KFRI

Evergreen

Half Yearly Newsletter of the Kerala Forest Research Institute, Peechi

Nos. 57 / 58 April 2006 – March 2007

From Director's desk...

There was a time when the term forestry was considered synonymous with plantation forestry. We see that over the years, the scope of forestry has enlarged enormously to cover diverse areas like biodiversity, watershed, agroforestry, ecosystems, eco-restoration, soil conservation, carbon sequestration, and so on. Our perception of forestry and forests has widened. Today, forestry is viewed almost synonymous with environment.

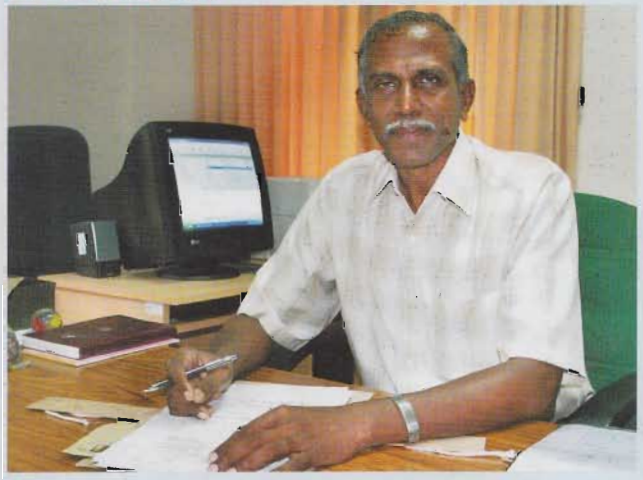
Forest can no longer be regarded as an infinite resource in the absence of conscious efforts to sustain it. It is not a mere source of timber anymore, but is an intricate system that supports life on earth by sustaining land, water, atmosphere and biotic components. Forests are large gene pools of much valuable genetic information, the potential of which is immense for the current and future generations. How a resource of such a spatio-temporal magnitude together with its environmental legacies should be managed in future requires serious thinking. The strategies so evolved should be pertinent at regional and local levels and at the same time, should achieve the overall objective of conservation of the global environment.

Kerala Forest Research Institute (KFRI) a premier research institute dedicated to tropical forestry has several areas of expertise that address the various aspects of the above-mentioned issues. The three decades' experience in diverse aspects of forestry spreads over areas such as nursery and plantation management, biodiversity documentation and conservation, wildlife biology and protected area management, watershed management and reclamation of degraded lands, bioshield planting, livelihood improvement of rural communities, cultivation of medicinal plants, landscape ecology and geographic information processing. This expertise can be utilized for judicious resource utilization, its enhancement, and the management of a healthy environment.

Endowed with a luxuriant forest wealth and a repository of a rich heritage of biodiversity, the Kerala State has a lead role to play in terms of environmental conservation. The literate population of the state is quick to recognize changes that are detrimental to the environment and acts as a catalyst for their correction. Moreover, the State Government has also been keen to bring in changes that can lead to prosperity to the society by supporting targeted programmes on forestry, environment, socio-economic development and long-term sustainability of resources like the land, water, biodiversity and the human resources.

With support from the Government and the Kerala State Council for Science, Technology and Environment (KSCSTE) and in close interaction with its sister concerns, KFRI is in a position to take up challenging issues related to forestry and environment. The social dimension of the problems is one thing that cannot be lost sight of; as a matter of fact, it is important that most of our research efforts focus on issues that are socially relevant and of immediate or long-term benefit. The Institute has a major role to play in the development of the State and its people, and we accept the challenges and work towards this end.

Dr. R. Gnanaharan takes charge as Director



Dr. R. Gnanaharan, the senior-most Scientist of KFRI, took charge as ninth Director of the Institute in January 2007. He has been the Research Coordinator and a member of the Institute's Management Committee.

Dr. Gnanaharan obtained his M. E. in Chemical Engineering from the Indian Institute of Science, Bangalore (1973), and Ph. D. from the University of Minnesota, USA (1979) in Wood Technology. He has made valuable contributions to timber preservation technology and is well known in the field. He is also known for his contributions to bamboo research.

KFRI looks forward to a fruitful period under his leadership.

'Buffer zone' management: Its past and present

Buffer zones of protected areas are designed to receive the tremor of human activities but at the same time checking them from reaching the core, which they surround and insulate. Aspects of buffer zone management in the context of India and Kerala are reviewed and the need for making an in-depth study of the buffer zone of the Silent Valley National Park is highlighted.

Buffer zone of protected areas

Protected areas are representative wilderness areas declared under the prerogative of governments for ensuring long-term protection which is enforced through adequate legal and managerial reinforcements. Established for the purpose of long-term conservation of biodiversity (plants, animals and microbes) these natural landscapes would remain in the future the living evidence of the bygone biospheres. World heritage sites, biosphere reserves, national parks and sanctuaries are different entities generally recognized under protected areas.

Many ecological, sociological and managerial issues are intricately interwoven into the architecture of the protected areas. Zonation is a fundamental strategy envisaged to allow protection combined with human use and the concepts of the *core zone* and *buffer zone* are two abstract ideas involved in this. When the core zone is the forbidden equivalent of the *sanctum sanctorum* of a temple, the buffer zone enables to ensure the sanctity of the former. Areas of prime importance for conservation are thus effectively 'fenced' by establishing buffer zones around, so as to minimize the negative impacts of human activities.

By definition, a buffer zone is 'any area, often peripheral to a protected area, inside or outside, in which activities are implemented or the area managed with the aim of enhancing the positive and reducing the negative impacts of conservation on neighbouring communities ...' (Wild & Mutebi, 1996).

The concept of buffer zone has undergone conceptual changes on the following lines:

- At first, buffers were mainly defined as a means to protect people and their crops from animals leaving the conservation areas and forests.
- Later, the buffer zone principle was applied as a remedy to protect conservation areas from negative human influences and to enhance the conservation value of the area.
- Presently, buffer zones are more often applied to simultaneously minimise human impact on conservation areas and address the socio-economic needs and wants of the affected population.

Benefits from nature conservation projects are typically of long gestation period and are often intangible or not easily quantified. By virtue of the classic economic view and as the benefits become available only in the distant future, appraisal of such projects through discounted measures often turns out to be unattractive. If market prices for environmental services and amenities do prevail at all, they are often an imperfect reflection of value; in other words, market failure works to the detriment of nature conservation efforts.

It is often difficult to integrate the direct and indirect benefits of nature conservation in an analytical framework and the incremental costs and benefits of establishing buffer zones are even more difficult to assess. However, the value and feasibility of buffer zones is indeed to be found in this incremental analysis. It is therefore difficult to establish the feasibility and sustainability of buffer zones from a purely economic point of view, even though such zones may have tremendous indirect (secondary, non-use and/or implicit) benefits (Eberget & De Greve, 2000).

The buffer zone approach is a long-term intervention for various reasons:

- It demands a participatory and process approach, which takes time. It also demands a change of attitude and even of cultural thinking, and changes that cannot be achieved instantly.
- Buffer zones are crucial areas for both people and nature. Therefore, careful planning based on complete information of the natural resource base and socio-economic context is necessary.
- The multi-disciplinary planning process is complicated, as many stakeholders at different levels will be involved, ranging from local/native people to government officials at the State and National level.
- It usually takes a long time to establish a stable institutional arrangement.

There does not exist a ready-to-use protocol for developing and managing buffer zones. Establishing buffer zones is highly situational and can only be achieved successfully through a process approach that includes all stakeholders and integrates ecological, social, economic and institutional aspects.

For various reasons, identification and formulation of buffer zone projects are normally based on limited information. Nevertheless, it is essential that these projects are well monitored and periodically evaluated. Clear criteria and indicators must be described before the actual implementation. Developmental components like stability, sustainability, equity and productivity should at the same time achieve the goals of protection, restoration and management of biodiversity. In appraising a buffer zone project, technical, sustainability and feasibility criteria including that of gender, poverty

alleviation and environment are to be applied. This implies that ecological, socio-economic, institutional, policy and physical indicators are to be worked out.

Buffer zones, the Indian context

In 1982 an Indian task force developed a 'Core-Buffer-Multiple Use Zone' strategy and this suggested separating incompatible land uses, particularly in relation to wildlife. In this approach, the buffer zone would be under the administration of the park authorities and controlled use of forest produce was permitted to some extent. The multiple-use zone was located outside the park boundaries designated for rural development (Berkmueller & Mukherjee, 1989).

The buffer zone in Indian context therefore refers to:

- A buffer entirely inside the park boundaries,
- A buffer with a sanctuary status adjoining the park,
- A buffer of reserved forest status adjoining a park or sanctuary.

