	28.00	43.40	9.10	0.00	120.05	0.00	154.95	89.33
APRIL	0.00	105.80	95.30	192.00	33.80	124.00	29.50	174.70	49.00	119.90	71.30	51.50
MAY	169.50	419.10	149.60	215.90	295.10	45.70	546.30	59.85	610.00	176.35	47.00	244.95
JUNE	762.40	516.10	626.80	841.50	478.00	462.90	791.00	727.50	512.25	777.50	585.11	569.60
JULY	785.50	875.80	354.80	567.00	438.60	538.40	4.8.60	918.70	604.10	1273.85	422.95	1013.00
AUGUST	447.90	234.60	636.70	389.60	606.10	464.70	486.20	314.00	499.35	690.00	415.25	539.75
SEPTEMBER	650.40	70.30	231.70	183.63	169.00	143.60	110.40	574.50	457.74	676.30	381.50	400.60
OCTOBER	571.80	690.80	226.70	367.10	636.10	415.00	285.30	209.95	390.40	635.70	382.00	222.90
NOVEMBER	184.80	19.90	32.50	68.10	22.20	49.40	94.27	63.15	124.60	90.10	23.80	112.00
DECEMBER	63.80	0.00	5.80	0.00	0.00	7.60	0.00	15.50	0.00	7.50	9.75	87.22
TOTAL (mm)	3636.10	2998.70	2394.30	2845.53	2706.90	2409.00	2760.67	3077.00	3367.49	4447.80	2504.11	3330.85

C.K. Soman and K.K. Unni

Training Programmes Conducted

September 2009 – March 2010

No.	Date and year	Title	Sponsor
1.	9 Sept. - Oct.2009	KILA Training	KILA
2.	20 October 2009	Vegetative propagation and seedling development of *Saraca asoca*	NMPB
3.	26-31 October 2009	Priority species, resource estimation, plantation development, post harvest technology and socio-economic livelihood potential of bamboos	NBM
4.	14 -15 November 2009	Training for teachers Ideal English Higher Secondary School	IEHSS
5.	16 -20 November 2009	Training course on collection, compilation, validation and dissemination of forestry statistics	MoEF
6.	7- 9 December 2009	Bamboo training for farmers from Thiruchirappilly	NBM
7.	8-9 December 2009	Bamboo training for farmers from Krishnagiri	NBM
8.	26 Nov. - 1 Dec. 2009	Modern trends in teak cultivation and management	Future Forests, Fiji Island
9.	30 Nov.- 5 Dec. 2009	KILA Training	KILA
10.	14-15 January 2010	Two-Day training workshop on effect of weeds on productivity of forest plantations and natural forests and different cost effective methods for their control	MoEF
11.	18-23 January 2010	Training course on priority species, resource estimation, plantation development, post harvest technology and socio-economic livelihood potential of bamboos	NBM
12.	6-9 February 2010	Training on vegetation carbon pool field data collection demonstration	ISRO
13.	30 March 2010	FRLHT Training	CCF project II

TEAKNET

With the support of FAO, the International Teak Network viz., TEAKNET was established in 1995 in order to promote interaction and information sharing among the stakeholders of teak sector. The first secretariat of TEAKNET was located in Myanmar. In 2008, the secretariat was moved to Kerala Forest Research Institute (KFRI), Peechi, India as per the decision of the Steering Committee which met at Hanoi, Vietnam on 21 April, 2008. Since then KFRI has been acting as a host institution for TEAKNET. Dr. K.M. Bhat was serving as Coordinator of TEAKNET after the secretariat was shifted to KFRI. Due to the untimely demise of Dr. Bhat, there was a short period of inactivity. In June 2009, Dr. K. Jayaraman was appointed as TEAKNET Coordinator and the unit has resumed its activities.

TEAKNET office at KFRI

TEAKNET is committed to enhance the capacity of international stakeholders particularly teak growers, forest resource managers, processors, traders, researchers and policy makers in responding effectively to the changing social, economic and environmental needs. The specific objectives of the network are:

- To link the relevant institutions/organizations of international/regional and national significance, working on teak.
- To facilitate the transfer of knowledge and dissemination of information among the stakeholders in all aspects of teak cultivation, marketing and utilization.
- To facilitate the exchange of reproductive material to improve plantation productivity of teak.
- To promote studies on critical areas of common interest to participating institutions/countries.

