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Contents

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

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With this issue evergreen comes to you in a new format. The new Editorial Committee which took over reins with this issue, felt that a change was due. We hope evergreen with the new look is still appealing enough and will be recognisable on your library shelf. Since there has been a big delay in publishing the newsletter (Nos. 32 and 33, due in March and September 1994 respectively,) we have brought out this consolidated issue. As to the contents we hope to make changes for the better as we go along. We would like to provide as much useful information as possible and for that we would like to know the opinion of the readers. So, kindly write and let us know.

Editor

A Glimpse on the Status of Teak Plantations in Kerala

Abstract

The age structure of teak plantations in Kerala was found uneven with around 75 per cent of the area below 35 years of age. A survey on the status of the teak plantations in the State revealed that nearly 20 per cent of the plantations are fully stocked, 40 per cent understocked and an equal extent overstocked. However considering the presence of miscellaneous species growing in teak plantations which were more in older plantations, the degree of understocking reduced to 20 per cent with a corresponding increase in the per cent of overstocked plantations. The predominant site quality class was site quality III (49%) followed by site quality II (37%). The fraction of plots belonging to site quality I and IV were 10 and 4 per cent respectively. There was a marked absence of higher site quality levels in older plantations. On the other hand, young plantations mostly belonged to higher site quality levels. The mean expected 'total yield' at 60 years which is the sum of final yield and accumulated yield of thinning worked out to 336.496 m^3 ha^{-1} for the State. This value is applicable for plantations maintained under full stocking for a full rotation period under the assumption of constancy of site productivity over time. An estimate of the currently realizable 'final yield' at 60 years under full stocking based on the site quality distribution of area with stands of age 50 years and above came to 136.588 m^3 ha^{-1}. The information on the present age structure, stocking and productivity levels will be useful in projecting the future out-turn from these plantations.

Introduction

Kerala has a long history of raising teak plantations in large scale. Teak continues to occupy a prominent place among the forest plantations covering nearly 50 per cent of the area under forest plantations in the State. Compared to many of the plantation crops in the agricultural sector, teak plantations receive the least intensive management. However, the species has come up well in pockets like Nilambur, Wynad and Thenmala (Jayaraman and Rugmini, 1993). Teak yields high quality timber and demand for the same is expected to remain high in the future. With the ban on clearfelling of natural forests, any further increase in the area under teak in the public sector is

unlikely. For this reason, productivity of the existing plantations is of utmost importance. An examination of the overall status of teak plantations in Kerala is attempted here utilizing the data accrued out of the project: Structural dynamics of teak stands in Kerala (KFRI 147/92)

Age structure

The list of plantations raised by the Forest Department as by the year 1987 was obtained from the office of the Chief Conservator of Forests (Development). The details of plantations raised after 1987 were gathered from the Range Offices of the Department. The age structure of pure teak plantations in the State as by 1992 was generated from the above data base.

The teak plantations were found to occupy around 78,225 ha. in the State. A substantial portion (17 per cent) of the total area under teak belonged to the Wildlife Wing. The plantations belonging to Wildlife Wing are not supposed to be available for the normal commercial operations on the crop. With respect to the area belonging to the Territorial Wing, nearly 75 per cent of the area was below 35 years of age. This has implications on the future out-turn from these plantations in the sense that a major portion of the plantations will be available for final felling only after 20 years from now. Since the distribution of area in different age classes is uneven, it is difficult to follow the sustained yield principle readily unless a policy towards that is implemented.

Stocking

To obtain an idea of the stocking and site quality levels of the pure teak plantations in Kerala, a low intensity reconnaissance survey was conducted. The plantations were stratified by Territorial Circles and age groups. The Wildlife Circle was avoided since the area under this Circle comes from different parts of the State. Moreover the plantations belonging to this unit do not come under the regular management operations as in other Circles. The age groups were 0-4, 5-9, 10-14 and so on up to 59 years. Plantations older than 59 years were put in the last group. Three plantations were selected at random from each of the strata except two of the strata, which contained only one plantation each. Plots of size 50 m x 50 m were laid out in the plantations selected and measurements on girth at breast-height (gbh) of trees were taken. Observations were restricted to trees having a minimum gbh. of 10 cm. Basal area $ha.^{-1}$, number of trees $ha.^{-1}$ and composition of the stand as of teak and miscellaneous species were worked out. The stocking status was determined based on basal area $ha.^{-1}$ and number of trees $ha.^{-1}$ as expected by the yield table for teak (Anonymous,1970). This was done based on the teak trees alone and also by combining other trees in the plots. Frequency distribution of the stocking ratio was obtained and its variation over the age groups was examined. Plantations having a stocking ratio between 0.9 and 1.1 were taken as fully stocked.

Considering teak alone, based on basal area, nearly 19 per cent of the plantations were fully stocked, 36 per cent understocked and 45 per cent were overstocked. The corresponding figures based on number were 17, 42 and 41, confirming that the overstocking has resulted mostly due to the trees being not removed in time as per the standards set by the yield table. However, overstocking at least in some places was found to be due to the presence of coppice shoots not removed in time. When the presence of miscellaneous species was taken into account, the degree of understocking lessened as can be expected. With respect to the basal area of teak alone, the stocking pattern did not show significant differences over age groups. However, with respect to number of trees, understocking was more common in older age groups. Considering the growth of miscellaneous species, overstocking was more prevalent in older plantations although by number the miscellaneous species just compensated for the understocking of teak in older plantations.

The composition of teak stands based on basal area and number of trees worked out indicated that there is a gradual though not systematic increase in the proportion of stand basal area occupied by miscellaneous species when the plantations get older. The fact that this is more due to the ingrowth rather than survivor growth was indicated by the increase in the proportions of miscellaneous species by number of trees over years. However, considering the range of the proportion of teak by number of trees, there were plantations in the older age groups wherein the proportion of teak was as low as 0.10. This happens mostly in the case of plantations situated away from human settlements. Undergrowth in plantation in accessible areas is mostly disturbed by human interference.

Productivity levels

Site quality level of each plot included in the above survey was ascertained by referring to the yield table for teak (Anonymous, 1970). The height-diameter relation for the purpose was obtained from Chaturvedi (1973). Cross tabulation of the data as per age and site quality classes was done to know the status of teak plantations by these categories. Chi-square test of independence of two factors was done to find out if the site quality levels were dependent on the age-groups or regions (Circles). The expected yield at 60 years based on the observed site quality

distribution was worked out for each Circle by taking yield figures given against each site quality class in the yield table for teak (Anonymous,1970). The 'total yield' at 60 years which is the sum of 'final yield' and 'accumulated yield of thinning' was taken for the purpose. The overall site quality distribution for plantations of age greater than or equal to 5 years was also worked out and tested for normality.

The proportion of number of plots in different site quality classes tabulated by the age groups considered is given in Table 1. There is a predominance of III and II site quality classes compared to other quality classes. The Chi-square test indicated significance at P = 0.05 indicating the dependence of site quality levels on age groups. There is a marked absence of higher site quality levels in older plantations. This could be due to the probable site degradation happening in teak plantations over time. On the other hand, young plantations mostly belonged to higher site quality levels.

The mean site index worked out to approximately 25 m. This happens to nearly coincide with the midpoint of the range of site indices considered in the yield table for teak (Anonymous, 1970). It is a soothing fact that though the above yield table pertains to the national level, the range of site quality levels of the yield table is more or less centrally placed with respect to the performance of teak in Kerala. Moreover the overall site quality distribution for the plantations included in the survey was found to fit well with the normal distribution. This means that most of the plantations in the population are expected to lie in II and III site quality classes and extreme cases of I and IV are likely to be rare. This pertains to the overall site quality distribution for Kerala and does not preclude regional variation in the pattern.

Table 1. Proportion of number of plots in different site quality classes by age groups

Age group (years)	Site quality class I	II	III	IV	Total
< 10	0.92	0.08	0.00	0.00	1.00
10 - 19	0.13	0.87	0.00	0.00	1.00
20 - 29	0.03	0.53	0.44	0.00	1.00
30 - 39	0.00	0.17	0.83	0.00	1.00
40 - 49	0.00	0.17	0.73	0.10	1.00
> 50	0.00	0.23	0.63	0.14	1.00
Overall	0.10	0.37	0.49	0.04	1.00

The Chi-square test of independence of factors showed significant differences in the site quality distribution over Circles. Olavakkod Circle had a slight edge over other Circles by having more area under site quality II when compared to others. Northern, Central and High Range Circles showed a more or less similar pattern. Southern Circle had a more balanced and well distributed pattern. The effect of these differences were reflected in the corresponding expected mean yield. The Olavakkod Circle had the maximum (374.581 m^3 $ha.^{-1}$) followed by the Southern Circle (335.739 m^3 ha^{-1}). The State level figure was 336.496 m^3 $ha.^{-1}$ for 'total yield' at 60 years which is the sum of 'final yield' and 'accumulated yield of thinning'. These values for the mean expected yields are to be interpreted with caution. The values are based on the site quality distribution of the entire set of plantations including both young and old, currently existing. Naturally, this value will be applicable for plantations under full stocking for a full rotation period in the future, under the assumption of constancy of site productivity over time.

A more realistic estimate of the current yield levels that can be realized will be that based on the site quality distribution of the area having stands around rotation age. The expected final yield at 60 years under full stocking based on the site quality distribution of area, with stands of age 50 years and above was 136.588 m^3 $ha.^{-1}$. However, the total yield cannot be worked out this way as the thinning yield comes from stands below 40 years.