Two simple but important qualifying necessities were also agreed upon for a functional buffer zone:

- The buffer zone cannot have a national park status as this carries too many restrictions, and
- In order to have maximum control over its use, the buffer zone has to be under the park authorities' jurisdiction.

However, it is clear that 'economic' buffer zones do not have much in common with conservation area management. In such instances liaison between the various responsible authorities is needed.

The Convention on Biological Diversity (CBD, 1992) does not explicitly mention buffer zones, but there are relevant indications pertaining to their management. Article 8 of this document deals with *in-situ* conservation, including the role of indigenous people:

8e. Promote environmentally sound and sustainable development in areas adjacent to protected areas with a view to furthering protection of these areas.

8j. Subject to its national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biological diversity and promote their wider application with the approval and involvement of the holders of such knowledge, ...

Although not all buffer zones deal with indigenous people, buffer zones could facilitate the participation and protection of their traditional rights. Article 10 deals with the sustainable use of components of biological diversity, and often relates to buffer zone management, as the use of components of biodiversity is often permitted in buffer zones.

In accordance with the international convention under the UNESCO Man and Biosphere (MAB) Programme, India declared its first Biosphere Reserve in 1986, the Nilgiri Biosphere Reserve (NBR) in the Western Ghats. The NBR is spread over an area of 5,520 km^2 in the three southern states namely Karnataka, Kerala and Tamil Nadu. In the initial stages of the deliberations, area falling in the NBR was suggested to be differentiated into a variety of zones such as Core Zones, Manipulation Zone, Agricultural Zone, etc. These zones were prescribed by the respective state governments and were to be managed according to the state rules. The core areas, about eight of them, were identified in the NBR (The Silent Valley National Park – foremost among them) have been recognized by the Ministry of Environment and Forests, Government of India, and all other zones were subsequently given a tentative status as 'buffer areas'.

The 'Project Tiger' and 'Ecodevelopment' initiatives

All the '*Project Tiger' Reserves* in India have a different zonation pattern comprising core zone, buffer zones and tourism zones. While the core areas of these reserves are mostly without extractive activities, a variety of human activities are permitted in the buffer zones. The Sabarimala Temple area, where the renowned massive pilgrimage is staged every year, belongs to the buffer zone of the Periyar Tiger Reserve (PTR). Ecodevelopment initiatives of the PTR is one of the excellent examples of how buffer zone management has given rise to positive changes towards conservation and at the same time reducing the negative impacts of conservation on the surrounding people (Government of India, 2005a). The ecodevelopment of the PTR was initiated as a World Bank aided project in 2000 and as on today it self-sustains even after the termination of funding. It is all the more encouraging that the Kerala Forest Department has nurtured as many as 73 Ecodevelopment Committees (EDCs) that cater to the overall buffer zone management of the PTR.

A pioneering study by KFRI in the early 1980s had brought out the alarming rate of 'vayana' (*Cinnamom*) bark collection prevalent in the PTR. The Kerala Forest Department, and particularly the determined staff of the Reserve, deserves appreciation, for being a model in transforming some of the poachers like the erstwhile vayana bark collectors to protectors of the Reserve. In this venture the role of Periyar Foundation which is 'a role model NGO' with government's control and approval is notable. Still more could be achieved if the good work initiated by the Department is carried forward with sufficient interaction and support from all the stakeholders including the academic/scientific communities.

The buffer zone of Silent Valley: An example

Among the many animal and plant species, *Macaca silenus*, the lion-tailed macaque, is an endangered primate found endemic to the Western Ghats. This

● Populations of Lion-tailed Macaque in Silent Valley

species has just two viable populations, one known from Ashambu hills and the other from Silent Valley. In Silent Valley, the species is known by 14 troops comprising a total of 275 individuals. These troops are restricted to the southern quarter of the Park, because of the obligate relationship existing between the animal and its food plants.

Out of the 14 troops, two troops inhabit the area outside the Silent Valley National Park. In fact, the entire area of the Silent Valley National Park is treated as core zone (of the Nilgiri Biosphere Reserve) and no separate buffer zone has been demarcated. The two populations therefore inhabit the potential buffer zone of the Park, which falls within the area suggested for the Pathrakkadavu hydro-electric project. If the so-called buffer zone is to be used for the hydro-electric project, hundreds of people (labourers and others) would be staying for prolonged periods in the area. Increasing canopy openings, poaching, forest fire, MFP collection, encroachment, and adverse changes in the physical environment, will be the result.

A buffer zone of a protected area can be considered 'fragile' on the following grounds. Drastic modification of the buffer zone will enable extraneous interferences to reach the core zone of the protected area. This in turn will affect the natural equilibrium existing there. The core zone is an area of high biodiversity, where, many rare and threatened plants and animals survive and is the last survival site for many of them. Opening up or modifying the buffer zone will be sacrificial to the core zone *per se* and to the species conserved there.

What is so alarming with the proposed Pathrakkadavu Dam is that it is just 500 m away from the natural habitat of the remaining viable lion-tailed macaque population and the ecological landscape of the Park. Virtually, the buffer zone and even the adjoining core area of the Park, where the macaque inhabits, will be adversely affected. The result would be a drastic reduction in the surviving population of the macaque to still lower counts and the risk of extinction of the species would be very high. In a previous Population-Habitat Viability Analysis (PHVA), the Silent Valley populations of the macaque was assigned a 'least-disturbed' status, based on the undisturbed vegetation and absence of any serious threat to the region. So, with respect to the lion-tailed macaque, the buffer zone of Silent Valley National Park is highly fragile. This is a very definite example with high probability while endangerment and survival of many other organisms would also be involved with the opening up of the buffer zone of the Park.

It is also heartening that the State Government has declared the area around the Silent Valley National Park as a buffer zone with scaling up of the protection staff too. It is the need of the hour to conduct an in-depth multidisciplinary study to bring out sufficient information on the socio-economic as well as biological aspects of the designated buffer zone of the Silent Valley National Park, which can be done with people's participation. This is more relevant in the context of the newly introduced the Scheduled Tribes Bill (Recognition of Forest Rights-2005; Government of India, 2005b).

References cited

Berkmüller K. and Mukherjee, S. 1989. Buffer zones in the service of eco-development. *Tiger Paper* Vol. XVI; No. 3: 12-19.

Eberget, A. and De Greve, P. 2000. *Buffer Zones and their Management: Policy and Best Practices for terrestrial ecosystems in developing countries.* International Agricultural Centre , Wageningen, the Netherlands. 64pp.

Government of India, 2005a. The Report of the Tiger Task Force: Joining the Dots. Union Ministry of Environment and Forests (Project Tiger), Government of India. 206p.

Government of India, 2005b. The Scheduled Tribes (Recognition of Forest Rights) Bill, 2005.

Wild R.G and Mutebi, J.,1996. Conservation through Community use of Plant Resources. UNESCO People and Plants. Working Paper No. 5.

K.K. Ramachandran
Forest Ecology and Biodiversity Conservation Division

We need a public Forestry Information Exchange (FOR-INFEX) for the State

The authors explain the scope and potential for developing a Forest and Environmental Information Exchange (FOR-INFEX) for the State. Forestry and environmental information would become a commodity of much demand in the near future, when an effective and dynamic mechanism of information transfer/exchange will be needed to cater to the requirements of the user population. The suggested FOR-INFEX is just that. In addition to the freely accessible online knowledgebase module and the assisted information exchange module, forest and environmental expert personnel are conceived as an integral component of this functional exchange. The exchange is supposed to mediate and facilitate smooth information transfer across information seekers and information holders/experts. The authors describe the relevance, philosophy, resource requirement, working strategy, and the different phases through which the exchange can evolve.

The last few decades have witnessed a growing awareness of the vital role of forests in global environment. The contemporary world uses 'forest' and 'environment' more or less interchangeably. The consequence of environmental degradation, depletion of principal resources of human consumption, pollution of life-sustaining resources like water, air and land, global warming and perforation of the ozone layer are some of the common subjects of great concern and debate these days. Thus, accelerated degradation of the environment and health/ survival-conscious society is going to be the future world order. Not only conservationists and environmentalists, but also policy makers, planners, economists, researchers, educationalists, judiciary, entrepreneurs, villagers and the student world would require Forest and Environmental (F&E) information in future increasingly.