FAREWELL

Dr. M. Balasundaran

Dr. M. Balasundaran, Scientist F and Programme Coordinator, Forest Genetics and Biotechnology Division superannuated from the Institute on 31st March, 2010, after serving the institute for 31 years. His area of specialization was biotechnology and molecular biology as well as soil microbiology and plant pathology. He initiated and organised the new biotechnology laboratory and a state of the art molecular biology laboratory at KFRI. During the early years of service, he concentrated on diagnosis/control of non-fungal diseases such as sandal spike and developed immunological and molecular techniques for early detection of the disease. He took leading role in identifying eucalypts and acacia provenances suitable for Kerala and in developing disease resistant and fast growing clones of these species which were later planted by Forest Department and Hindustan Newsprint Ltd. The technology of aerobic composting using forest weeds for mass production of compost was standardized and the technology successfully transferred to the central nurseries of the Forest Department. His DBT sponsored research projects on genetic diversity of sandal and teak growing in the Western Ghats, DNA barcoding of Dalbergia species contributed information to undertake further conservation strategies. During his tenure in KFRI, he successfully completed about 40 research projects funded by DST, DBT, UNESCO, European Union, FAO, Forest Dept., etc. As part of three decades of research career, he co-edited five books; published 25 research reports as PI; and published 40 research papers in national and international journals and 42 papers in books and seminar proceedings. He produced six Ph. D's as supervisor and three as co-supervisor as well as 15 Masters Dissertation work.

Smt. K.N. Rajamma

Smt. K. N. Rajamma joined the KFRI on 2nd July 1979 as Office Assistant and retired from the service on 31st March 2010 as Senior Section Officer.

Shri. C.K. Vincent

Shri. C.K. Vincent joined the KFRI on 6th January 1981 as Bus Cleaner and retired from the service on 28th February 2010 as Helper

Shri. A. C. Antony

Shri. A.C. Antony joined the KFRI on 10th November 1982 as Watchman and retired from the service on 31st January 2010 as Clerical Assistant.

Smt. K.V. Bharati

Smt. K.V. Bharati joined the KFRI on 3rd November 1986 as garden worker and retired from the service on 31st October 2009 as Helper.

TEAKNET currently functions as per the directions of the TEAKNET Steering Committee, consisting of a Chairman, a Member Secretary and six members. Mr. Lars Graudal, Head of Division, Forest Genetic Resources & the Hoersholm Arboretum, Forest & Land-scape Denmark is currently the Chairman of the Steering Committee. The secretariat is managed by the TEAKNET Coordinator at KFRI, Dr. K. Jayaraman, who is also the Member Secretary of the Steering Committee responsible for implementing the decisions of the Steering Committee.

Of late, the TEAKNET Secretariat was fully furnished. The major accomplishment during the period has been that an international workshop was conducted on 'Production and Marketing of Teakwood: Future Scenarios', during 23-25 November 2009 at the Institute. A membership drive was initiated to enroll new members to TEAKNET and renew the membership of old members.

TEAKNET Bulletin was released in October 2009 and January 2010. Several modifications were also made in the TEAKNET website (www.teaknet.org).