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Applications of Statistical Designs in Forestry Research

Abstract

Forestry research employs scientific method based on the general inductive-deductive approach. Statistical methods are employed in the process for objective verification of hypotheses. Experiments conducted for the purpose are to be designed such that the conclusions are not only objective but are also amenable to generalizations.

The experimental designs which are of practical importance in forestry are reviewed with a reference to the context under which each class of designs becomes useful. The designs range from completely randomized design to the complex confounded fractional factorial designs. Some of the practical considerations involved in the use of these designs like field layout, choice of designs, missing value estimation, data transformation etc. are also mentioned in the context of laboratory, nursery and field experiments.

Introduction

Like in any other branch of science, the research methods employed in forestry are also based on the general inductive-deductive approach which involves formulation of hypotheses from observed facts followed by deduction and verification repeated in a cyclical process. Statistical methods are employed for objective verification of hypotheses and to deal with the uncertainty involved in making generalizations. Two major practical aspects of the whole process are the collection of data and interpretation of the collected data. The data may be generated through a designed experiment on a hypothetical population or through a sample survey on a naturally existing population. The collected data are condensed and useful information extracted through techniques of statistical inference.

As stated, experiments serve to test hypotheses under controlled conditions. The experiments are to be designed so that the conclusions are objective and amenable to generalizations with specified degree of confidence. Ever since the basic principles of experimentation such as randomization, replication and local control which are the prerequisites for obtaining a valid estimate of experimental error and for reducing its magnitude, were enunciated by R.A. Fisher, a number of exciting developments took place in this field. A brief review of the developments in the theory of experimental designs is given below followed by their application in forestry research.

Developments in the theory

The simplest of the designs is the completely randomized design (CRD) in which the 'treatments' are allotted randomly to the `plots' in an unrestricted manner. An experimental unit or plot is the unit of material to which one application of a treatment is applied. The treatment is the procedure whose effect is to be measured or compared with other treatments. The genuine variation among the treatments with respect to their responses on the experimental units, is separated from that due to unaccounted factors, through a technique known as analysis of variance.

When the experimental material is heterogeneous, the experimental units are first grouped into 'blocks' based on some factor causing heterogeneity and each treatment is made to appear in each block in a random sequence. Such an arrangement is termed randomized complete block design (RCBD). When the units are grouped by two factors and each treatment is made to appear in each of the groups by each of the factors, the design is termed a latin square design (LSD), which is useful for elimination of heterogeneity in two directions.

Quite often variation within a block is considerable either due to a large number of treatments or due to the nature of the experimental material in which case all the treatments cannot be accommodated in a single block. Designs used in such instances are called incomplete block designs. If each of the 'v' treatments are replicated 'r' times in 'b' blocks of size 'k'(< v), such that every pair of treatments appear together in a block λ times, the arrangement is a balanced incomplete block design (BIBD). In such a case, it will be possible to compare every treatment pair with equal precision, in spite of the incomplete nature of blocks.

One difficulty with BIBD is that it is not possible to construct such arrangements for all treatment-block size combinations. If one is ready to sacrifice the specification of equal precision for all treatment comparisons and allow multiple levels of precision, the design gets more flexible. This calls for varying the parameter over the design and those designs having unequal are called partially balanced incomplete block designs (PBIBD).

Early designs were mostly concerned with single factor experiments in which the levels of only a single factor formed the treatments. It is often advantageous to include multiple factors in the experiment wherein the levels of more than one factor are allowed to vary

simultaneously in the experiment. The treatments are formed by taking all possible combinations of all the levels of the different factors included in the experiment. Such experiments are called factorial experiments. The advantages of factorial experiments are that the number of replications required for a given level of precision will be considerably less than that for separate single factor experiments retaining the same number of levels. Added to this, factorial experiments provide information on interaction between factors which is impossible to be obtained from single factor experiments. The factorial experiment could itself be laid out in one of the standard designs like CRD, RCBD etc.

In a two factor experiment, if levels of one of the factors require large plot size, one can resort to a split-plot arrangement wherein one whole replication is divided into a set of main plots and each main plot is divided into sub-plots. The factor for which the levels require larger plot size is put in the main plots and the other factor in the sub-plots. One disadvantage is that the main plot factor will be assessed with lesser precision compared to the sub-plot factor and its interaction with the main plot factor. Usually the factor which causes large treatment differences is chosen as the main plot factor. When both factors require large plot size, the experimental units are grouped in two directions by the two factors within a replication and the arrangement is termed a strip-plot design.

When the number of factors or number of levels of the factors in a factorial experiment is large, the number of treatment combinations in the experiment will be huge, giving rise to problems of heterogeneity within a block. In such situations one goes for a confounded factorial design. A complete replication is split into specified number of blocks and specified groups of treatment combinations are assigned randomly to each of the blocks within a replication. The grouping of the treatments is done in such a way that certain effects of minor importance become non-estimable. In a multiple factor experiment, interactions of order three or higher are usually non-significant and such effects are chosen for confounding. The confounded effects get mixed up with the block effect and the two become inseparable whereas the effects not confounded are estimated with much higher precision. It is also possible to confound different effects in different replications giving rise to a partially confounded design.

With large number of factors in the experiment, the number of treatments may go to levels unmanageable even with confounded designs. Attempts to reduce the number of treatment combinations in a factorial experiment led to fractional factorial designs. Here the treatment combinations in the experiment are grouped according to certain specified schemes like in a confounded design and only a subset of such groups is included in the experiment. Grouping of the treatments is done in such a way as to allow all effects of importance to be estimated. One is able to reduce the number of treatment combinations at the cost of information on certain effects suspected to be negligible.

Factorial experiments were originally devised to include distinct qualitative levels of different factors in the experiments. When the factors are quantitative and the object of the experiment is to estimate the dose-response relationship rather than multiple comparisons among the levels of a factor, there is a problem of choosing the treatment levels within specified ranges for individual factors. Designs suitable in such cases are response surface designs (RSD). If the dose-response relationship can be represented by a second-order response function, the design becomes a second-order response surface design (SORD). Such designs will have considerably lesser number of treatments when compared to their counterparts in classical factorial experiments for the given number of factors and levels.

In certain cases the factor levels could be proportions taking values in the range of 0 to 1. The levels of different factors in a treatment combination would add up to 1 in such cases. Because of this restriction, the parameters of the corresponding response function (say polynomial) cannot be estimated uniquely. The polynomial response function is then redefined with changes in the parameter expression which is then called a canonical polynomial. The factor space will form a q dimensional simplex for q factors in the experiment. The design points are usually selected at the vertices, edges or at the centroid of the simplex such that parameter estimation is possible with maximum precision. Such designs are called mixture designs.

The above is not an exhaustive list of designs possible but the designs mentioned are of practical importance in forestry. The details of construction and analysis with respect to most of these designs are available in Das and Giri (1979).

Practical considerations

Experiments related to forestry are mostly conducted in the forests (field experiments) but many associated trials are often conducted at the nursery or laboratory level. These experiments differ with respect to their complexity and also with respect to the difficulties encountered in their implementation. Some of these aspects are detailed below.

Field experiments

These are large scale experiments conducted in the forests and plantations and may address evaluation of many of the management alternatives. Provenance trials, spacing trials, fertilizer trials, regeneration trials etc. are typical examples. They may be simple experiments involving comparison of a few pre-selected treatments or complex factorial experiments designed to investigate the responses to combinations of several factors at different levels.

Field layout and ancillary measurements

Field experiments are characterized by large error variance caused a free play of many non-experimental factors and this should be controlled by appropriate field plot techniques. Optimum plot size and shape of plots and blocks have a role in reducing error variance but quite often these are governed by the nature of treatments and availability of material. Use of guard rows or alleys between plots makes the observations independent, which is one of the basic requirements in statistical analysis. Analysis of covariance helps in bringing down the error variance. Sub-sampling within the plots will not help in reducing the error variance though it may sometimes produce an independent estimate of error. Most often it becomes a must when either plot size is large or when the individual responses are difficult to measure. It is a good practice to repeat the experiments in different places to study treatment-environment interaction.

The choice of design

The traditional design for most of the field experiments in forestry has been randomized block design. However, many of the forest field trials require large plot sizes and thereby blocks become heterogeneous with a fairly large number of treatments. Confounded or incomplete block designs would be valid alternatives in such cases. Though not in common use, response surface designs are suggested for most of the fertilizer trials. Certain specific designs used in plant breeding trials are progeny row trials (RCBD), compact family block designs (split-plot design) and lattice designs (incomplete block design). Similarly in spacing trials, some of the systematic designs like circular designs have been of use. However, the use of such designs has been criticized for lack of randomization in the treatment allocation. Jayaraman and Rugmini (1990) have given certain guidelines to be followed in choosing designs for forestry experiments.

Missing values

One of the most common features of data from field trials is the occurrence of missing values. These are traceable to damages caused by elephants, wind, fire or other natural calamities. Missing values destroy many of the nice features of the designs like balance, orthogonality etc. and make the analysis complicated. Missing value estimation techniques are available for most of the standard designs when the number of missing observations is few (Gomez and Gomez,1984). A complete least square analysis would be warranted with thoroughly nonorthogonal data with unequal subclass numbers. Alternatively the use of robust designs would lessen the effect of missing values on the structural properties of the design.

Analysis of data

Most of the observations coming out of the field experiments are quantitative and so are amenable to analysis of variance after due considerations to the assumptions involved. Normality and homoscedasticity are quite often assumed which is not a desirable trend. In cases where these assumptions are not satisfied, appropriate corrective measures like data transformations are to be adopted if gross errors in conclusions are to be avoided.