The activities performed under Forestry and Environment (F&E) have increased several folds in recent years. They include plantation forestry, protected area management, conservation of rare plants, medicinal plant cultivation, cultivation of bio-diesel plants, growing multi-purpose trees, planting for pollution abatement, disaster control, watershed management, and so on. A corresponding diversification has also occurred in the F&E information users. However, information and knowledge are always localized. Thus, catering to the requirements of the F&E users is becoming a more difficult task. Making available the right information in the right place and in the right time is the crux of information handling that determines success, particularly in a society on its transformation to an 'information society'.

[illegible] information dissemination: [illegible]

It is not an isolated instance that a scientist or a subject expert in F&E sciences often finds it difficult to provide the required information to the information seeker approaching him. Quite often, the seeker may fail to obtain the required information for various reasons. It could be surprising that, though knowledge/ information generation is done by a large number of institutions, making the information available to the potential users or the public does not take place effectively. Much information remains frigid with the institutions where it is generated, unable to find way to the desirous or potential users. In other words, while information generation is considered the mandate of the institutions, making it available to the needy is not; this is quite a fundamental lapse. Denial of access to information and the consequent under-utilization of information are not socially justifiable.

Information: the non-correspondence between its generation and utilization

Unlike in the past, modern electronic and IT gadgets are quite efficient in performing the task of information transfer across varying ranges of recipient population. Yet information transfer does not take place the way it ought to have been. Economic reasons alone need not be the constraint on the part of the institutions. Even if the user is ready to pay for the contingent cost of information transfer, under the existing set up of public institutions, one need not succeed in getting the required information. This is because information remains in a form not suitable for easy transfer. The low importance given to information transfer has also contributed to this. The situation with F&E information is quite the same.

On the other hand, if we conceive transfer of the generated information as another fundamental mandate of the institutions, then there are various possibilities to achieve this. Infrastructure for 'effective information transfer' can be organized by working out a feasible, cost-effective set up. In a nation with surplus qualified human resources, instituting a strong information transfer mechanism will not only enable enhanced manpower utilization, but at the same time the society can reap common benefits out of it. It is against this background we can think of evolving a mechanism for effective information dissemination to the public.

[illegible] environmental information requirement: future trends

The following situations would compose a cross section of the future world. A state planner might ask, how

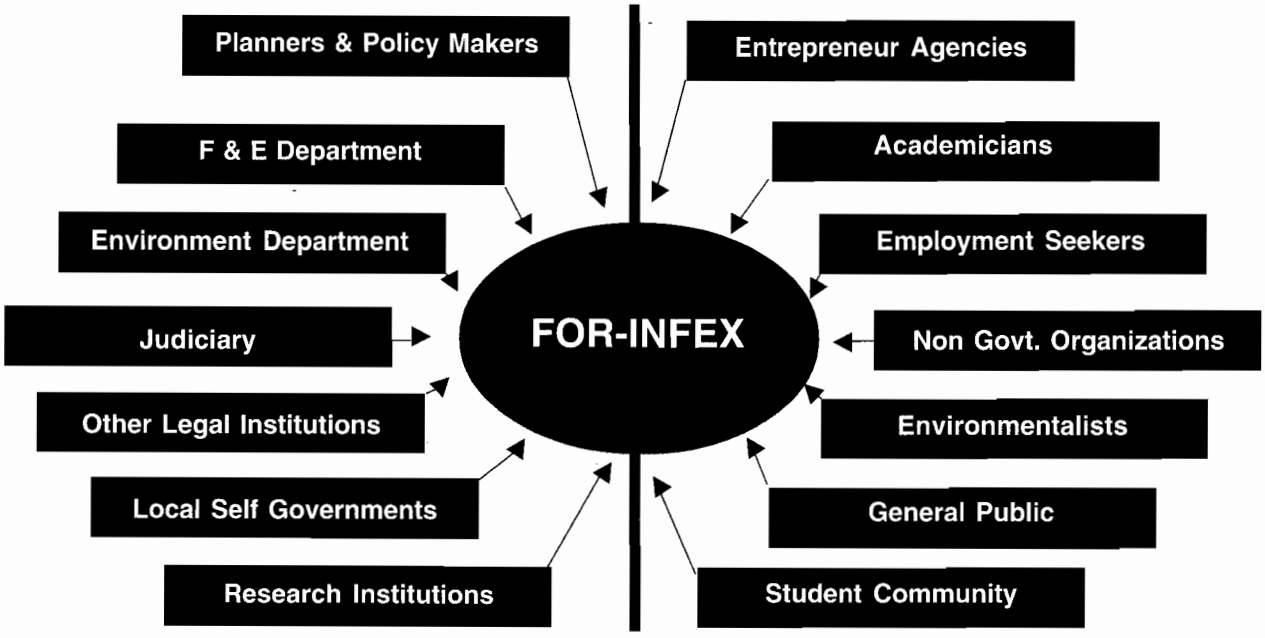
much of the population would benefit, if a particular (development) project were commissioned. An EIA agency might need the information as to what F&E rules and regulations would be binding on a particular developmental project? A highway planner might face the problem, on which of his options will least affect the natural ecosystems, but with a moderate project cost? An entrepreneur might explore for a list of competent specialists who can streamline and make their new initiative environment-friendly. A landscape specialist may be confronted with what species to suggest for planting in the given environment. Pre-project environment impact assessment is becoming an inevitable routine and F&E information is in great demand under such instances.

Gathering a list of more important stakeholders of a particular resource can be the concern for an agency wishing to generate public opinion regarding a proposed development project. An agency wishing to implement a certain F&E project might need to get a list of nature clubs/schools/ NGOs available in the area. A judiciary or a legal adviser might need to ascertain a certain ecological/environmental fact about an ecosystem. The two sectors of the academia, the students and the academicians, would also be tremendously benefited.

Forest officials in a variety of contexts would wish to utilize certain relevant databases. Databanks hosted on on-line sites could be very much useful for them while revising the *Working Plans*. Information on plantations, demand and supply of wood, auctions, offences, on-going activities, research initiatives, etc., are often sought. The information can also be useful to all other stakeholders of the forest resource including the Government and the public. Special packages for the identification of trees of the State, medicinal plants, pests, birds, snakes, butterflies, frogs, etc. can be useful for field foresters as well as naturalists. In short, F&E information would become much valuable for the public.

A 'Forestry/ environmental Information Exchange' (FOR-INFEX)

Any particular information, even when it exists, if not available in the desired place and time, is practically 'unavailable'. Many institutions and organizations generate F&E information. In India, government establishments like research institutions, university departments and other academic institutions contribute more than 60% of this and the rest is contributed by private concerns. However, the institutional mechanism for information sharing and exchange in the country has not been enabled to permit desired public utilization of the information. Lack of proper transformation of the generated information to deliverable forms and the missing 'information-exchange mechanisms' are bottlenecks. Prevalent social barriers qualifying 'official' and 'private', and strained personal relationships manifest forbidden corridors in information accessing. Conventional informatories dealing with F&E information exist; these institutions are quite inefficient to meet the information requirements of the expanding user population. The mechanism of information exchange is largely through technical and scientific reports and articles in journals, which are the domain of the academia. In the contemporary world, certain on-line domains also exist. However, when the information is to be used by the general public, comprising thousands of users, experts and information/knowledge units need to interact in a real-time dynamic-mode, where the mechanism should be cost-effective, simple and user-friendly. It should be capable of serving the less skilled average users who constitute more than 60% of the country/state's population. Developing a dynamic '***For****estry/ Environmental* ***Inf****ormation* ***Ex****change'* (FOR-



Various Stakeholders that might benefit from the FOR-INFEX

INFEX) is a promising solution. The FOR-INFEX should have structure, organization, functioning, and a philosophy quite different from what exists today in information generating institutions. This is the scope of FOR-INFEX as a new 'information exchange' mechanism which is not just an informatory.

A working philosophy for the FOR-INFEX

What could be the probable assumptions and philosophy for the emerging FOR-INFEX? Data, information, technology, knowledge, and wisdom are products of differing quality or magnitude of the information world. They are collectively addressable as 'Information Products' (IPs) and F&E Information Products' (FIPs) are a subset of the former. There are many, who require FIPs for various purposes, the F&E information seekers (*Seekers*), and there are many who hold FIPs, the information holders (*Holders*). Many holders are willing to help the seekers by sharing FIPs, while many are not able to do so because of time constraints.

Information sharing costs time both to the seeker and the holder - the *information sharing time* - in addition to the FIPs being shared. Quite often, the information sharing time is an impediment for information sharing, particularly of the holder. It is obvious that if information sharing time can be minimized, it is expected that the holders ready to share the FIPs would increase by several folds. For example, a personal meeting can be replaced by a telephone call, an information leaflet can replace an interview and the like. The FOR-INFEX should have an online module facilitating real-time access, although this alone will not suffice to perform the entire range of information exchange. Side by side with this, an assisted information accessing module facilitating information accessing in person, through mail, phone, fax or e-mail would also be required. Information exchange is often constrained by the distance between the holder and the seeker, both physical and status-related. FOR-INFEX, supported by modern IT gadgets can be an effective mediator and can overcome unfamiliarity and inapproachability across the holders and seekers. Thus the role of FOR-INFEX should be as an effective mediator rather than a mere informatory.