Species of Seedlings Distributed From KFRI

During 2009-2010

Sl. No.	Scientific name	Common name
1	*Adenanthera pavonina*	Manchadi
2	*Aegle marmelos*	Koovalam
3	*Ailanthus triphysa*	Matti
4	*Albizia odoratissima*	Kunnivaka
5	*Alpinia galanga*	Chittaratha
6	*Annona reticulata*	Aatha
7	*Anthocephalus cadamba*	Attuthekke
8	*Antiaris toxicari*	Maravuri
9	*Araca traintra*	Palm
10	*Areca concinna*	Cylon areca
11	*Artocarpus hirsutus*	Ayini
12	*Azadirachta indica*	Ariyavepu
13	*Bacopa monnieri*	Brahmi
14	*Bambusa bambos*	Mula
15	*Bauhinia malabarica*	Arampuli
16	*Bauhinia racemosa*	Mandaram
17	*Borassus flabelifer*	Karimpana
18	*Bridelia retusa*	Mullankaini
19	*Caesalpinia coriaria*	Divi divi
20	*Caesalpinia sappan*	Chappangam
21	*Calamus thwaitesii*	Thadiyan chooral
22	*Calamus travancoricus*	Ari chooral
23	*Cassia fistula*	Kanikkonna
24	*Cassia siamea*	Manjakonna
25	*Castenospermum australe*	Australian chestnut
26	*Chrysophyllum cainito*	Star apple
27	*Cinnamomum verum*	Karuva patta
28	*Cleistanthus collinus*	Oduku
29	*Crescentia cujete*	Beggers bowl
30	*Dalbergia latifolia*	Veetti
31	*Datura metel*	Neelaummam
32	*Dilonix regia*	Gul mohur
33	*Dysoxylum malabaricum*	Vellakil
34	*Eryngium foetidum*	African malli
35	*Eucalyptus globulus*	Eucali
36	*Ficus racemosa*	Athi
37	*Ficus religiosa*	Arayal
38	*Garcinia gumi-gutta*	Kudampuli
39	*Grewia tiliifolia*	Chadachi
40	*Holoptelia integrifolia*	Aval
41	*Hopea parviflora*	Thambakam
42	*Hydnocarpus pentandra*	Marotti
43	*Indigofera tinctoria*	Neelamari
44	*Knema atenuata*	Chorapathri
45	*Lagerstomeia microcarpa*	Ventheak
46	*Lagerstomeia speciosa*	Manimaruthu
47	*Licuala grandis*	Garden palm
48	*Mangifera indica*	Mavu
49	*Melia dubia*	Malaveppu
50	*Mesua thwaitesii*	Naagu
51	*Mimusops elengi*	Elengi
52	*Ochlandra travancorica*	Eetta
53	*Oroxylum indicum*	Palakapayyani
54	*Persea macrantha*	Kulamavu
55	*Polyalthia coffeoides*	Nedunar
56	*Polyalthia longifolia*	Arana maram
57	*Pongamia pinnata*	Ungu
58	*Pterocarpus marsupium*	Venga
59	*Samadera indica*	Karinjota
60	*Santalum album*	Chandanam
61	*Sapindus trifoliate*	Saopnut
62	*Saraca asoca*	Ashokam
63	*Strychnos nux-vomica*	Kanjiram
64	*Swietenia macrophylla*	Mahogany
65	*Syzygium aqueum*	Chamba
66	*Syzygium cumini*	Njaval
67	*Tectona grandis*	Teak
68	*Terminalia arjuna*	Neermaruthu
69	*Terminalia bellirica*	Thani
70	*Terminalia catappa*	Bedham
71	*Terminalia crenulata*	Karimaruthu
72	*Vateria indica*	Vellappain
73	*Vepris bilocularis*	Moothassary
74	*Wrightia tinctoria*	Dandapala
75	*Xylia xylocarpa*	Irul

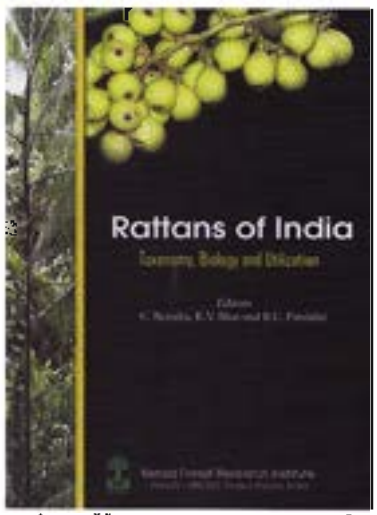
Mr. P.K. Chandrasekhara Pillai
Silviculture Department
SFM Division

Departmental museum commissioned in the Wildlife Department

Mammals 67, Reptiles 113, Amphibians 80, Fishes 454, Invertebrates 16. In addition to the above 140 wet specimens from *Myristica* swamps and 116 wet specimens from the Mangroves were also displayed.

New Books Released

Rattans of India



Our forests abound in many useful plant species that provide for human comfort and livelihood. Rattans, the climbing palms of tropical forests, can be regarded as one such group of plants which have been in use for many centuries for diverse wickerwork and handicrafts. The resource has been a means of income for thousands of forest dwellers, craftsmen and traders. However, rattan manufacture and export picked up momentum only during the latter half of 20th century due to the growing popularity of its products in Asian and European markets. This has led to indiscriminate exploitation and depletion of rattan resources from their natural habitats in South and Southeast Asian countries and attempts to replenish the resources have been only nominal.

Rattans are climbing palms which belong to the subfamily Calamoideae under the family Arecaceae (Palmae). The mature stems yield the canes that are utilized for a variety of furniture, basketry and handicraft items. Being a lignocellulosic material like wood, rattans also have certain inherent limitations with respect to their durability, susceptibility to fungal discolouration and weathering. However, in recent years, processing technology for rattans has considerably improved and techniques for treatment, processing and finishing have been developed which have enabled substantial value addition of rattan products.