When measurements are repeated over time with the treatment structure intact, the data are likely to be correlated. In such cases a mixed model analysis is carried out in which treatments are taken as main plots and repeated measurements are taken as subplots and analysis follow that of a standard split-plot design. Alternatively a multivariate analysis can be performed taking the repeated measurements as multiple characters observed on the same experimental unit.

Analysis of variance only reveals the overall differences among the treatments if any. This is followed by pairwise comparison of the treatments (when qualitative) for identification of the best set of treatments. A large number of multiple comparison tests are available in this respect and these may vary mainly with respect to their degree of conservation in declaring a specified difference as significant.

Nursery experiments

Experiments conducted on seedlings in nursery beds, polythene bags, concrete pots or any such media can be referred as nursery trials. The important point is that experimental material can be made relatively homogeneous and several extraneous factors affecting the response can be regulated. For instance, seedlings of uniform size can be selected, the soil mixture made more homogeneous and other management practices can be standardized. Consequently simple designs like CRD or RCBD are sufficient for such studies. The required number of replications, size of the experimental unit, frequency of observations etc. will need to be worked out for individual species. Most of other things stated under field experiments apply here as well. White (1984) gives a detailed account of the statistical and practical considerations to be made while planning a nursery experiment.

Laboratory experiments

These are investigations carried out under well controlled conditions of the laboratory. Simple designs are good enough but the experimental error should be taken care of by repeated sampling. No additional design or analytical considerations exist other than those mentioned under field and nursery experiments. However, one special class of designs to be mentioned here is that for bio-assays. Bio-assays are experiments conducted for comparing the efficacy of two or more substances, or preparations, like drugs, by using responses produced by them on suitable living organisms. In general, there are two types of assays; direct assays in which the dose required for producing a pre-assigned response is measured and indirect assays wherein the relationship between the dose and response of each preparation is ascertained first and the dose corresponding to a given response is obtained from the relation worked out. Indirect assays further split into parallel line assays and slope ratio assays depending on the nature of the dose-response relationship. In either case, the doses of each of the preparations are taken in geometric progression but at the same time evenly distributed in the transformed scale in which the dose-response relation is linear. When the number of doses is large, it may not always be possible to get homogeneous groups of experimental units for adopting randomized block designs. Das and Giri (1979) describe suitable incomplete block designs to be used in such cases.

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Video Image Analyser (*Leica- Quantimet 500+*) Installed in Wood Science Laboratory

One major objective of forest plantation management is to produce more wood or non-wood products of acceptable quality to meet the increasing material requirements of various industries. This calls for a study of the relationships between wood production and utilisation through the link of tree biology - wood anatomy - wood properties - end-uses. The Division of Wood Science has therefore the task of subjective and objective analysis of wood anatomy in view of the fact that many differences in physical, mechanical and technological properties are determined by the microscopic anatomical features.

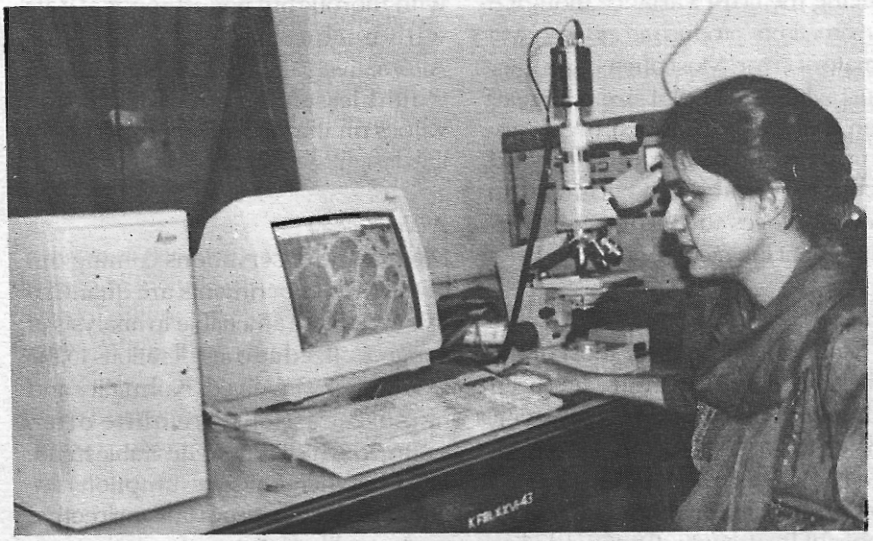

Fig. 1. A general view of image analysis system showing microscope, video camera and computer scanning of the image.

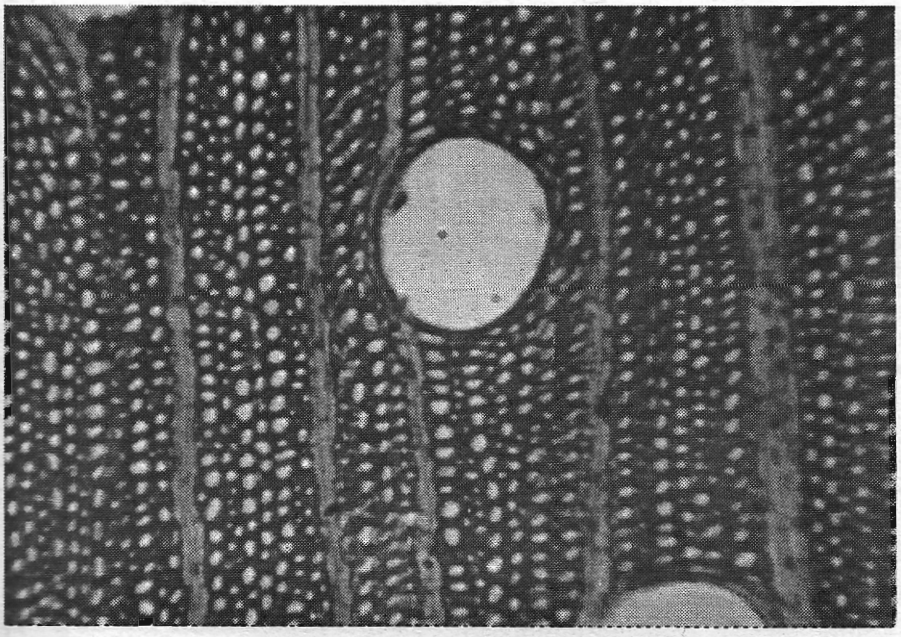

Fig. 2. The image of the part of a cross section of teak wood obtained for analysis.

In order to make the microscopic investigation easier and more efficient, recently a *Video Image Analyser (Leica - Quantimet 500+)* has been installed in Wood Science Laboratory of KFRI.

What is Image Analysis?

This is an area of modern science which deals with the geometric and densitometric measurements of images from any source. The main application is quantitative microscopy, providing quick, accurate and statistically significant data replacing the more laborious traditional methods.

Basically the image analyser equipment has important components like microscope, video camera, computer and output printer (Fig. 1). The system converts the optical image from the light microscope into an electronic signal suitable for processing. The camera generates the electronic signal proportional to the intensity of illumination which is then digitised into picture elements or "pixels". At each pixel the brightness of the image is scanned (for grey values) and it is this digital representation which is analysed by the computer software (QUIN in case of *Quantimet 500+*).

The image analysis consists of a sequence of operations which reduces total information content of an image to a few pertinent measurements as follows: Production of grey image - Detection of image component to be measured - Binary image processing - Measurements - Data output.

How the System is applied for Wood anatomy?

For an illustration, the microscopic image of teak wood section, to be analysed, is shown in Fig. 2. It is neither too bright nor too dark, with all the pixels falling within the grey level range of 0-255 (Fig 3). If the image is too bright all the pixels will end up at level 255 and conversely if too dark they will end up in O grey level. The grey profile in horizontal line of the section is shown in the Fig 3. where the brighter area due to the presence of big pore (vessel) shows higher grey level. The Fig. 4. shows that the pixels are more frequent in lower grey level (64) indicating the greater proportion of darker area of fibres. The output data showed only 22% of the vessel area in this section of teak wood tissue.

This system is useful to quickly assess the percentages of different tissues and cell dimensions in wood quality research programmes. This will be of utmost importance when millions of wood fibres have be quantified for length, width and wall thickness in pulpwood quality assessment of several hundreds of trees. Similarly, ecological conditions can be assessed by the quantification of water conducting cells (vessels) of the trees. Further, it will be helpful in tree ring analysis for the determination of growth periodicity and tree age as well as for the prediction the past events including the climatic changes in the field of dendrochronology.

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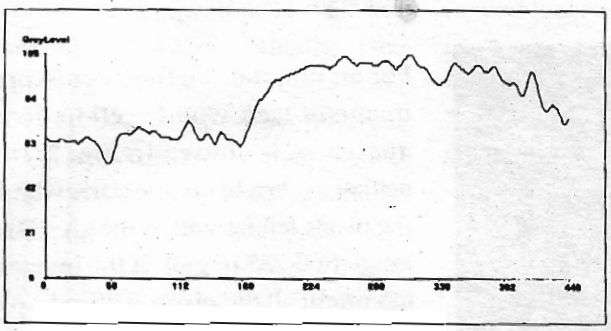

Fig. 3. The grey profile of the image of teak wood section.

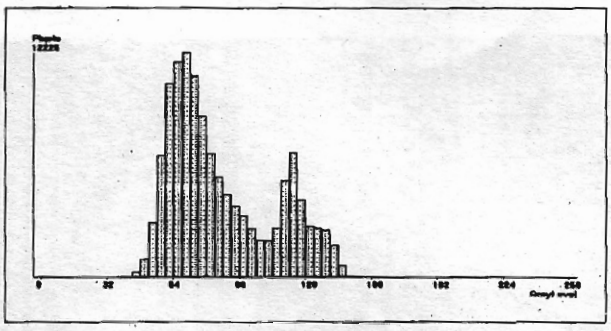

Fig. 4. The histogram showing the intensity of darker and white fields indicating fibres and vessel tissues respectively in terms the frequency of pixels and grey level.