At times information sharing is hindered as some of the FIPs are expensive and not affordable to the seekers, when FOR-INFEX can facilitate information sharing by various means. Even if the FIPs are costly, some of the holders would still be ready to share them, if they get a minimal service charge for that. While some of the FIPs are monopoly of one and the only holder and not sharable, in most cases, there are a few to many holders of the same FIPs in the society, when selective approach might also be feasible. FOR-INFEX would be an effective mediator in such situations also.

Developing the FOR-INFEX: the resource requirement

Conceiving the development of a FOR-INFEX in a phased mode seems appropriate. Finance, equipment, information, personnel and infrastructure are needed for establishing a FOR-INFEX.

Personnel resources required for the functioning of the FOR-INFEX are of four kinds: (a) Experts, for initial setting up of the FOR-INFEX, (b) Subject experts, for sharing their F&E expertise or information resources, (c) Staff, to run the institution, and (d) Managers, to moderate and regulate. Specialists in F&E sciences and social sciences for framing the structure of the FOR-INFEX, and IT specialists for linking various information networks are needed. A large number of subject experts would be needed in order to provide the necessary information to users and they should be willing to share their time and expertise. Staff would be needed to receive the requests, to gather the information from various sources, to effect information transfer, or to 'connect' the user(s) to the expert(s) and must be well-versed with tools and conventions of IT and F&E information. When the FOR-INFEX becomes operational, proper coordination of the entire set up would also become inevitable.

Equipment resources include servers, computers, LAN, telephones, fax, archived databases, and access to specialized information sources. The master server will have to be 'mirrored' in order to ensure the safety of the assembled knowledge base and the user-holder interactions. Ample computer facility has to be ensured for mass storage, accessing and dissemination of the information. A local area network can provide connectivity across the workstations, and web connectivity can provide access to the vast outside information world. Telephone, photocopier and fax facilities would be needed for delivering the information to the users. Archived specialized information held in compact discs and flash cards would be another worthwhile knowledge bank. Contact address of experts such as mobile, phone, e-mail, fax, and postal are to be obtained and compiled, after obtaining their willingness to be part of the FOR-INFEX.

The FOR-INFEX: a working strategy

Primarily, the FOR-INFEX should assemble a knowledge base on various aspects of the F&E pertaining to the State and otherwise, hosted on a public domain/server for on-line access. The knowledge base may contain data types such as knowledge bases, databases, semi-automated expert systems, image banks, geographic information systems (GIS), bibliographic lists, expert lists, databanks of e-documents, glossaries/ dictionaries on F&E terms, list of various indices used in F&E sciences, and other relevant information. Databanks of the following categories of information would also be relevant: (a) Titles of developmental initiatives, (b) Titles of research initiatives, (c) Funding agencies, (d) Listing of F&E NGOs, and (e) F&E statistics (searchable form) pertaining to Kerala. Much of the information should be in a database mode enabling the people to search and find out the relevant information. A high-speed

'search engine' capable of multiple tasking is an unavoidable companion. A convenient registration facility should also be a built-in component of the system that permits experts, institutions, NGOs and the public to register their willingness to provide (a) expertise for the FOR-INFEX, or (b) human resources and collaboration for specific initiatives.

The FOR-INFEX should evolve sequentially at least through three different phases, viz., developmental, implementation and expansion phases.

During the developmental phase, a useful knowledge base has to be assembled. A meeting of selected few individuals concerned about instituting the FOR-INFEX – the *Interest Group* - may be called for and the matter discussed. With the help of this interest group, a list of experts has to be derived envisaging the future demand on information requirement. The interest group may include foresters, environmentalists, economists, industrialists, planners, sociologists, researchers and IT specialists. Potential experts capable of organizing information in individual subjects into a structured frame, have to be identified and contacted. The structure for assembling the knowledge base in each subject can be finalized after discussion with IT specialists. Once a somewhat sizable knowledge base has been built up, the same can be experimented with and improved upon.

In the implementation phase, the knowledgebase can be housed on a web domain for public access. Availability of information exchange for the public will have to be notified across the entire gamut of mass media and across institutions. Staff for running the FOR-INFEX will have to be recruited and further modules and equipments will have to be added. Side by side with this, potential experts willing to share information and expertise can be inducted to FOR-INFEX. This can be based on proven expertise and ability. The experts' list can be enlarged stage by stage by inducting more and more of them to join. Some can even be inducted on a payment basis. Invitation to join the programme can also be a mechanism for inducting people to join the venture. The service offered by FOR-INFEX or its mediation can be kept completely free during this period.

Once the FOR-INFEX is more or less operational, it can be institutionalized and opened up to the service of the wider public. Tie-ups with other information exchange systems, information dealers and more experts can be thought of during this phase. Regular 'personalized information service' can be thought of as an extended activity during the expansion phase. Under this facility the information seeker will receive only directly relevant filtered FIPs, when a minimal charging for the service might be feasible. Facilitation for document peer review across mutually unfamiliar seeker-holder pairs is another potential avenue. In a similar manner, suitable consultants for achieving specialized tasks can also be located, contacted and contracted using the FOR-INFEX's channel. Appropriate corrective measures and modifications would also be necessary of the working system. Eventually the FOR-INFEX can be transformed to a 'portal' (a streamlined consortium of sites and a sure site of information on a particular subject) or an 'Open Access Initiative' (OAI – a collaborate archive), when the public can also contribute to the enrichment of the knowledgebase. Providing e-storage facilities for archiving databanks and facilitating data mining can also be extended facilitations. Alternatively, a portal or an OAI can be planned in parallel with the FOR-INFEX's knowledge base.

What is feasible for Kerala now?

The Kerala Forest Department (KFD) is a potential umbrella for developing a FOR-INFEX. Kerala Forest Research Institute (KFRI) is an institution with 30 years' history and experience in F&E research. The former is custodian and the management authority of the State's forests and holds vast stock of old and recent records on forests/forestry in the State. KFRI has accumulated another equally valuable treasure of information on F&E and is the contact point for a good gathering of scientifically trained personnel expertise. Should these institutions join together, an unparalleled expertise and treasure house of F&E related information would result. Such a consortium of personnel expertise would be able to address the present and future F&E information requirements of the State. The social relevance of these institutions (KFD & KFRI) will be further justified, when the FOR-INFEX also provides service to the people. Institutions like TBGRI, CESS, CWRDM, NATPAK, KAU and the Kerala State Biodiversity Board (KSBB) could also enrich the FOR-INFEX by collaborating in the venture.

The FOR-INFEX has to function as a public F&E information exchange for the state and an effectively dynamic network of personal expertise. It should improve the F&E scenario of the State to desirable quality by facilitating unstrained information access/ exchange across the people. Such a dynamic informatory should also be instrumental in checking redundancy in developmental and research initiatives. For the Kerala Forest Department, giving start for such a noble and important initiative means giving the right momentum to societal progress, in the right moment. Other national agencies and the public might also be interested in seeing develop such an initiative, and might also be willing to facilitate it.

K. Swarupanandan and
V.S. Ramachandran
Forest Ecology and Biodiversity Conservation Division

Establishment of an Arboretum in KFRI

The Institute has established an arboretum in its main campus at Peechi. The five-hectare area of the arboretum now contains representations of 170 native tree species. All the existing trees and seedlings planted have been labeled. The arboretum thus serves as a demonstration plot facilitating familiarization of our native trees to students as well as all those interested in our natural flora.

Kerala is endowed with a bewildering diversity of flowering and non-flowering plants, inhabiting the varied ecosystems of the State. Angiosperms numbering to more than 4500 taxa (including trees, shrubs, herbs and lianas), constitute a dominant component of this diversity. A major proportion of flowering plants of Kerala are arborescent and they occur in five major forest types of the State, namely evergreen, semi evergreen, moist deciduous, dry deciduous and the shola forests. Apart from the *in situ* means of conservation, establishment of arboreta (tree gardens) is the most effective *ex-situ* method of conserving our rich floristic diversity.