Due to the depletion of rattan resources and the shortage of raw material experienced, the rattan industry in South and Southeast Asian countries is already facing a setback. Uncertainty in availability of raw material has been the main impediment for the industry. To overcome the shortage, some countries have already taken to establishment of rattan plantations which is a welcome sign for the development of rattan sector. Besides scarcity of raw material, lack of a well developed trading network has been a handicap for the rattan sector in many Southeast Asian countries.

It is time to realise that attempts are required to rise to the occasion and give thought to conserving the rattan resources which has been one of the valuable non-timber forest resource in the region. In this regard, it is necessary to create awareness of the importance of resource among the forestry personnel, scientific community, NGO's, industrialists, traders and other individuals, policy-makers and governments. The present book which is a team effort by Dr. C. Renuka and her group from KFRI, is an attempt in this line which will go a long way in achieving the objective.

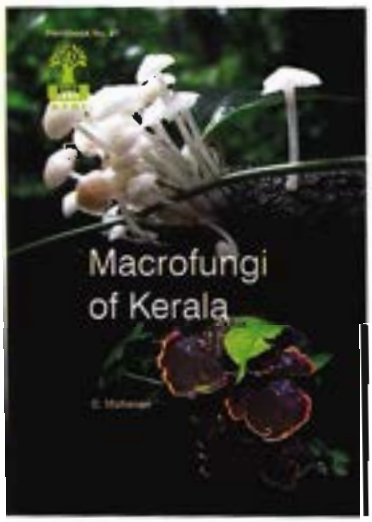
Price: Rs. INR 1500.00 US$ 150

Rust Fungi of Kerala

Information on rust fungi affecting the vegetation in various forest ecosystems in Kerala is meager. Most of the available information on rust fungi in this region was generated during 1940s and 1950s by the pioneering researchers like Prof. T.S. Ramakrishnan which forms the knowledge base of this important group of obligatory fungi. Representative forest areas in the State were systematically surveyed and quite a large number of rust fungi associated with host plants in different forest ecosystems viz., evergreen, semievergreen, shola forests, moist-deciduous and deciduous forests, forest nurseries and plantations were encountered. A total of 95 species of rust fungi belonging to 25 genera associated with 117 host species belonging to 80 host genera under 43 host families were collected and studied. Of these, 15 are hitherto undescribed taxa. The recent taxonomic concept of rust fungi has been followed and taxa have been rearranged and described. This volume will be useful to students, teachers and researchers in plant pathology/ mycology and fungal biodiversity.

Price: Rs. INR 500.00 US$ 50

Macrofungi of Kerala



This Handbook is intended to provide a systematic account of the macrofungi in different forest ecosystems of the Kerala part of the Western Ghats. The Kerala State represents an epitome of the Western Ghats in many respects and the diverse types of forest ecosystems support unique assemblage of biological communities including macrofungi. High rainfall, immense litter load on forest floor together with tropical humid climate provide a conducive environment for the growth and development of macrofungi on different substrata. However, information on macrofungi of the State is very meagre and limited to certain groups of Agaricales. Representative forest areas in different forest ecosystems were systematically surveyed and more than 4000 macrofungal specimens were collected and processed. Altogether 550 macrofungal species belonging to 166 genera under 51 families were identified and described. Of these, a large number of genera and species are reported for the first time from India; more than 360 species are new records from the State and 15 new taxa are described. The recent taxonomic concept based on the emerging information on molecular phylogenetic data has been followed and taxa have been rearranged and described. Information generated through research projects entitled "Biodiversity of Terricolous and Lignicolous Macrofungi of the Kerala part of the Western Ghats" sponsored by Ministry of Environment and Forests, Government of India and "Macrofungi of Kerala: Biodiversity and Biosystematics" sponsored through KFRI Plan Fund, granted to the author has been used for the preparation of this manual.

UPCOMING EVENTS

24 June 2011

International Renewable Energy & Environment Conference 2011, Kuala Lumpur, Malaysia.

This conference is the leading forum that will bring together renowned researchers, engineers and scientists in this domain of interest from all around the world. The deadline for abstracts/ proposals is 15 February 2011. For details contact: Inam Bhatti in the web address http://warponline.org/conferences.htm

26 June-2 July 2011

IUFRO Tree Biotechnology Conference 2011 "From genomes to integration and delivery", Arraial d'Ajuda, Bahia, Brazil. Registration and abstract submission are now open. For further information, please contact: Conference & Scientific information: organizing.treebiotech2011@gmail.com, Registration : treebiotech2011@creacteve.com.br.