Educational Video Available for Sale

THE TEAK DEFOLIATOR

A 20 min scientific documentary produced by the Kerala Forest Research Institute on the teak defoliator, *Hyblaea puera* (Lepidoptera), the most dangerous forest plantation pest of the Asian tropics.

Depicts the biology, and the spectacular drama of pest population outbreaks and defoliation which no words can fully describe.

Summarises our present knowledge on outbreak causation and suggests management methods.

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at US$ 50 per copy (VHS) excluding postage. Special rate of Rs. 500/- excluding postage for bonafide users within India.

(Please make the drafts payable to Director, Kerala Forest Research Institute, Peechi.)

Weather data for Peechi - 1993

The monthly averages of the various weather parameters measured at the KFRI Weather Station are presented in Table.1. The rainfall at Peechi was low when compared to the previous year. The south west monsoon contributed 1643 mm while north east monsoon 489 mm. The total rainfall including the summer showers amounted to 2370 mm during the whole year. The number of rainy days, when rainfall was greater than 10 mm, was 73 days which is four days less than that of the previous year. The annual rainfall from 1988 onwards, and the monthly rainfall for 1993 are presented graphically in Fig.1 a. and b. respectively.

Highlights

Day with highest maximum temperature	:	26th March (41°C)
Day with least minimum temperature	:	20th January (16°C)
Day with highest maximum r.h.	:	24th November (96%)
Day with least minimum r.h.	:	26th March (30%)
Total rainfall for the year	:	2370mm
Day with maximum rainfall	:	8th June (102 mm)
Month with maximum rainy days	:	July (20 days)
Total number of rainy days	:	73 days
Day with maximum sunshine	:	10th April (10.3 hours)
Month with maximum sunshine	:	February (9 hours)

The maximum temperatures recorded during the year varied from 24°C (June) to 41°C (March) while the minimum temperatures varied from16°C (Jan) to 26.5°C (May). Relative humidity varied between 30% and 96% during the year. From January to March sunshine was high and February was blessed with maximum sunshine. The minimum sunshine was in July due to monsoon clouds.

Details of monthly averages of weather parameters, cumulative rainfall etc. recorded at KFRI weather station are given below.

Jose Kallarackal and C.K. Somen
Plant Physiology Division

Table.1. Monthly averages of weather data for 1993 at Peechi
(Latitude : 10°32'N, Longitude : 76°20'E, Altitude : 100 m)

Month	Mean Temp (°C)		Mean r.h.(%)		Rainfall	Daily mean wind velo-city (km/hr)	Daily mean bright sun-shine (h)
	Max	Min	Max	Min	(mm)		
January	34.50	19.10	83.00	48.00	0.00	(0)	NR	7.20
February	36.80	20.30	87.00	48.00	3.20	(0)	NR	9.00
March	38.30	22.70	85.00	46.00	0.00	(0)	2.30	8.20
April	30.60	23.90	76.00	44.00	52.10	(1)	1.80	8.60
May	36.40	23.70	76.00	51.00	175.80	(5)	1.80	4.70
June	30.90	22.40	77.00	61.00	604.40	(16)	2.00	2.40
July	29.60	21.30	81.00	66.00	633.30	(20)	1.40	1.20
August	30.40	21.90	81.00	62.00	312.00	(15)	1.90	2.90
September	32.00	22.00	80.00	57.00	94.00	(3)	1.40	4.70
October	32.50	22.00	82.00	57.00	427.90	(11)	1.00	2.90
November	32.20	20.10	79.00	53.00	61.00	(2)	1.70	4.90
December	32.50	20.60	79.00	53.00	6.60	(0)	2.50	6.50

Note: r.h. : Relative humidity; The figures in parenthesis indicate the number of rainy days when rainfall was >=10 mm; NR : Not recorded.

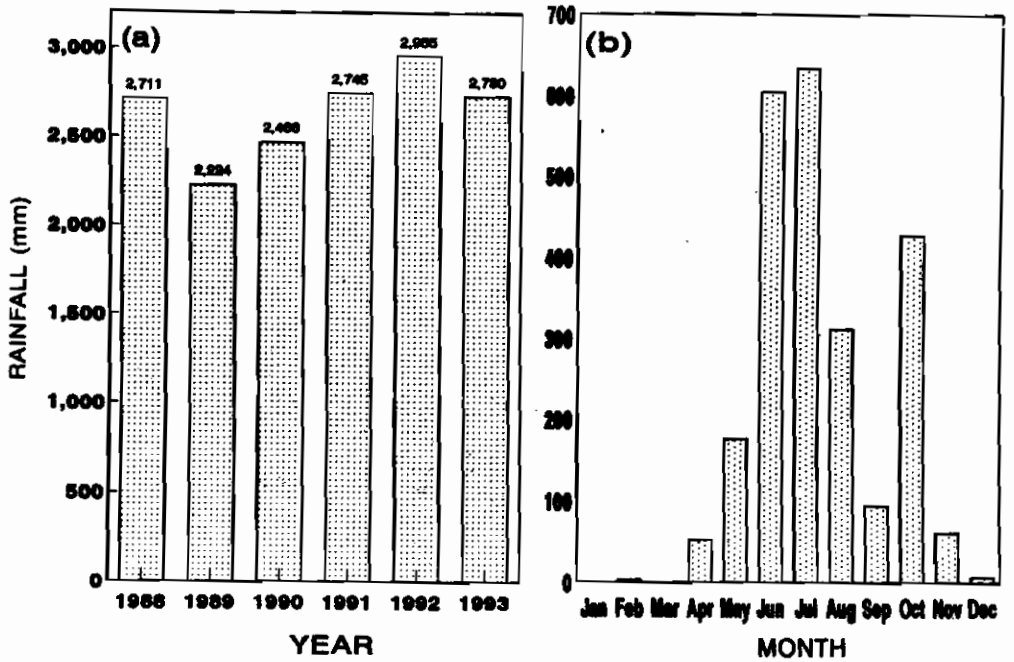


Fig.1(a) Cumulated annual rainfall from 1988 to 1993 at Peechi. (b) Cumulated monthly rainfall for 1993 at Peechi.

Pathological investigations in forest nurseries and plantations in Vietnam

Dr.J.K. Sharma, Division of Pathology, KFRI, visited Vietnam as a FAO Consultant from 18 April to 15 May 1994. The main objectives of his visit were to identify the serious disease problems in eucalypts, casuarina, cashew and acacia and report interim emergency action to be addressed by various agencies involved with the reforestation programme in Vietnam for minimizing losses due to diseases. He recorded nineteen new diseases, on the four tree species.

In eucalypts, severe premature defoliation during the rainy season, due to leaf blight caused by *Cylindrocladium quinqueseptatum* was widespread in central and southern provinces. There were also a couple of other new leaf diseases recorded from the northern provinces which have the potential to cause severe defoliation. In addition, the identity of the pathogens causing stem canker in two locations, is yet to be confirmed. Localised occurrence of pink disease (*Corticium salmonicolor*) and die-back disease was also recorded. All the four stem diseases are potentially serious. Disease management by introduction of disease-resistant provenances was suggested. In some of the species/provenance trials of eucalypts, established in southern Vietnam, promising provenances of *E. camaldulensis* and *E. tereticornis* were identified to possess field resistance to CLB and other canker diseases.

A low incidence of the blister bark disease in *Casuarina equisetifolia*, caused by *Trichosporium vesiculosum*, previously known to occur only in India and Mauritius, was also recorded in Vietnam. Dr. Sharma recommended adoption of control measures to avoid epidemic that can be potentially devastating. In acacia, of the four diseases recorded, a stem canker and a die-back appeared to be potentially serious diseases capable of affecting the growth of trees considerably, although localised to small areas at present. In cashew, blossom blight was found to be a serious problem in one of the southern provinces visited. The suitable pesticide spray schedule for control was recommended.

At the end of the visit Dr. Sharma presented the results, conclusions and recommendations of his consultancy in a Workshop attended by senior officials of Vietnam Government and various International Organizations. He stressed the need of modernizing the forest protection research in Vietnam to meet the challenges posed by pest and disease problems affecting the reforestation programme.

Recent Publications

Scientific papers

Dhamodaran, T.K. and Gnanaharan, R. 1993. Verification of an economical schedule for boron impregnation treatment of partially dried rubber wood. Journal of Timber Development Association of India 39(2): 33-35.

George Mathew and V.K. Rahamathulla (1993). Studies on butterflies of Silent Valley National Park. Entomon 18(3&4):185-192.

Gnanaharan, R. and Dhamodaran, T.K. 1993. Mechanical properties of rubberwood from a 35-year-old plantation in Central Kerala, India. Journal of Tropical Forest Science 6: 136-140.

Gnanaharan, R. 1993. Shrinkage behaviour of bamboo grown in Kerala, India. BIC-India Bulletin 3(2): 1-6.

Kallarackal, J. and Soman, C.K. 1993. Microclimate and transpiration in relation to growth in eucalypts. Plant Physiology and Biochemistry 20 :107-113.

Kallarackal, J. and Somen, C.K. 1994. *"Eucalyaekkurichu veendum"* (In Malayalam) Aranyam 19: 7-9.