The Institute is presently establishing an Arboretum of the natural floral elements of Kerala. The arboretum is established in five hectares of moist deciduous forest land within the Institute's main campus at Peechi.. Obviously, the species assembled are mostly components of the moist deciduous forests. Initially, the area was divided into 80 square subplots of 25m by 25m and each demarcated by concrete stumps. The subplots were graphically transferred to an area map of the arboretum. Next, maps of the subplots were prepared at a larger scale (2m = 1cm) and divided into grids at 2 m interval. All the standing trees were plotted, identified, accessioned and name boards provided. In the subplot maps, gaps for tree introduction were identified and marked.

Seeds of tree species not already represented in the plot were collected from natural forests and seedlings raised in the nursery. Altogether, seedlings of 136 indigenous tree species were planted in the identified tree gaps at 3 m by 3 m or 4 m by 4m spacing. While planting, the availability of space and the overall growth pattern of existing and introduced species were taken into account. An accession number was provided to each of the existing trees and planted seedling, as a means for its future identification. They were also provided with name boards containing botanical, family and local names and the date of planting. Necessary tending operations like casualty replacement, weeding and watering were done. Survival and growth of the planted seedlings are also being monitored.

Originally the natural stand of the arboretum had 726 trees belonging to 34 species, falling in 28 genera and 19 families. This included both gymnosperms and angiosperms. To this, 136 woody species belonging to 126 genera and 45 families were added by planting 2,825 seedlings. Each species added to the arboretum has 5-25 individuals. In total, there are representations of 170 species in the arboretum with a total holding of 3,550 individuals.

The live collection now includes more than 30 percent of very rare and endemic tree species like *Gluta travancorica* Bedd., *Dysoxylum malabaricum* Bedd. *ex* Hiern, *Diospyros bourdilonii* Br., *Myristica beddomei* King., *Syzygium travancoricum* Gamble, *Vateria macrocarpa* B. L. Gupta, *Hopea racophloea* Dyer, and so on. The gymnosperm represented is *Cycas circinalis* Linn. The live collection also includes important medicinal trees like *Oroxylum indicum* (Linn.) Benth. *ex* Kurz, *Emblica officinalis* Gaertn., *Terminalia bellirica* (Gaertn.) Roxb., *Terminalia chebula* Retz., *Santalum album* Linn., *Ficus racemosa* Linn., *Gmelina arborea*

Roxb., *Aegle marmelos* Corr., *Vitex altissima* Linn.f., *Wrightia tinctoria* (Roxb.) R. Br., *Saraca asoca* (Roxb.) de Wilde, and so on. Other interesting tree species represented in the live collection include *Antiaris toxicaria* (Pers.) Lesch. (Maravuri), *Diospyros malabarica* (Desr.) Kostel. (Panachi) and *Kingiodendron pinnatum* (Roxb. *ex* DC.) Harms (Oleoresin tree).

The arboretum is provided with trekking path. When fully developed, it will serve as a seed source of several forestry species, in addition to being a conservatory and a facility for studying the phenology and reproductive biology of the included species. The labeled live collection of trees is also of educational value, as a demonstration plot permitting familiarization of our native trees to students as well as all others interested in our natural flora.

Species presently represented in the arboretum

Acacia ferruginea
Acacia leucophloea
Acacia mellifera
Acacia nilotica
Actinodaphne malabarica
Adenanthera pavonina
Aegle marmelos
Aglaia barberi
Aglaia lawii
Ailanthus triphysa
Alangium salvifolium
Albizia amara
Albizia lebbeck
Albizia odoratissima
Allophylus cobbe
Alstonia scholaris
Alstonia venenata
Antiaris toxicaria
Aphanamixis polystachya
Aporosa lindleyana
Archidendron monadelphum
Artocarpus heterophyllus
Artocarpus hirsutus
Azadirachta indica
Baccaurea courtallensis
Bambusa bambos
Barringtonia acutangula
Bauhinia malabarica
Bauhinia purpurea
Bauhinia racemosa
Beilschmiedia wightii
Bixa orellana
Bombax ceiba
Briedelia airy-shawii
Caesalpinia coriaria
Caesalpinia sappan
Calamus prasinus
Calamus rotang
Calamus thwaitesii
Calamus travancoricus
Calamus vattayila
Calophyllum calaba
Calophyllum inophyllum
Canarium strictum
Carallia brachiata
Caryota urens
Cassia fistula
Chukrasia tabularis
Cinnamomum malabatrum
Cinnamomum verum
Clausena indica
Cleistanthus collinus
Cordia wallichii
Cryptocarya wightiana
Cycas circinalis
Dalbergia lanceolaria
Dalbergia sissoides
Dimocarpus longan
Diospyros bourdillonii
Diospyros buxifolia
Diospyros ebenum
Diospyros malabarica
Emblica officinalis
Erythrina stricta
Ficus dalhousiae
Ficus exasperata
Ficus racemosa
Ficus religiosa
Firmiana colorata
Flacourtia montana
Garcinia gummi-gutta
Gliricidia sepium
Gluta travancorica
Gmelina arborea
Grewia tiliaefolia
Gymnacranthera farquhariana
Delonix regia
Dichrostachys cinerea
Diospyros montana
Diospyros paniculata
Diospyros sylvatica
Dipterocarpus bourdillonii
Dipterocarpus indicus
Drypetes roxburghii
Dysoxylum malabaricum
Elaeocarpus tuberculatus
Haldina cordifolia
Harpullia arborea
Holigarna arnottiana
Holoptelia integrifolia
Hopea parviflora
Hopea racophloea
Humboldtia bourdillonii
Humboldtia vahliana
Hydnocarpus pentandra
Ixora brachiata
Kingiodendron pinnatum
Knema attenuata
Lagerstroemia microcarpa
Lagerstroemia speciosa
Lannea coromandelica
Leucaena leucocephala
Litsea coriacea
Maesa indica
Mastixia arborea
Melia dubia
Melicope lunu-ankenda
Memecylon lawsonii
Memecylon umbellatum
Mesua ferrea
Miliusa tomentosa
Mimusops elengi
Mitragyna tubulosa
Myristica beddomei
Psidium guajava
Pterocarpus marsupium
Pterocarpus santalinus
Pterygota alata
Radermachera xylocarpa
Samadera indica
Santalum album
Sapindus trifoliata
Saraca asoca
Schleichera oleosa
Semecarpus auriculata
Semecarpus travancorica
Senna siamea
Spathodea campanulata
Sterculia guttata
Sterculia urens
Stereospermum colais.
Strychnos nux-vomica
Strychnos potatorum
Myristica fatua
Neolamarckia cadamba
Nothopegia colebrookeana
Olea dioica
Oroxylum indicum
Otonephelium stipulaceum
Palaquium ellipticum
Peltophorum pterocarpum
Polyalthia fragrans
Polyalthia longifolia.
Pongamia pinnata
Prosopis juliflora
Swietenia macrophylla
Swietenia mahagoni
Syzygium cumini
Syzygium palghatense
Syzygium travancoricum
Syzygium zeylanicum
Tectona grandis
Terminalia arjuna
Terminalia bellirica
Terminalia catappa
Terminalia chebula
Terminalia crenulata
Terminalia paniculata
Toddalia asiatica
Toona ciliata
Trema orientalis
Trewia nudiflora
Vateria indica
Vateria macrocarpa
Vitex altissima
Walsura trifolia
Wrightia tinctoria
Xanthophyllum arnottianum
Xylia xylocarpa
Zizyphus mauritiana
Zizyphus xylopyrus

K. K. N. Nair, K. Yesodharan and **K. K. Unni**
Forest Ecology and Biodiversity Conservation Division

Notes on the rare leguminous tree, *Humboldtia bourdillonii* Prain

Humboldtia bourdillonii Prain was originally collected from the Peermade Ghats in 1894 and no details of the species was available for over a hundred years. The authors have generated valuable demographic details regarding the species.

Plants and animals having cosmopolitan distribution constitute only a very small proportion of the world's biota. The larger proportion of them, however, are endemic being restricted by geographic bounds of differing scales. Depending up on rarity (in terms of the population size) and possibly, a higher risk for extinction, the endemics constitute various categories such as critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), etc. Compared to the temperate, tropical forests abound in endemic biota falling in the above risk categories. Oceans, islands and mountains are also estimated to contain more concentration of endemics and rare biota. These are the segments of biodiversity that could be lost forever, if conservation efforts and species recovery programmes are not undertaken urgently.

From the point of biodiversity resources, India is an extremely rich country with as many as 17,500 flowering plants, 61 percent of which are endemics. Taking note of the prospective potential of the rarer segments of biodiversity and calling upon the urgent need to conserve these biogenetic resources, the Department of Biotechnology, Government of India, has launched a National Species Recovery Programme. To start with, a small number of highly endangered/threatened plants were given priority for investigation. Among other species, *Humboldtia bourdillonii* (Leguminosae) is a rare species under investigation by the Kerala Forest Research Institute, in collaboration with a few other institutions, the Botanical Survey of India, College of Forestry (University of Agricultural Sciences), Ponnampet, and the Kerala Forest Department.