29 July- 4 Aug 2011

International Biodiversity Conference, Banos, Ecuador. The deadline for abstracts/proposals is 1 June 2011. Enquiries: Dr. Barry W. Barker arkerb@wildspotsfoundation.org, Website:http://www.wsfbioconference.org

23-30 July 2011

XVIII International Botanical Congress, Melbourne, Australia, The XVIII IBC will be held under the auspices of the International Union of Biological Sciences (IUBS), through the International Association of Botanical and Mycological Societies (IABMS) of the IUBS. Registration is now open. Registration deadline: 1 March 2011. For details : IBC 2011 Congress Secretariat registration@ibc2011.com

16 - 21 October 2011

3rd meeting of IUFRO Working Unit 7.03.12 "*Alien invasive species and international trade*", University of Tokyo, Tokyo, Japan. For details contact fukuda@k.u-tokyo.ac.jp, Website: http://www.a.u-tokyo.ac.jp/yayoi/info.html

19-22 October 2011

Rediscovering wood: The key to a sustainable future. International Conference and Exhibition on the art and joy of wood, 19-22 October 2011, Bangalore, India. For detailed programme registration, visit www.artjoywood .org

31 October - 2 November 2011

5th International Woodfibre Resources and Trade Conference: "*Woodchips and biomass for global markets*", Grand Copthorne Waterfront Hotel, Singapore. Organised by DANA Limited, Pike & Co and Wood Resources International. For more information contact: E-mail: enqury@prcc.com.au

31 October- 2 November 2011

Planted Teak Forests – A Globally Emerging Forest Resource" Guanacaste, Costa Rica. CATIE in cooperation with FAO and TEAKNET of KFRI is organizing the conference and will focus on planted teak forests as a globally emerging forest resource online registration: starting from 1st June 2011. For further information : Luis Dalpra Ldalpra@catie.ac.cr, Walter Kollert, Walter.Kollert@fao.org; http://www.teaknet.org

7 - 11 November 2011

24th Session Asia- Pacific Forestry Commission, Beijing, China. For details contact: FAO Regional Office for Asia- Pacific (RAP), Dr. Patric Dust, patrick.durst@fao.org. Website: http://www.fao.org/forestry/33587/en/

15 - 18 November 2011

Research Priorities in Tropical Silviculture: Towards New Paradigms? IUFRO International conference, Montpellier, France. Under the framework of the International Year of Forests, CIRAD, CIFOR and ECOFOR are organizing this International Conference under the auspices of IUFRO. Registration Fee: •150; Deadline for Registration: March 30th 2011; For details contact: Plinio Sist, sist@cirad.fr

8-13 July 2012

2012 IUFRO All Division 5 Conference, Estoril, Lisbon, Portugal. This conference, organized by IUFRO Division 5 (Forest Products), in conjunction with the Technical University of Lisbon, will provide a mechanism for the exchange of knowledge and experience in forest products research at both the national and international level. Participants will discuss recent research progress, exchange information, and collaborate on research related to the conference theme of "Forest Products ". Conference Chair: Pekka Saranpää (Finland). For details contact: iufro2012@the.pt

OBITUARY

Dr. P. M. Ganapathy

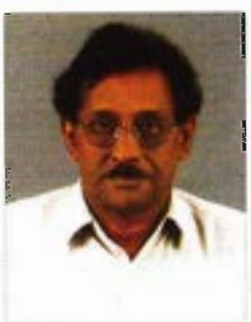
The fraternity of Kerala Forest Research Institute records with profound sorrow the sad demise of our beloved former Director, Dr. P.M. Ganapathy, on 20th March, 2010. Dr. Ganapathy served as Director from July 1976 to June 1982 and was guiding force in KFRI's rapid development in its formative years. We owe our present standing in forestry research to his vision and farsightedness which was instrumental in the development of the organizational structure and establishment of campus at Peechi and Nilambur, during his tenure. As Director he initiated many important research programmes which brought international and national attention.

Always humble and unassuming gentleman, Dr. Ganapathy endeared himself to all sections of the KFRI staff with whom he interacted in a jovial manner. We also benefited from his able leadership and the cordial relationship he had with the Kerala Forest Department and other stakeholders.

Dr. Ganapathy left the Institute in June 1982 to take up the reins of the Indian Plywood Industries Research Institute, Bangalore. He was a member of the Indian Forest Service (UT Cadre) and was internationally renowned in the field of Forestry and Wood Science & Technology. He had completed several assignments for FAO, Rome and ITTO, Japan.

Dr. Ganapathy will be greatly missed by his relatives, colleagues and friends. He is survived by his wife, two daughters and a son.