Mathew, G. and Nair, K.S.S. 1993. Factors influencing susceptibility of stored reed (*Ochlandra travancorica*) to infestation by *Dinoderus* borers. Proc. 6th Kerala Science Congress, pp 78-80.

Nair, K.K.N. 1993. Southern Penninsular endemic trees in the proposed Pooyamkutty Hydroelectric Project area. J. Econ. Tax. Bot 17(2):265-273.

Nair, K.S.S. and Mathew, G. 1993. Diversity of insects in Indian forests - the state of our knowledge. Hexapoda 5(2):71-78.

Renuka, C. and T.T. Vijayakumaran (1994). Rattans of Andaman and Nicobar islands. A State of the Art Report.

Seethalakshmi, K.K. 1993. Flowering and fruiting of seed bamboos in Kerala. BIC - India Bulletin 3(2): 37-41.

Books

Day, R.K., Rudgard, S.A. and Nair, K.S.S. (1994). Asian Tree Pests-An Overview. FORSPA Publication No.12, FAO, Bangkok, 71 pp.

Chapters in books

Gnanaharan, R. 1994. Physical and strength properties of *Dendrocalamus strictus* grown in Kerala, India. In: Bamboo in Asia and the Pacific. FORSPA Publication No. 6. FAO, Bangkok. pp 188-192.

Gnanaharan, R. 1994. Field evaluation of preservative treated bamboo. In: Bamboo in Asia and the Pacific. FORSPA Publication No. 6. FAO, Bangkok. pp 243-246.

Nair, K.S.S. 1994. Pest Control Practices in Forestry. In: The Pesticide Industry (B.V. David, Ed.). Kothari's Desk Book Series, H.C. Kothari Group, Madras. pp 86-101.

Research reports

Dhamodaran, T.K. and Gnanaharan, R. Upgradation of Rubberwood. KFRI Research Report No. 93. Final Report of Project No. KFRI/123/89.

New Research Projects

***KFRI/208/94*: Water relations and rooting depth of selected eucalypt species.**

Investigators : Jose Kallarackal, C.K. Somen (Physiology)
Objectives : a. Water relationships
i. To study the water relation parameters of six eucalypt species found successful in a trial conducted in Kerala.
ii. To examine the stomatal control of transpiration in the above six species.
iii. To quantify the instantaneous water use efficiency of the above six species.
iv. To analyse the photosynthetic efficiency in stressed and unstressed conditions
b. Rooting depth
i. To examine the rooting depth of *E. tereticornis* and *E. grandis* in plantations
ii. To study the root length density of the above two species at different soil depth.

Duration : 3 Years
Funded by : Ministry of Environment and Forests, Government of India.

***KFRI/209/94*:Patterns and processes of Fish Assemblages in the Periyar Lake - Valley system**

Investigator : L.K.Arun (on working

arrangement with Wildlife Biology Division.)
Objectives : To study the distribution pattern and biotic processes of fish population in the Periyar Lake and associated streams.
Duration: 2 years
Funded by : Kerala Forest Department (Wildlife Wing)

***KFRI/210/94*: Botanical studies in the Medicinal Plant Conservation Areas in Kerala.**

Investigators: S. Chand Basha (Director), N. Sasidharan (Botany), K. Swarupanandan (Ecology), C. Renuka (Botany)
Objectives :
i. Preparation of a complete list of the flora of the 5 MPCAs viz. Athirappally, Peechi, Wynad, Silent Valley and Eravikulam, selected by the FRLHT.
ii. Preparation of Herbarium specimens of each species
iii. Preparation of Botanical profiles for the species-wise population, distribution pattern, regeneration status, status of medicinal plants, diameter distribution of trees in MPCA and species area correlation for medicinal plants.
Duration : 1 year
Funded by : Foundation for Revitalization of Local Health Traditions (FRLHT, Bangalore)

***KFRI/211/94*: A survey of the reptiles and amphibians in the Kerala part of the Nilgiri Biosphere Reserve.**

Investigators: S. Chand Basha (Director), P.S. Easa (Wildlife Biology)
Objectives :
i. To document the reptiles and amphibians in the area.
ii. To assess the status of the species
iii. To evaluate the threats and suggest management options.
Duration : 3 years
Funded by : Ministry of Environment and Forests, Government of Kerala.

***KFRI/212/94*: Preparation of a perspective plan for forestry sector in Kerala.**

Investigators: S.Chand Basha (Director), S.Sankar(Soil Science), A.R. Rajan (Programmer)
Duration : 3 months
Funded by : Planning Dept, Government of Kerala

***KFRI/213/94*: Palm resources of Kerala and their utilization.**

Investigators : S. Chand Basha (Director), C. Renuka (Botany), K.V. Bhat (Wood Science)
Objectives:
i.To gather detailed information on the biology, distribution and utilisation status of palm species of Kerala.
ii.To identify appropriate course of action for conservation and maintenance of maximum biodiversity of palm species and its sustainable use.
Duration : 2 years
Funded by: STEC

***KFRI/214/94*: Study on man-wildlife interaction in Wynad Wildlife Sanctuary, Kerala.**

Investigators: P.S. Easa (Wildlife Biology), S. Sankar(Soil Science), P.K. Muraleedharan (Economics)
Objectives :
i.To estimate the population and assess the distribution of animals in relation to season, habitat, water availability, settlements, salt licks and cropping pattern. Movement pattern of selected herds of elephants will also be studied.
ii. To conduct a floristic study of the area.
iii.To study the impact of fire on soil, vegetation and wild animals.
iv.To assess the pattern of crop damage by elephants and other wild animals.
v. To determine the soil types, properties and current status in different land use/vegetation types.
vi. To study the socioeconomic structure of the settlements in the study area to assess their dependence on forest products and forestry works thereby assessing the impact of human activities on forest and suggest possible alternatives.
vii. To develop a model for man-wildlife interaction that can be used for better management of the sanctuary.
Duration : 3 years
Funded by : Ministry of Environment, and Forests, Government of India

***KFRI 215/94*: Socioeconomic and ecological aspects of developing bamboo resources in homesteads.**

Investigators : S. Chand Basha (Director), S. Sankar (Soil Science), U.M. Chandrasekhara (Agroforestry) and C.N. Krishnankutty (Statistics).
Objectives : The broad aims of this multidisciplinary project are
i. to develop a replicable model for transferring knowledge about bamboos developed in research institutes to farmers.
ii. improve the management of bamboos through a holistic approach to on-farm research.
iii. encourage expansion in bamboo planting and expand number of types

of bamboo grown.
Funded by : Natural Resources Institute, U.K.

***KFRI/216/94*: Management of the shoot borer *Hypsipyla robusta* (Lepidoptera: Phycitidae) in mahogany plantations.**

Investigator : K. Mohandas (Entomology)
Objectives:
i. To gather information on factors leading to the build up of the shoot borer caterpillar in plantations.
ii. To develop strategies for the management of this pest using chemical or bio-insecticides.
Duration : 2 years
Funded by : KFRI

***KFRI/217/94*: Studies on the effect of fire on forest soils, vegetation and timber value.**

Investigators: K. Swarupanandan (Ecology)
Objectives :
i. To study the changes brought about by fire on soil physical and chemical properties.
ii. To examine the qualitative and quantitative changes in soil microflora due to fire and to assess how fast the original status is regained.
iii. To identify fire tolerant and fire hardy tree species and to test the feasibility stump planting.
iv. To assess the survival ability of regenerants(of 1-3 cm dbh.).
v. To assess the type and extent of damage to tree species.
vi. To study the response of fire exclusion in forest vegetation.
Duration : 4 Years
Funded by : Kerala Forest Department

***KFRI/218/94*: Insect biodiversity in disturbed and undisturbed forests in the Kerala part of Western Ghats.**

Investigators : George Mathew, V.V. Sudheendrakumar (Entomology).
Objectives :
i. To gather basic information on the insect fauna of major insect groups with special emphasis to the Group Lepidoptera in the Western Ghats.
ii. To study the distribution pattern of these insects in different habitats.
iii. To study the impact of disturbances due to various biotic and abiotic factors on biological diversity.
Duration : 3 years
Funded by : World Wide Fund for Nature - India

***KFRI/219/94*: Evaluation of methods for estimating the abundance of herbivores in the forests of Kerala.**

Investigators : K. Jayaraman (Statistics), P.S. Easa and E.A. Jayson (Wildlife Biology)
Objectives :
i. To compare the presently available methods with respect to their efficiency for estimating the abundance of herbivores in the forests of Kerala.
ii. To develop new methods / suggest alterations in the existing methods to make them suitable to the forests of Kerala.
Duration : 3 years
Funded by : Kerala Forest Department (Wildlife Wing)

***KFRI/220/94*: Studies on the shola forests of Kerala.**

Project Leader: S. Chand Basha
Investigators : K. Swarupanandan (Ecology), N. Sasidharan (Botany), U.N. Nandakumar, K.C. Chacko (Silviculture).
Objectives :
i. To document the extent and distribution of Shola forests in Kerala and to develop a Geographic Information System (GIS) on these forests.
ii. To collect bench mark data on the structural parameters.
iii. To establish a series of semi-permenant plots for continuous monitoring of silvicultural parameters.
iv. To look into the possibility of establishing permanent plots for long term monitoring of ecological processes.
v. To make an assessment of plant resources of these forests.
vi. To work out a possible management strategy for these forests.
Duration : 2 years
Funded by: Kerala Forest Department (Wildlife Wing)

***KFRI/221/94* : Studies on the diversity of selected groups of insects in Parambikulam Wildlife Sanctuary.**

Investigators: V.V. Sudheendrakumar, George Mathew (Entomology)
Objectives :
i. To generate baseline data on the insect diversity in the Sanctuary.
ii. to prepare an inventory of the insects.
iii. to document plant-insect relationships in the different forest types.
Duration : 3 years
Funded by : Kerala Forest Department

***KFRI/222/94*: Studies on the Flora of Chinnar Wildlife Sanctuary.**

Investigator : N. Sasidharan (Botany)
Objectives :
i. To study the flora of the Sanctuary

and the distribution of economically important plants.
ii. To identify the rare and endangered plants in the Sanctuary.
iii. To prepare a reference herbarium collection.
Duration : 3 years
Funded by : Kerala Forest Department (Wildlife Wing)

***KFRI/223/94*: Soil microflora of shola forests of Eravikulam National Park.**

Investigator: M. Balasundaram, K.V. Sankaran (Pathology)
Objectives :
i. To prepare an inventory of the soil and litter microflora in the shola forests.
ii. *ex situ* conservation of microorganisms in the form of live culture collections.
Duration : 3 years
Funded by : Kerala Forest Department (Wildlife Wing)

***KFRI/224/94*: Ecological studies on Sloth bear in the Parambikulam Wildlife Sanctuary.**

Investigator: P.S. Easa
Objectives:
i. To study the food and feeding habits of the species.
ii. To study their role in dispersal of seeds.
iii. To assess its status in Parambikulam Wildlife Sanctuary.
Duration : 3 years
Funded by : Kerala Forest Department (Wildlife Wing).