The evergreen forests that clothe the Western Ghats show a high degree of endemism and out of 490 tree species found inhabiting the low and medium elevation evergreen forests, 308 are endemic. Looking at the floral elements of Kerala, which retains a larger segment of the Western Ghats, Sasidharan (2003) enlists 497 red-listed species. The economically important bean family, Leguminosae (also known as Fabaceae), with a global species count of 19,327 is represented in India by about 340 species. *Humboldtia* is one genus coming under the subfamily Caesalpinioideae having six species; all of them are confined to Southern Western Ghats, except one extending to Sri Lanka (Sanjappa, 1986). *Humboldtia bourdillonii* Prain is a medium-sized tree originally recorded from the Peermade Plateau of Southern Kerala. After the original collections made from Peermade by Bourdillon in 1894, there has been no subsequent report of the species (Sanjappa, 1991). Nearly after 100 years, Sasidharan (1998) relocated it from the Periyar Tiger Reserve (Peermade Plateau). It was again reported form the same area subsequently by Augustine (2002). Sasidharan (2003) ranked the species as 'endangered'. Apart from this fragmentary information, no other details of the species are available including its population size and specific details of distribution. During the erly 2007, we had the opportunity to investigate the distribution and population structure of the species, which we communicate in this note.

This species inhabits the wet evergreen forests of Pampa valley (Kerala) in the Peermade Plateau at Arjunan Kotta and Poonkavanam area, near Sabarimala at altitude ranging from 450 to 800 m msl. Contrary to the earlier notion that the species is a riparian element, it occupies areas between streamlets, 10-60 m away from the streamlets, preferring medium to high slope and rocky or bouldery ground. Basically, *H. bourdillonii* is cauliflorous producing flowers on the trunk as well as on branches and branchlets. Inflorescence is a mixture of cyme and raceme. Inflorescences are produced on the trunk, on slightly thickened or raised 'cushions'. The light pinkish flowers and the oblong, velvety-brown or reddish pubescent pods are very attractive. Viable seeds are available in the months from March to May.

A sample survey of the species was carried out in the forests of Arjunan Kotta and Poonkavanam falling within the Periyar Tiger Reserve (PTR). The species showed a patchy distribution. Seven discrete patches were identified in the region and the patch size varied from 0.1 ha to 2 ha. The largest patch was having an area of almost 2 ha and it being a narrow strip traversed a length of 1.2 km. The patches were found distributed at distances ranging from 177 m to 638 m from each other. The area of occurrence of the species in the above two areas was found to be approximately 2 km^2 and the area of occupancy (area sampled plus non-sampled area) 0.06 km^2. The common associates of *H. bourdillonii* are *Palaquium ellipticum, Mesua thwaitesii, Drypetes confertiflora, Vateria indica, Calophyllum tomentosum, Mastixia arborea, Myristica beddomei, Sageraea laurifolia, Reinwardtiodendron anamalaiense,* and species of *Ardisia* and *Lasianthus*.

Growing to a height of 25 m, the tree occupies the sub-canopy in evergreen forests and attains a maximum girth of 210 cm. The species is found well represented in all life stages, seedlings, saplings and trees. The estimated population size in the sampled areas is as follows: Mature trees (>= 30 cm gbh): 1,008, and saplings (>=10 cm and <30 cm gbh) 478. Number of

Recent flowering of different bamboo species in Kerala

Bamboos are renowned for their mass seeding and subsequent death of the clumps. Based on observations in forests, homesteads and bambuseta, the authors provide first hand information on the flowering of 11 species of bamboos found in Kerala. In *Dendrocalamus giganteus* and *D. stocksii*, they have identified a few clumps that revert to vegetative phase after flowering. Vegetative propagation of materials from these and monitoring their subsequent flowering behaviour are suggested, on the prospective potential of obtaining an unending regeneration cycle.

In recent years development of bamboo sector has been accorded a high priority in India. Establishment of large-scale industries has been envisaged throughout the country for manufacture of value added premium products. India has become self-reliant in the field of manufacture of bamboo machinery. Mechanized processing of bamboo has been introduced recently to enhance the product quality in traditional small-scale industries like mat weaving and basketry. All these developments have led to the increased utilization of available bamboo resources. Long-term plans for resource enhancement both by increasing productivity of existing bamboo areas and establishment of new plantations are being implemented in a mission mode to address the raw material shortage.

Availability of planting stock of selected species for new plantations is still a limitation. Plantations with known genetic age are necessary for prediction of year of flowering and management of raw material after flowering. Records on flowering and details on management of flowered areas are not available for many species of bamboos.

Most bamboos are monocarpic, *i.e.,* flowering once in their lifetime. They grow for decades, reproduce vegetatively and at the end of a certain period (specific for each species), they flower and the clumps die off. Flowering starts synchronously in all the daughter clumps originated from one parent clump even if they are widely separated geographically. The vegetative phase varies from one year to as many as 120 years among the various species. Continuous observations are necessary in areas where different species grow and within different populations of the same species, so as to identify flowering cycles of the species and different flowering cohorts of the same species.. Observations on flowering are also necessary in the context of collection of seeds to raise a seedling population with known genetic age. It also facilitates to study the post-flowering behaviours like death of clumps or return to vegetative phase, and also to study the natural regeneration of the species in the location.

From the forests of Kerala, seven genera and 25 species of bamboos have been reported. Several bamboo species seen in homesteads, were introduced from different parts of India and abroad. In addition, KFRI has one of the largest collections of Indian bamboos with as many as 70 species distributed in three bambuseta, one at FRC, Velupadam, the second at Sub-Centre, Nilambur, and the third at Devikolam. All these provided a good opportunity to document bamboo flowering in the State and conduct in-depth studies.

During our field investigations and visits to bambuseta in the last couple of years, flowering of 11 bamboo species belonging to four genera was encountered from different locations. The species are *Bambusa bambos*, *B. striata*, *B. tulda*, *Dendrocalamus giganteus*, *D. strictus*, *D. stocksii*, *Pseudoxytenanthera ritcheyi*, *P. monadelpha*, *Ochlandra ebracteata*, *O. scriptoria* and *O. travancorica*. The locations of bamboo stands, the nature of flowering, seed availability and post flowering behaviour of these species are given in table below.

Of the 11 species that flowered, profuse seed formation was observed for seven species (*Bambusa bambos*, *B. tulda*, *D. strictus*, *Pseudoxytenanthera ritcheyi*, *Ochlandra ebracteata*, *O. scriptoria* and *O. travancorica)*

trees across the seven patches varied from 17 to 390 and saplings from 18 to100. The results presented are part of an ongoing work and the estimates of population size presented are incomplete as some more areas adjacent to the areas sampled are to be explored.

Acknowledgements

This study was carried out with the financial support from the Department of Biotechnology, Government of India.

References cited

Augustine, J. 2002. Some threatened plants collected from Sabarimala and surrounding evergreen forests, Kerala. *Indian J. For.* 25 (3): 338-340.

Sanjappa, M. 1986. A revision of the genus *Humboldtia* Vahl (Leguminosae–Caesalpinioideae). *Blumea* 31: 329-339.

Sanjappa, M. 1991. Endemic legumes of Western Ghats. Pages: 30-43. *In*: Karunakaran, C.K. (ed.). The Proceedings of the symposium on rare endangered and endemic plants of the Western Ghats. Kerala Forest Department (Wildlife Wing), Thiruvananthapuram.

Sasidharan, N. 1998. Studies on the flora of Periyar Tiger Reserve. *KFRI Research Report No.150.*

Sasidharan, N. 2003. Red listed threatened tree species in Kerala: a review. Pages: 1-12. *In*: Jose Kallarackal, J., Swarupanandan, K and Sharma, J.K. (eds.). *Conservation and research needs of the rare, endangered and threatened (RET) tree species in Kerala part of the Western Ghats.* Proc. Workshop. KFRI, Peechi.