Shri. P. Padmanabhan

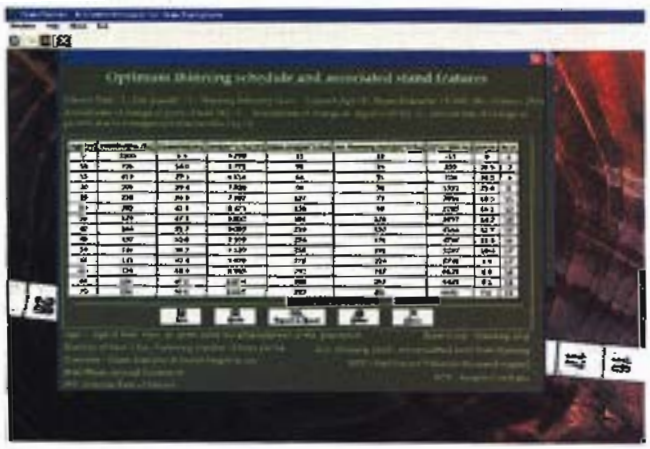


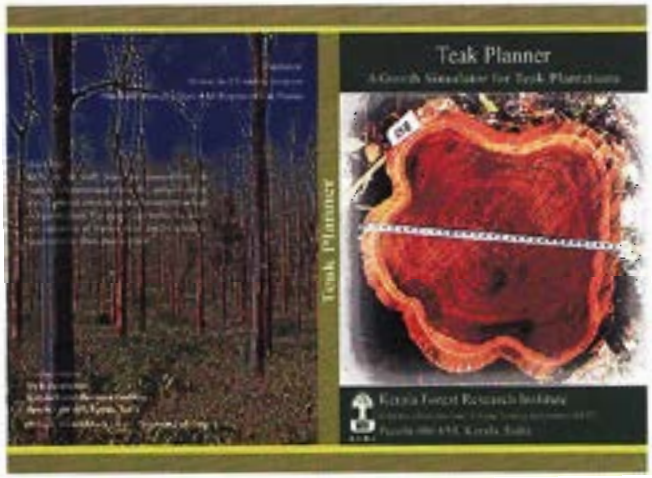
Kerala Forest Research Institute records with profound sorrow the sad demise of Shri. P. Padmanabhan, Scientist C, Department of Wildlife Biology on 26th December 2009. His contributions were in the field of Honey bees and the biodiversity of sacred groves. He is survived by his wife, two sons and a daughter.

Teak Planner

Teak planner functionally is a growth simulator for teak plantations. Its scope of application is the range of growing conditions that is available in Kerala. This programme can be used to identify the optimum thinning schedule and rotation age for even-aged teak stands under a range of site quality and management levels. The optimum thinning schedule is that which maximizes the net present value of cash flows, out of a variety of possible thinning schedules in a plantation. It also enables the user to make an investment plan by providing information on net present value (NPV), internal rate of return (IRR), benefit cost ratio (BCR) and payback period (PBP) for a range of management options. The software is also an effective tool for financial valuation of the growing stock for commercial purposes.

The input data at the first level consists of interest rate that is to be used for discounting purposes, site quality class and weeding intensity. The system can then generate mean diameter at 5th year which is the starting point of simulation assuming an initial planting intensity of 2500 trees per ha. In case, the user wants to optimize purchase cost of a plantation or maximize the returns from a purchased plantation, the corresponding input values can be entered and can proceed further. With the input data that is supplied, the programme identifies the optimum thinning schedule for the stand under consideration and displays the number of trees to be retained at 5 yearly intervals with information on several associated stand features like mean diameter of trees, volume of standing crop, accumulated yield from thinning and mean annual increment in total volume (MAI).





It also displays the NPV, IRR and BCR. The optimum rotation age can then be taken as the age at which NPV reaches its maximum. This programme thus fills in the need for a self-contained user-friendly software for finding out optimum thinning schedule and associated stand features for any given stand.

One additional feature is that the user is supplied with the option of making the financial projections either under 'constant' levels of teak timber price, input cost and management interventions or under 'varying' rates. This option provides the user a whole scenario of possible projections and every time the simulator identifies the best thinning schedule to be followed to maximize the returns.

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

Kerala Forest Research Institute
Peechi - 680 653, Kerala, India

Contact person :
Dr. K. Jayaraman
KFRI, Peechi 680 653
Thrissur, Kerala, India

Training Programmes

KFRI Main Campus, Peechi

KFRI offers specialized training courses in tropical forestry. It will also be possible to provide tailor-made training depending upon specific needs of the stakeholders. The medium of instruction is English. KFRI is an approved training centre of the Ministry of Environment, Government of India for training the officers of Indian Forest Service. Also, various state forest departments have sponsored candidates for several training courses in the past. Overseas participants from Myanmar, Sri Lanka, China, Nepal, Ethiopia and Uganda have attended different training courses.