***KFRI/225/94*: Evaluating plant diversity in different forest types of Kerala by laying out permanent sample plots.**

Investigators: K. Balasubramanyam (Ecology), K.K.N. Nair (Botany)
Objectives :
i. To generate data on floral diversity of different forest types of Kerala.
ii. To generate structural data on different components of each forest type.
iii. To identify various associations with different forest formations.
iv. To record the occurrence of endemic/endangered/threatened taxa.
v. To identify indicator/umbrella species.
vi. To identify the species/ products contributing to rural economy.
vii. To gather phenological/regeneration data.
Duration : 3 years
Funded by: World Wide Fund for Nature- India.

***KFRI/226/94* : Status and distribution of rare and endangered animals of Kerala and publication of a booklet.**

Investigator : E.A. Jayson
Objectives :
i. To document and summarise the available information on the status and distribution of endangered animals in the forests of Kerala.
ii. To conduct limited field survey for assessing the present status of endangered animals.
iii. To produce a booklet on the status and distribution of rare and endangered animals in the forests of Kerala.
Duration : 1 year
Funded by : Ministry of Environment and Forests, Government of India.

***KFRI/227/94* : Provenance trial in *Acacia*.**

Investigator: E.P. Indira
Objective : To select the best species/ provenances for growth and other morphological characters
Duration : 3 years
Funded by : KFRI

***KFRI/228/94*: Status of *Acacia mangium* in Kerala.**

Investigators: T.K. Dhamodaran (Wood Science), K.C. Chacko (Silviculture)
Objectives :
i. Gather information on wood properties of *Acacia mangium* trees growing in Kerala for evaluating their end use applications.
ii. Gather growth rate data to evaluate the potential of this species for extensive plantation programmes in Kerala.
Duration : 2 years
Funded by : KFRI

***KFRI/229/94*: Micropropagation of some medicinal plants.**

Investigator : E. M. Muralidharan (Genetics)
Objectives:
i. Development of micropropagation protocols for the following medicinal plants: *Kaempferia galanga, K. rotunda, Alpinia calcarata* and *Malaxis rheedii*
ii. To carry out pot culture and field trials of the above species to evaluate the growth performance and yield of the micropropagated plants.
Duration : 18 months
Funded by : KFRI

Participation in Seminars, Symposia and Workshops

Dr. K.M. Bhat attended the Cane and Bamboo Craft Workshop at Nandyal, Andhra Pradesh during March 22-24, 1994 and gave lectures on resource production and rural technology for cane crafts.

Mr. K.C. Chacko, Division of Silviculture attended an Expert Consultation Meeting on Non-Wood Forest Products, organized by the FAO and the Government of Indonesia at Yojakarta, Indonesia during January 17-27, 1995.

Dr. U.M. Chandrashekara attended the 3rd Swadeshi Science Congress held at Palakkad on November 5-7,1994 and presented a paper ***Grameena sthrikal veetuvalappugalile vrikshajathi vaividhyathe engane vilayiruthunnu?*** *(How rural women view tree species diversity in their homegardens?)* (U.M. Chandrashekara and S. Sankar).

Dr.U.M. Chandrashekara attended the discussion meeting of scientists working for conservation of biodiversity of the Western Ghats. This meeting was jointly organised by Tata Energy Research Institute and Centre for Ecological Sciences, IISc, Bangalore on January 5, 1994.

Dr. U.M. Chandrashekara participated in the State level workshop for voluntary organizations organised by the STEC at Thiruvananthapuram on February 12, 1994.

Dr. U.M. Chandrashekara participated in the National Seminar on Ecologically Sustainable Economic Development organised on February 21-22, 1994 at John Mathai Centre Thrissur. He presented a paper entitled *Ecological and economic benefits of tree components in homegarden farming systems of Kerala.*

Dr. U.M. Chandrashekara attended the National Workshop on Agroforestry for Sustainable Development which was held June 22- 25, 1994 in the Indian Institute of Forest Management, Bhopal. He delivered a lecture on *Homegarden agroforestry systems of Kerala.*

Dr. U.M. Chandrashekara participated in the 3rd Meeting of Biodiversity Forum organised in MS Swaminathan Research Foundation, Madras on July 11, 1994.

Dr. U.M. Chandrashekara participated in a training programme on Agroforestry for Ecodevelopment as a resource person and he delivered a lecture on the topic *Agroforestry for high- ranges in Kerala.* This programme was organised by the Peermade Development Society on July 23-24, 1994.

Dr. U.M. Chandrashekara attended the Rural Programme Advisory Committee Meeting of the All India Radio, Thrissur held on August 25, 1994 at Thrissur.

Dr. George Mathew participated in the International Congress of Kerala Studies held at Trivandrum during August 27-29, 1994 and presented a paper on *Insect Biodiversity in Kerala Forests - An Overview.*

Dr. George Mathew attended the Kerala Science Congress held at Trivandrum during January 27-29, 1994 and presented a paper entitled *Factors influencing susceptibility of stored reed to infestation by Dinoderus borers* (George Mathew and K.S.S. Nair).

Dr. R. Gnanaharan attended the Task Force Meeting convened by UPASI, Kottayam for the promotion of rubber wood, at Kottayam on March 7, 1994.

Dr. R. Gnanaharan attended a one-day Seminar on Cost Effective Technologies and Use of Indigenous Materials in Housing and Habitat Sector' organised by the Kerala State Nirmithi Kendra at Trivandrum on May 3, 1994 and presented a paper *Use of indigenous timbers in housing sector.*

Dr. R. Gnanaharan attended the INBAR Production Research Working Group meeting held at Bangalore on May13, 1994.

Dr. R. Gnanaharan was a resource person at the Workshop on the Processing of Rubber Wood organised by STED, Calicut at Kasaragod on June 17-18, 1994 and at Trivandrum on June 20, 1994.

Dr. R. Gnanaharan and Mr. T.K. Dhamodaran participated in the Workshop on the Utilization of Timber organised by the Karimpuzha Social Development Project, Kottappuram, Palakkad District and Mr Dhamodaran took classes on *Preservative treatment and utilization of timber with special reference to rubber wood,* on August 9, 1994.

Mrs. E.P. Indira attended a seminar on Emerging Trends in Life Sciences at the University of Kerala, Thiruvananthapuram on January 17, 1994.

Dr. A.R.R. Menon and Dr. K. K. Ramachandran attended the User's Workshop on Coastal Zone Mapping using sensing data at the Centre for

Earth Sciences, Thiruvanathapuram, on February 4, 1994.

Dr. P.K. Muraleedharan attended the Joint Forest Management Network Meeting held during September 14-16, 1994 at New Delhi.

Dr. E.M. Muralidharan participated in the 2nd Asia Pacific Conference on Agricultural Biotechnology held during March 6-10, 1994 at Madras and presented a poster paper on *Tissue culture of Indian rattan species.*

Dr. K.K.N. Nair attended the National Seminar on Non-wood Forest Produce organised by ICFRE at the Institute of Forest Genetics and Tree Breeding, Coimbatore, from October 15-16, 1993 and presented a paper entitled *Non wood forest produce plants of Kerala State, India: An overview.*

Dr. K.K.N. Nair attended the High Level Committee Meeting on Pooyamkutty Hydroelectric Project on October 4, 1993, on behalf of the Director.

Dr. K.S.S. Nair, Dr. V.V. Sudheendrakumar and Mr. K. Mohandas participated in the Seminar-cum-Workshop on *Biological control of insect pests of social and plantation forests* in the Entomology Research Institute, Madras during February 25-26, 1994 and presented a paper entitled *Biological control of the teak defoliator Hyblaea puera using insect parasitoids - problems and prospects.*

Dr. K.K. Ramachandran attended the Third International Lion-tailed Macaque Symposium, Population and Habitat Viability Analysis Workshop and Global Animal Survival Plan Workshops held at Arignar Anna Zoological Park, Madras, during October 11-14, 1993 and presented a paper entitled *Status of lion-tailed macaque in Silent Valley National Park and adjacent areas.*

Dr. C. Renuka participated in the International Consultative Meeting on Priority species of Bamboos and Rattans held at Dehra Dun in December, 1993

Mr. K.Sankara Pillai, Librarian and Project Leader, Bamboo Information Centre-India , attended the IDRC Information Project Leaders' Meeting at Kuala Lumpur, Malaysia from February 21-23, 1994.