V.S. Ramachandran and
K. Swarupanandan
Forest Ecology and Biodiversity Conservation Division

Details of flowering of various species of bamboos in Kerala between 2003-2007

No.	*Species* (*Synonyms*)	Year of flowering, Localities	Seed formation, Post flowering behaviour
1	*Bambusa bambos* Voss = *B. arundinacea* Retz.	2006-07. Wyanad, Attappady, Vazhachal, Edamalayar. Homesteads of Malappuram Palakkad and Trichur Districts	Profuse seed production. Flowered clumps dried after seed set.
2	*Bambusa striata* Lodd.*ex* Lindl. = *B. vulgaris* var. *striata* (Lodd.*ex* Lindl.) Gamble = *B. vulgaris* var. *vittata* A. & C. Riviere	2006-07. Tiruvalla, Kottayam.	No seed formation. Flowering continues in the clump.
3	*Bambusa tulda* Roxb. = *Dendrocalamus tulda* (Roxb.) Voigt	2003-04. KFRI Bambuseta; both in Nilambur and Velupadam.	Good seed production. Flowered clumps dried after seed set. A seedling population is maintained at FRC, Velupadam.
4	*Dendrocalamus giganteus* Munro = *Bambusa gigantea* Wall.	2004. Kallupara, Kottayam. 2006-07. Civil Station, Kozhikode. Kanjikuzhy, Kottayam.	Limited seed production. Out of the three clumps flowered in 2004 one reverted to vegetative phase.
5	*Dendrocalamus strictus* (Roxb.) Nees = *Bambusa stricta* Roxb.	2004-06. Attappady.	Profuse seed set. Flowered clumps dried. Seedlings were produced and used for afforestation programme in Attappady Hills.
6	*Dendrocalamus stocksii* (Munro) M.Kumar, Ramesh & Unnikrishnan = *Pseudoxytenanthera stocksii* (Munro) Naithani = *Oxytenanthera stocksii* Munro	2003-06. Cherkkala, Chattanchal and Kanhangad in Kasaragod District. One clump in KFRI bambusetum, FRC Velupadam, collected from the same location also flowered synchronously.	No seed formation was observed in any of the flowered clumps. Some of the flowered clumps in Kasaragod District and the flowered clump in the bambusetum reverted to vegetative phase.
7	*Ochlandra ebracteata* Raizada & Chatterji	2003-04. Edapalayam, South Kerala. Synchronous flowering of the seedlings of 1992 flowering in Edapalayam and in FRC bambusetum, Velupadam.	Seed formation was observed and flowered clumps dried after seed set.
8	*Ochlandra scriptoria* (Dennst.) Fisch. = *Bambusa scriptoria* Dennst.	2007. Flowering is observed in 5 clumps in KFRI bambusetum, FRC, Velupadam. The material was collected from Pandalam.	Seed set has been observed. Post flowering behaviour of the clumps is being monitored.
9	*Ochlandra travancorica* Benth. = *Bheesa travancorica* Bedd.	2004. Neriamangalam. 2007. Mankulam.	Profuse seed set was found. Flowered clumps dried after seed set. Seedlings were raised from the seeds of 2004 flowering and distributed to various Panchayaths.
10	*Pseudoxytenanthera ritcheyi* (Gamble) Naithani = *Oxytenanthera monostigma* Gamble	2006-07. A few clumps in Nilambur. Synchronous flowering of the plants raised from this mother stock and planted in KFRI campus, Peechi.	Seed formation was found in the plants flowered at Peechi campus. The flowered clumps at Nilambur were completely destroyed prior to seed formation.
11	*Pseudoxytenanthera monadelpha* (Thw.) Soderstrom & Ellis = *Oxytenanthera monadelpha* (Thw.) Alst.	2006-07. Rajamala, Eravikulam National Park, Munnar.	No seed formation was observed. The flowering still continues and post flowering behaviour is under observation.

while very few seeds developed in one species (*Dendrocalamus giganteus*) and no seed formation was seen in three species (*B. striata, D. stocksii, P. monadelpha).*

Observation on flowering of any species provides an opportunity to document the flowering year of that population and understand the reproductive biology. If seed setting occurs, production of a seedling population with known genetic age becomes possible. When these seedlings are used as planting stock, the year of flowering can be predicted in advance. Such prediction is useful to plan strategy to be followed for utilization of excess raw material resulting from the

Gregarious flowering and death of *B. bambos* at Attappady

Seeds of *D. giganteus*

Reversion to vegetative phase in *Dendrocalamus stocksii.*

Inflorescence of *Dendrocalamus giganteus*

Flowering of *Pseudoxytenanthera monadelpha* at Munnar.

death of flowered clumps and also to cope with the possible shortage of raw material that follows.

In bamboo, the scope of genetic improvement through selection and hybridization is limited and the benefit of such selected clones will last only for one generation. When selection is made from populations that are already at harvestable stage and once these elite clones are vegetatively multiplied, the daughter clumps also inherit the flowering timing from the parent. This will cause the daughter clumps to flower prematurely along with the parent and subsequent death.. Juvenile selection of superior planting stock from seed- derived populations provides an opportunity to harvest the benefits of selection for a longer period.

It is usual that many gregariously flowering sympodial bamboos die after seed set. However, during our field visits, a few clumps of *Dendrocalamus giganteus* and *D. stocksii,* were found reverting to vegetative phase after flowering. It is interesting to note that, seed formation was limited in the former and absent in the latter. It is worth exploring the flowering behaviour of vegetatively propagated planting stocks derived from these clumps. If they also do not die off after flowering

Reversion to vegetative phase in *D. giganteus*

and revert to vegetative phase subsequently, mass multiplication of the stock and establishing plantations can be quite promising as this would practically queue up an unending regeneration cycle.

K. K. Seethalakshmi[1], **V. P. Raveendran**[2], **C.M. Jijeesh**[1] and **V. B. Beena**[1]

[1] *Sustainable Natural and Plantation Forest Management Division* [2] *Extension and Training Division*

A Bioresources Nature Park in the KFRI Sub Centre

The recently established Bioresources Park at the KFRI Sub Center, Nilambur, is an effort to bring together the various segments of our biodiversity in one place. It provides an opportunity for the public to see and get informed about our valuable heritage of plant and animal wealth; along with, it also performs the function of extending environmental education. In addition to having separate display of various groups of plants, the Park has an attractive Orchid House, Succulents Garden, Palms Garden and a Butterfly Garden.

The major issues in biodiversity conservation include over-exploitation and endangerment of biological resources and loss of habitats of flora and fauna in the face of growing human population. At the present rate of habitat loss, by the year 2030, about 1/3 of biodiversity in India would be extinct or would remain in isolated refugia of non-viable populations which may enter into the vortex of extinction. Conservation of our bioresources in their native habitat, no doubt, is the best way to preserve them in view of the persisting threats due to various anthropogenic activities. However, *in-situ* conservation measures alone may not be always effective and feasible. In this context, conservation, both in and outside their native habitat and mass propagation of plants are important. Thus, the Kerala Forest Research Institute (KFRI) has initiated a programme to establish a *Bioresources Nature Park* with the financial assistance from the Department of Biotechnology, Government of India, at the KFRI Sub Centre, Nilambur.

The Park was inaugurated on 12-02-2007 by Shri. Binoy Viswam, Hon'ble Minister of Forests, Government of Kerala, in a public function presided over by Shri Aryadan Mohammed, MLA. The Park is located adjacent to the Teak Museum en-route to Mysore and Ooty on the western fringes of the Nilgiri Biosphere Reserve, which is also an important ecotourism zone in the Western Ghats. Being the result of a conscious effort of gathering all different segments of the plant diversity of the State, the Park is an educative masterpiece giving opportunity of familiarization of the plant wealth of the State, and to get information about its ecological, social, cultural and economic importance.

The Bioresources Nature Park has conservation themes for the lower groups of plants (such as algae, bryophytes and pteridophytes), plants found in specialized ecological niches such as xerophytes (cacti and succulents) and hydrophytes (aquatic plants), beneficial plants (medicinal), ornamental and aesthetic plants (orchids) and endemic, rare, and threatened (RET) species. Propagules of over 700 species of plants have been collected and introduced in the thematic areas of the Nature Park. In the *Orchid House* one can see many rare orchids, South Indian endemics, medicinal, commercially important and ornamental ones. The *Fern House* contains about 75 species of ferns. Here also,

Bioshield for protection of coastal areas - bamboo planting with people's participation

This is the report of a lab-to-land programme organized in connection with the establishment of a coastal bioshield along the Munackal Beach, Thrissur District.

The serious damage caused to coastal ecological and economic resources by recent Tsunami disaster has alerted the public and policy makers alike on the need for measures to counter the effects of such natural calamities. Establishment of bioshields along the coast with suitable plant communities such as mangroves, salinity tolerant species, *Casuarina* and some of the multipurpose species like bamboo is a means for protection of coastal regions.