Faculty

The Institute has 56 well – qualified and trained scientists with national and international exposure. Apart from the scientists of the Institute, renowned experts from other reputed institutions/universities are also engaged as resource persons/guest faculty.

Facilities

Training courses are conducted in the Training Extension Centre with modern lecture hall, seminar hall, meeting room and computer hall with internet facility. The Institute has well-equipped laboratories, library, herbarium, insect museum, wildlife museum, nursery and live collection of bamboos, rattans, palms, medicinal plants and tropical tree species. Kerala Forest Seed center, Teak Museum and Bioresourse Nature Park are other attractions for the visitors. Accommodation is provided in the Trainees Hostel having modern facilities.

Bioresourse Nature Park, Nilambur

Teak Museum, Nilambur

For further details please contact:
Programme Co-ordinator
Extension and Training Division,
Kerala Forest Research Institute,
Peechi-680 653 Thrissur, Kerala, INDIA

Ph: +91 487 2690100
+91 487 2690330
Fax: +91 487 2699249

Email: training@kfri.org

Priced Publications

		Price	
	Bamboo	Rs.	US$
1	An Annotated Bamboo Bibliography. KFRI CD 4	200.00	20.00
2	Bamboo: A Crop (CD-ROM)	250.00	25.00
3	Bamboos of India	2250.00	100.00
4	Edible Bamboo Shoot Recipes	30.00	10.00
5	Edible Bamboo Shoots: Collection and Processing (Malayalam)	10.00	10.00
6	Information Resources for Bamboo and Cane Development in Kerala	75.00	10.00
7	Policy and Legal Issues in Cultivation and Utilization of Bamboo, Rattan and Forest Trees in Private and Community Lands	400.00	40.00
	Rattan (Cane), Palms		
8	A Manual on the Rattans of Andaman and Nicobar Islands	175.00	20.00
9	Annotated Bibliography on Rattans of the World	350.00	35.00
10	Commercial Rattans of Kerala	50.00	10.00
11	Field Identification Key for Rattans of Kerala	125.00	15.00
12	Field Identification Key for Indian Palms. KFRI CD 8	150.00	15.00
13	Nursery and Silvicultural Techniques for Rattans	50.00	10.00
14	Oil Curing Technology for Value-added Rattan (Cane) Products	50.00	10.00
15	Palms of Kerala	200.00	20.00
16	Protection of Rattan against Fungal Staining and Biodeterioration	50.00	10.00
17	Rattan Management and Utilisation	300.00	30.00
18	Rattans of the Western Ghats: A Taxonomic Manual	100.00	10.00
19	Structure and Properties of South Indian Rattans	75.00	10.00
	Teak		
20	Bibliography on Teak. KFRI CD 2	500.00	50.00
21	Processing and Marketing of Teakwood Products of Planted Forests: Proceedings	700.00	50.00
22	Quality timber products of teak from sustainable forest management	1000.00	80.00
23	Teak (Seminar Proceedings)	200.00	20.00
24	Teak Planner. KFRI CD 7	1000.00	80.00
25	Teak Bibliography (Print)	700.00	70.00
26	The Teak Defoliator (CD-ROM)	250.00	25.00
	Plantation Management		
27	Litter Dynamics, Microbial Associations and Soil Studies in *Acacia auriculifomis* Plantations in Kerala	75.00	10.00
28	Plantation Technology: *Calophyllum polyanthum* (Kattu punna)	50.00	10.00
29	Plantation Technology: *Dysoxylum malabaricum* (Vella akil)	50.00	10.00
30	Plantation Technology: *Garcinia gummi-gutta* (Kodampuli)	50.00	10.00
31	Plantation Technology: *Gmelina arborea* (Kumbil)	50.00	10.00
32	Plantation Technology: *Grewia tiliaefolia* (Chadachi)	50.00	10.00
33	Plantation Technology: *Haldina cordifolia* (Maniakaiambu)	50.00	10.00
34	Plantation Technology: *Laerstroemia microcarpa* (Venthekku)	50.00	10.00
35	Plantation Technology: *Melia dubia* (Malaveppu)	50.00	10.00
36	Plantation Technology: *Vateria indica* (Vellaoavin)	50.00	10.00
	Natural Forests		
37	Biodiversity Documentation for Kerala. Part 1: Algae	150.00	15.00
38	Biodiversity Documentation for Kerala. Part 2: Fungi	300.00	30.00
39	Biodiversity Documentation for Kerala. Part 3: Lichens	150.00	15.00
40	Biodiversity Documentation for Kerala. Part 4: Bryophytes	150.00	15.00
41	Biodiversity Documentation for Kerala. Part 5: Pteridrophytes	200.00	20.00
42	Biodiversity Documentation for Kerala. Part 6: Flowering Plants	600 .00	60.00