Invited talks

Dr. S. Chand Basha, Director and R. Gnanaharan attended a meeting convened by the Small Industries Development Bank of India at Trivandrum on September 6, 1993 to discuss the status of bamboo industry.

Dr. R. Gnanaharan gave lectures at the SFS College, Coimbatore on October 7, December 8, 1993 and on February 25, 1994.

Dr. R. Gnanaharan gave guest lectures at IPIRTI, Bangalore on November 19, 1993.

Mr. T.K. Dhamodaran gave an invited talk in Malayalam on the utilization of rubber wood at the Symposium on Timber-based Industry in Perumbavoor, organised by the State Bank of Travancore, Mudickal, Perumbavoor on January 22, 1994.

Dr. K.M. Bhat gave guest lectures at the SFS College, Coimbatore during February 7-10, 1994.

Dr. Jose Kallarackal gave a talk on AIR on the *Water consumption of eucalyptus and acacias.*

Dr. K.K. Seethalakshmi gave a guest lecture on *Physiology of flowering* at Govt. Victoria College, Palakkad.

Training

Mr. T.K. Dhamodaran attended a 7-month training programme at the University College of North Wales, Bangor, U.K from January - May 1994.

Dr. K.M. Bhat and Mr. T.K. Dhamodaran attended a 2-day training course on ISO-9000 conducted by the Institution of Engineers (India), Kerala State Centre, Trivandurm on August 24-25, 1994.

Dr. E. M. Muralidharan attended the Training - cum - Workshop on Bio-Informatics and CD-ROM Information Retrieval held at the Center for Plant Molecular Biology, TNAU, Coimbatore during March 16- 18, 1994.

Dr. E.M. Muralidharan participated in the Summer Institute on Cell Technology and Genetic Engineering of Crop Plants, held at the Centre for Plant Molecular Biology, TNAU, Coimbatore, from June 15-July 5, 1994.

Dr. R.V. Varma attended a training programme in U.K. under the Colombo Plan for April-June 1994 on Forestry - people and participation, which was held in the Universities of Wolverhampton and Oxford. As part of the training he has also visited Portugal. The training covered participatory issues in forestry, identification of training needs, presentation techniques, gender issues etc.

Campus News

KFRI Seminars

Dr. C.J. Thampi, Land Use Commissioner, Govt. of Kerala gave a seminar on *Conservation of land resources* on January 7, 1994.

Dr. W. Zentz, Technical University of Dresden, Germany, gave a talk on *Preservation of biodiversity* on March 28, 1994

Dr. V.R. Rao, IPGRI, Singapore, spoke about *The Role of IPGRI in biodiversity conservation in the APO region* on July 19, 1994.

Degrees/Awards/Prizes etc.

Dr. Jose Kallarackal was awarded a Fellowship by the International Tropical timber organisation, Japan to visit the Botany Department, University of Queensland (Australia) and the New Zealand Forest Research Institute to do research in forest ecophysiology.

Mr. C. Mohanan, Scientist, Pathology Division, has been awarded an Internship from INBAR, IDRC for a period of one year. The purpose of the Internship is : to collate available information on diseases of bamboos of Asia; to assess of the economic loss due to the major diseases; to suggest remedial measures or management practices for economically important diseases and to identify major problems with socio-economic implications due to depletion of the resource base as well as the loss of raw material due to biodeterioration. The main output of the study will be a up-to-date document on diseases of bamboos in Asia.

Dr. R.V. Varma, Scientist, Entomology Division, has been awarded an internship by International Development Research Centre (Canada) to review the pests of bamboos, along with Prof. Wu from China.

Visitors

Mr. Paul Stinson, Manager, International Network for Bamboo and Rattan.

Ms. Maria Rigter of M/s. Bamboo Development Corporation, Amsterdam, the Netherlands.

Dr.Eric Boa, Pathologist, Natural Resources Institute, UK.

Mr.Mick Blowfield, Social Scientist, Natural Resources Institute, UK.

Dr.W. Zentsch, Scientist, Technical University of Dresden, Germany

Dr.S.N. Rai, Conservator of Forests, Karnataka Forest Department, Bangalore.

Mr Paul Eastman, Consultant to INBAR

Prof. A.N. Rao of National University of Singapore.

Symposia, Workshops and Training Programmes Conducted

Report on the IUFRO Symposium on

Impact of Diseases and Insect Pests in Tropical Forests

November 23-26, 1993

KFRI was host to an IUFRO Symposium organised jointly by the Working Parties, S2.07-07: Protection of Forest in the Tropics, and S2.06-15: Diseases in Tropical Plantations, from 23 - 26 November 1993. The major financial support for the Symposium came from the FAO Forestry Research Support Programme for Asia and the Pacific (FORSPA), UNESCO Regional Office of Science and Technology for South and Central Asia and the International Union of Forestry Research Organisations (IUFRO) under its Special Programme for Developing Countries (SPDC). Some support was also extended by the State Committee on Science, Technology and Environment, Government of Kerala; the Indian Council of Forestry Research and Education (ICFRE); and Commonwealth Forestry Association, India Unit.

The Symposium elicited wide international interest. A large number of scientists from the developing countries, who had evinced interest, however could not attend since sufficient travel grants were not forthcoming from the international funding agencies. The final list of participants included 81 persons - 58 from India and 23 from abroad. The participants from abroad included 13 scientists from the Asia-Pacific, 4 from Africa and 6 from other countries. This included 32 entomologists, 28 pathologists, 17 Forestry professionals and 4 persons representing commercial enterprises.

The Symposium was dedicated to the memory of late Dr. Y.S. Rao, the former Senior Forestry Advisor to FORSPA whose enthusiastic support to the theme of the Symposium and FORSPA's commitment of financial support contributed substantially to the fulfillment of this Symposium.

Chief Minister Mr. K. Karunakaran inaugurates the Symposium

The Symposium was held from November 23-26, 1993.

The first day of the Symposium was devoted to the inaugural session and common technical sessions among the two subject groups - Entomology and Pathology. The Symposium was inaugurated by Mr. K. Karunakaran, Chief Minister of Kerala. Mr. G. Mukundan, Principal Chief Conservator of Forests, Kerala and Dr. S. Chand Basha, Director, KFRI addressed the meeting. Dr. K.S.S. Nair, KFRI, dedicated the Symposium to Dr. Y. S. Rao, and Mr. K.J. Joseph, former Principal Chief Conservator of Forests, Kerala gave the Dr. Y.S. Rao Commemorative Address.

November 24 : Concurrent technical sessions were held for Entomology and Pathology and a common Poster Session. A dance programme was arranged for the benefit of the participants in the evening.

November 25: A local sight-seeing trip was arranged which included visit to forest plantations of teak, rubber, oil palm, etc. and to a bamboo processing and board manufacturing unit.

November 26: Concurrent technical sessions, business meetings of the two Working Parties and a common technical session. This was followed by a common Plenary Session in which reports of each Technical Session was presented by the respective Chairmen. Issues relating to pest and disease problems and their management in tropical forests were then discussed and recommendations for future action were drawn up. The day ended with a farewell banquet.

A post-Symposium tour to Periyar Wildlife Sanctuary was also organised from 27 to 29 November. The participants were also given a glimpse of Kerala's forest wealth, sacred groves, wildlife sanctuaries, plantations of tea, cardamom, rubber, etc., in addition to pest and disease problems in various plantation tree species.

Printed Abstracts of the papers were distributed to all the participants. The proceedings of the Symposium containing the full papers will be published by FORSPA.

Some of the recommendations made by the Symposium were:

1. That there is an urgent need to assess the impact of pests and diseases in quantitative terms and highlight their significance by economic analysis.

2. There is a need to develop protocols and prepare a manual of methods for impact assessment and economic analysis to improve the awareness among researchers.

3. Improved communication within tropical countries be facilitated through newsletters and by providing opportunities for meetings and symposia.

4. Supportis needed for establishing insect/pathogen identification expertise through dispersed centers of excellence within the tropical region.

5. That funding be made available where support is critically needed, viz. to increase the interaction amongst researchers within and between the tropical developing countries and to enhance their capability through collective self-reliance.

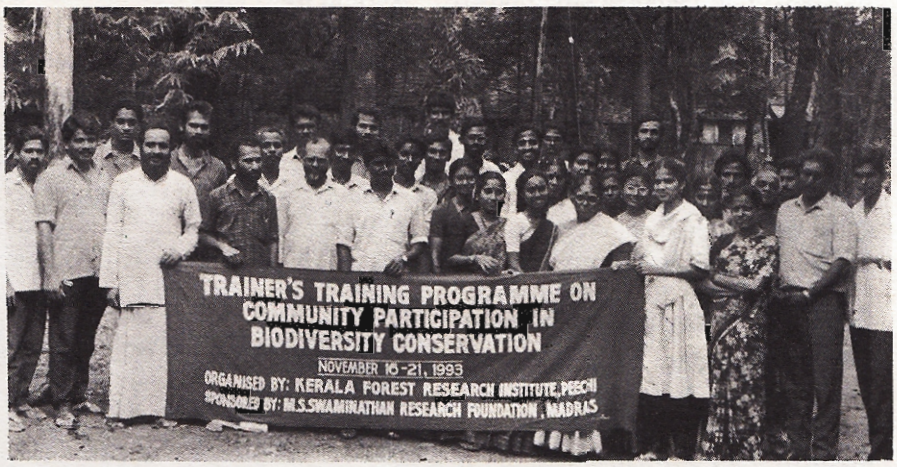
6. That pest and disease management be made a part of the regular management plan for plantations and the advice and inputs of plant protection specialists be sought at the planning stage.