	Natural Forests	Rs.	US$
43	Biodiversity Documentation for Kerala. Part 7: Insects	300 .00	30.00
44	Biodiversity Documentation for Kerala. Part 8: Freshwater Fishes	800 .00	70.00
45	Biodiversity Documentation for Kerala. Part 9: Amphibians	150.00	15.00
46	Biodiversity Documentation for Kerala. Part 10: Reptiles	150.00	15.00
47	Biodiversity Documentation for Kerala. Part II: Birds	150.00	15.00
48	Biodiversity Documentation for Kerala. Part 12: Mammals	100.00	15.00
49	Ecodevelopment of Western Ghats	200 .00	20.00
50	Field Guide to Animal Signs	100.00	10.00
51	Flowering Plants of Kerala: A Checklist. KFRI CD 6	300.00	30.00
52	Forest Trees of Kerala	75.00	10.00
53	Handbook on Statistical Analysis in Forestry Research	500.00	50.00
54	History of Forest Management in Kerala	150.00	15.00
55	Impact of Diseases and Insect Pests in Tropical Forests	500.00	50.00
56	KFRI Research Reports 1-200. KFRI CD 1	500.00	50.00
57	Manual of Seeds of Forest Trees Bamboos and Rattans	750.00	75.00
58	Shola Forests of Kerala: Environment and Biodiversity	800.00	70.00
59	State Biodiversity Strategy and Action Plan (SBSAP) for Kerala	300.00	30.00
60	Three Decades of Research in KFRI	200.00	20.00
61	TreeID: Tree Identification Key for Kerala. KFRI CD 5	300.00	30.00
62	Tropical Forest Ecosystem Conservation and Development in South and South-East Asia	200.00	20.00
63	Tropical Forestry Research: Challenges in the New Millennium	500.00	50.00
	Wood and Non-Wood Forest Products		
64	Handbook of Lesser Known Timbers (with CD)	500.00	50.00
65	Manual of the Non-Wood Forest Produce Plants of Kerala.	450.00	45.00
66	Upgradation of Rubber Wood	75.00	10.00
	Weeds		
67	Alien Weeds in Moist Tropical Zones: Banes and Benefits	400.00	40.00
68	Field Trials for Controlling *Mikania* Infestation in Forest Plantations and Natural Forests in Kerala	150.00	15.00
69	Integrated Management of the Alien Invasive Weed *Mikania micrantha* in the Western Ghats	150.00	15.00
	Socio-Economics		
70	Basic Readings in Forest Economics	150.00	15.00
71	Socio-economic Research in Forestry	300.00	30.00
	POSTER		
72	Amphibians of Kerala Part. I. Frogs (Counter sale only)	30.00	-

- Postage in India and surface mail charge for abroad are free
- Book Sellers will be given 25% discount for orders of minimum 10 copies of a single title or for Rs. 3,500/US $ 350 and above
- Educational Institutions will be given 10% discount
- Advance payment may be made by M.O./D.D. in favour of the Registrar, KFRI on any Bank in Thrissur, Kerala, India

Phone: 91 487 2690 100
Fax: 91-487-2690 111, 2690 121
E-mail: <kfri@kfri.org>
Website: www.kfri.org

- Send your orders to:
  The Librarian
  KFRI, Peechi, Thrissur, Kerala, India 680 653
  Phone: 0487 2690 210 E-mail<library@kfri.org>

Evergreen

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

ISSN 0254-6426

Evergreen, the newsletter of the Kerala Research Institute, brought out in March and September, is intended for free restricted distribution to individuals and institutions connected with forestry. The views expressed in the newsletter are those of authors and do not necessarily reflect the views of the Institute. The readers are welcome to communicate their comments and opinions. The Newsletter Committee reserves the right to choose among the contributions and make necessary editorial modifications.

Address all communications to:

The Editor, Evergreen
Kerala Forest Research Institute
Peechi-680 653
Thrissur, Kerala, India
Phone: +91 487 2690100
E-mail: kfri@kfri.org

Printed at Lumiere Printing Works