7. Programmes similar to the lab-to-land programme of agriculture may be introduced for transferring newly developed technology to forestry practice.

8. The Symposium endorsed the recommendations contained in the Strategy Paper prepared for CIFOR (Centre for International Forestry Research) on Management of Pests and Diseases in Tropical Forestry.

Trainer's Training Programme on Community Participation in Biodiversity Conservation
November 16-21, 1993

A training programme for 28 participants from selected non-governmental organisations (NGOs) of Kerala on community participation in biodiversity conservation was organised at the Institute on 16-21 November 1993. The programme was sponsored by M.S.Swaminathan Research Foundation (MSSRF), Madras.



Participants of the Trainer's Training Programme

The programme was inaugurated by Shri.John Joseph, IFS (Rtd.) of MSSRF on 16 November 1993. Dr.S.Chand Basha, Director of the Institute presided over the inaugural function. Classes were organised to highlight the importance conservation of biodiversity for the betterment of humankind. Ways and means to conserve biodiversity in natural ecosystems like forests, man-made ecosystems such as agroforestry systems, plantations and agricultural systems, and through animal husbandry and traditional health systems were explained by eminent resource persons. An illustrated book entitled *Nammude Vrikshangale Ariyuka* (Know Our Trees - in Malayalam) prepared by Dr. U.M. Chandrashekara, Dr. K. Swarupanandan and Mr. Naushad of KFRI was released as a resource material for the training programme.

Training Course in Forest Seed Management
February 21-25, 1994

A five day training course on Forest Seed Management was conducted by KFRI in collaboration with Kerala Forest Department. The course was inaugurated by Shri. P.N. Surendran IFS, Chief Conservator of Forests (Development), Kerala Forest Department on February 21, 1994.

The course covered various aspects of seed management in 27 lectures. The topics covered include: seed development and maturation, storage techniques, seed pathology, seed pelleting, seed-orchard designs, biotechnology and seed technology of selected forest species. The lecture classes were supplemented by demonstrations and a field visit to seed orchard. Seventeen resource persons from organizations such as the Kerala and Tamil Nadu Forest Departments and Agricultural Universities, National Bureau of Plant Genetics Research, Institute of Forest Genetics & Tree Breeding and KFRI were involved in the training programme. Dr. K. Vanangamudi, Professor (Seed Technology) from Forest College & Research Institute, Mettupalayam, served as a full time resource person.

Seventeen officers from various governmental and non-governmental organizations attended the course, including 14 Forest officers from the Kerala, Karnataka and Maharashtra.

Shri. T.M. Manoharan IFS, Conservator, Thrissur Circle gave the valedictory address and distributed the certificates to the trainees on 25 February. Dr. Jose Kallarackal, Division of Physiology chaired the meeting.

Environmental Awareness Seminar, Vellakkarithadam, Trichur
March 20, 1994

As a part of the National Environmental Awareness Campaign 1993-1994 launched by the Ministry of Environment and Forests, Govt. of India and the State Committee on Science, Technology and Environment, Govt. of Kerala, KFRI organised an Environmental Awareness Seminar on March 20th at Vellakkarithadam in the Puthur Panchayat of Trichur District. A local NGO - The New Brothers Library, Vellakkarithadam and two *Janvidya Kendras* provided all local assistance for the purpose. Over 100 local people including 25 women participants attended the Seminar. Most of the participants were farmers residing near forests.

The programme was inaugurated by Mr. Pithambaran, Secretary, *Swaraj Sanskarikavedi*, Puthur. The classes covered subjects like the threats to global environment and need for environmental protection; the importance of Peechi- Vazhani Wildlife Sanctuary, in conserving wild flora and fauna; the role of forests in conserving soil and water and on biodiversity and its conservation for sustainable ecological and economic growth of a region. Lectures on the ecologically and economically sustainable homestead farming in Kerala and on how the homegardens reduce the pressure on natural forests by being the source of fuel, fodder and medicinal plants and minor forest produces were also given.

In the group discussion that followed, participants expressed their happiness over the whole programme and suggested that more of such programmes on other themes be organised in their locality. Local people evinced interest in organising a task force to conserve natural forest and to afforest degraded lands in their village with fodder and fuelwood trees.

A class being conducted for the participants of the Seminar

Training Programme on Conservation Biology for Foresters and Forest Guards from Medicinal Plants Conservation Areas (MPCA's) of Kerala
April 4-9, 1994

The Foundation for Revitalization of Local Health Traditions (FRLHT), Bangalore and KFRI jointly organised a six day training programme on Conservation biology of medicinal plants for forest staff from the Kerala Forest Department, who are involved in the activities in the Medicinal Plants Conservation Areas (MPCAs) in various regions of Kerala.

The Inaugural Session of the Training programme was held in the KFRI auditorium on April 4, 1994. Mr. T.M. Manoharan, IFS, Conservator of Forests (Central Circle) gave the inaugural address. Dr. S. Chand Basha, Director gave the chairman's address.

The Training programme consisted of lectures and demonstrations by invited speakers from the various Divisions of KFRI and from other Institutions. Subjects covered in the lectures dealt with the biodiversity and value of the medicinal plant heritage of India and the strategies and methods of conserving them *in situ* and *ex situ*. A visit was also arranged to a local Ayurvedic manufacturing firm and a field exercise conducted in the MPCA at Vazhachal. At the end of the Training, an evaluation was conducted by Dr. B.S. Somashekara, the representative from FRLHT.

KFRI and NRI (UK) launch Integrated Rural Bamboo Programme

An integrated rural bamboo project funded by the Forestry Research Programme of the ODA has been launched by Natural Resource Institute, UK in collaboration with KFRI. The main objective of the project is to develop multidisciplinary, institutionally sustainable and replicable approaches to promote the conservation and expanded utilization of homestead bamboo for producers and users with an emphasis on supporting sustainable poverty alleviation.

Dr. Chandrashekara distributing bamboo seedlings to farmers

One of the activities under this project is to promote homestead bamboo in the low rainfall unirrigated dry areas of the State. People of this area have already recognised that few other crops thrive well here due to acute shortage of water. Besides this, cultivation of bamboo in their homesteads is important not only to obtain fencing materials they require but also for the income that the bamboo culms brings.

On July 2, 1994, a bamboo promotion programme, was held at Pallam in the Muthalamada Panchayat in Palakkad District. Seedlings of *Bambusa bambos* (the thorny species) and *Thyrsostachys oliveri* were distributed to selected 83 families. The objectives of this activity and methods of planting and management of seedlings were explained by Dr. U.M. Chandrashekara and Ms. Sandhya Varma of KFRI. Another aim of the study is to understand the growth and performance of the introduced bamboo species and the change in socioeconomic condition brought about by the introduction of bamboo. Available information on bamboo and research data obtained from this project will be disseminated to farmers by holding training programmes and through participatory rural appraisal techniques.

KFRI Participates in the VIII Kerala Forest Sports & Games Meet, Thiruvananthapuram
May 15-17, 1994

After a long gap, KFRI participated in the 1994 Forest Sports and Games Meet, as one of the seven sports & games circles in the State.It was in 1981 that the Kerala Forest Department organized a sports & games meet for the first time for its employees.

Seventeen employees (2 women and 15 men) represented KFRI. KFRI won nine prizes (7 for sports & games and 2 for fancy dress) and secured 21 points. Mrs. Maria Florence and Dr. K.K. Seethalakshmi were selected to represent Kerala in the 1994 Bhubaneswar National Meet.

SAMPLE
(Ver. 1.0)

Software package for statistical analysis of sample survey data

SAMPLE is a collection of programmes useful for estimating population parameters like mean, total and ratio for different sampling schemes. The package covers a wide array of sampling schemes involving stratification, multistage and multiphase sampling with systematic or random sampling pattern at the final stage. It also takes care of ratio or regression estimation with an auxiliary variable and performs computations associated with probability proportional to size (PPS) sampling. The programme can handle upto 3 response (main) variables at a time and has built-in data editing facilities.

SAMPLE requires a minimum of 640 KB memory and runs under DOS Ver. 3.0 and above. It is completely menu-driven and involves no external commands other than the command to invoke the programmes.

The programme **SAMPLE** was developed at the Division of Statistics, Kerala Forest Research Institute. Peechi. The software is nominally priced at Rs. 2000 per copy to defer the cost of development. Interested people may make a request with a Demand Draft drawn in favour of:

The Director, Kerala Forest Research Institute, Peechi - 680 653, Kerala, INDIA.

KFRI Publications

Author/Editor	Title	Price	
		India (Rs.)	Foreign (US$)
K.S.S. Nair, *et al.*	Ecodevelopment of Western Ghats	200.00	18.00
K.K.N. Nair, *et al.*	Tropical Forest Ecosystem Conservation and Development in South and South-East Asia	200.00	18.00
I.V.R. Rao, *et al.*	Bamboos : Current research	140.00	15.00
N. Sasidharan	Forest Trees of Kerala	15.00	5.00
C. Renuka	Rattans of the Western Ghats	100.00	8.00
K.M. Bhat	Structure and Properties of South Indian Rattans	75.00	5.00
S. Chand Basha & K. M. Bhat	Rattan Management and Utilisation	300.00	25.00
K.V. Sankaran, *et al.*	Litter Dynamics, Microbial Associations and Soil Studies in *Acacia auriculiformis* Plantations in Kerala	75.00	8.00
Mammen Chundamannil	History of Forest Management in Kerala	50 (Individulas) 150 (Institutions)	15.00

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