KFRI, Social Forestry Wing of Kerala Forest Department and Eriyad Grama Panchayath jointly initiated a programme for establishment of Bioshield. Bamboo planting with people's participation was taken up as part of this programme. On an experimental basis, a stretch of 1 km was planted in two rows with seven bamboo species viz. *Bambusa striata, B. tulda, B. vulgaris, Dendrocalamus asper, D. brandisii, D. longispathus* and *D. strictus* behind the *Casuarina* belt already established during the previous year at Munackal Beach, Eriyad Panchayath, Trichur District. The progamme was inaugurated by Hon. Minister for Forests and Housing Shri Binoy Viswam at a function presided over by Hon. Minister for Revenue Shri K. P Rajendran at Munackal, Eriyad Panchayath on 25 August 2006.

After taking an oath to protect the bamboo plants, the planting was done by voluntary participation from schools, colleges and Kerala Agriculture University, SHGs, NGOs, Government officials, representatives from local bodies, fisheries, agriculture and forest departments and several nature clubs in the locality. The benefits of bioshield were explained by Dr. J. K. Sharma, Director, KFRI and Shri Sheik Hyder Hussain, ACF, Social Forestry. KFRI is maintaining the planted area as an experimental plot and evaluating the performance of different species periodically to identify suitable bamboo species for bioshield establishment in coastal areas.

Shri K. P. Rajendran Hon. Minister for Revenue and Shri Binoy Viswam, Hon. Minister for Forest and Housing launching the programme

Participants planting bamboo.

K. K. Seethalakshmi
Sustainable Natural and Plantation Forest Management Division

endemic, rare and endangered ferns and species with ornamental value are assembled. Another attraction of the Park is the *Aquatic Plant Area*, where different kinds of water plants such as floating hydrophytes, submerged and rooted hydrophytes, emergent rooted hydrophytes, and floating leafy and rooted hydrophytes are grown. The *Xerophytes and Succulents Garden* has an outdoor rock garden and a greenhouse displaying medicinal and ornamental plants. A *Gymnosperm Garden* with five native gymnosperms and certain exotic species, which are of academic interest, is being established in the *Nature Trail.* Living thallophytes and bryophytes are grown in a specially designed shade house with mist and drip irrigation. In the *Palm Garden*, apart from over 40 ornamental palms, many species of economic, ecological and cultural significance are assembled. The *Butterfly Garden* hosts many flipping colourful butterflies. The juvenile caterpillars of these butterflies feed on foliage of specific plants. Thus, diverse forms of eggs, caterpillars and pupae of a variety of butterfly species can be seen.

An interesting cultural antiquity of the Park is the megalithic burial ground, dating 1800 to 2300 years back in history. Situated at one corner of the Park, these burials provide an opportunity to the visitors to learn more about the Megalithic civilization and the then culture. They also highlight the archeological and historical importance of Nilambur.

U.M. Chandrashekara
Sub Center, Nilambur.

KFRI Research Reports

[illegible] of regression sites selective logging in evergreen forests of Kerala. KFRI Research Report No. 278 (Chandrashekara, U.M., 2006).

In a humid evergreen forest of the Western Ghats of India, density and basal area of primary, late and early secondary tree species, both in seedling and tree phases in the undisturbed plot were compared with those in: (a) selectively logged plots with post-logging duration of 14 to 23 years, and (b) area around the logged tree and area covering coupe roads and adjacent to them within each logged plot. Although, the basal area of primary species in tree phase in selectively logged sites can become equal to that in unlogged forest in about 20-25 years, seedling and tree density and seedling basal area remained less in logged plots. The study also demonstrated that the primary species showed less fluctuation in population size apart from differences in the duration of the post-logging period. Compared to the unlogged forest, logged plots still retained the structural features characteristic of secondary forests such as higher density and basal area of secondary species. The study also indicated that the population of secondary species is sensitive to length of the post-logging period. However, time required for the logged forests to regain values for a given parameter comparable to that in unlogged forests differ; it takes less time for the reduction of density than for the decline of basal area of trees of secondary species. The recruitments of late secondary species in logged forests continue to be more in samples having a post-logging duration of 32-36 years. In terms of seedling and tree density, secondary species composition and basal area, it is expected that a minimum post-logging duration of 80 to 90 years will be required for the secondary forests to simulate the primary forests. It is concluded that the degree of disturbance caused by selective logging in the evergreen forest is severe and that the prescribed felling cycle of 40-45 years is too short for the forest to recover from the impacts of selective logging.

Biodiversity of plant pathogenic fungi in the Kerala part of the Western Ghats. KFRI Research Report No. 280 (Mohanan,C., Sankaran, K. V. and Yesodharan, K., 2006).

An extensive survey on plant pathogenic fungi in the Kerala part of the Western Ghats carried out during 2001-2004 revealed a rich fungal flora harboring the plants in different forest ecosystems. Of the 4,101 fungal isolates obtained in the study, 60 pathogenic fungi were new species. A total of 151 pathogenic fungi were found to be new records for the Western Ghats, while 104 pathogenic fungi are reported for the first time from India. Altogether 639 plant species belonging to 395 genera were found infected with pathogenic fungi. Of these, 175 plant species were found as new host records for different pathogens.

Among the different forest ecosystems studied, forest plantations supported a rich pathogenic fungal flora with plant-pathogenic fungal ratio as high as 1:14. In moist deciduous and semi-evergreen forests, the figures of plant-pathogenic fungal ratio are 1:3.1 and 1:3.48 respectively. Shola forests and wet evergreen forests registered comparatively low plant-pathogenic fungal ratio of 1:1.65 and 1:1.46 respectively. In forest nurseries, though, a large number of host plants (154) were found diseased with the fungal pathogens, the plant-pathogenic fungal ratio is only 1: 3.77. Monoculture exotic plantations and disturbed natural stands support a large number of fungal pathogens. Anthropogenic disturbances including forest fires seem to be the major contributing factors for incidence and spread of fungal diseases and thereby build-up of pathogenic fungal populations.

Biodiversity indices for plant pathogenic fungi in different forest ecosystems in the Western Ghats were worked out separately. Fungal species richness indices (Margalef's index and Menhinick's index) ranged from 2.5605 to 5.6652 and 4.0899 to 21.0853 respectively. Among the eight forest ecosystems studied, moist deciduous forests exhibited maximum fungal species richness. Fungal species diversity indices (Simpson's index and Shannon's index) were deduced for each forest ecosystem, which ranged from 0.0228 to 0.1183 and 1.1026 to 2.4482 respectively.

With regard to the community structure and species composition, almost same fungal flora was observed in moist deciduous, semi-evergreen forests, and forest plantations; however, fungal species dominance and abundance reflected the environmental conditions, level of disturbances, as well as host plant status.

Evaluation of plant diversity in unlogged and logged forest stands of varying intensities. KFRI Research Report No. 281 (Balasubramanyan, K. and Menon, A. R. R., 2006).

The effect of logging on plant diversity and regeneration was studied in three tropical forest sites in Kerala. The sites are at Goodrikal RF in Ranni Forest Division in southern Kerala, Sholayar RF in Vazhachal Forest Division in central Kerala and Kottiyoor RF in Kannur Forest Division in northern Kerala. Statistically designed plots were laid out in unlogged and logged forests of different types in all the three sites. The vegetation analysis and regeneration evaluation were done by conventional ecological methods. The microclimate was monitored using thermo-hydrographs at various places for one year. Regeneration data were gathered for un-established and established seedlings, saplings and poles of the area. It is interesting that species, which are highly aggregated, are still present in low numbers as rare species in the same sites. The presence of *Podocarps* in some parts of Moozhiyar Reserve (near Urani) indicates that even a species, which is no more

than a competitive equal in some areas and at a distinct advantage elsewhere, can persist in the forest for very long periods before going locally extinct. Clumping of species is yet another interesting feature noted in the area. The sparse sub-populations do self-sustain or simply represent accidental establishments of rare individuals, because of good site factors.

KFRI Research Report No. 282 (Sharma, J.K., Mathew, G. and Easa, P.S., 2006).

Biodiversity of selected landscapes at five different locations was studied with the active participation of college teachers and students. In Cheruvathur Grama Panchayath, the study was carried out in different habitats such as lateritic plateau, sacred groves, rice fields and human settlements. A total of 295 species of plants belonging to 239 genera under 82 families were recorded. With regard to the fauna, seven families of butterflies, four families of anurans, six families of reptiles, 30 families of birds and 13 families of mammals were found represented in the study area. In all locations, the natural vegetations supported rich biodiversity. Settlements and paddy fields were relatively poor in biodiversity probably due to pesticide and chemical fertilizer usage.

In the case of Muthur Grama Panchayath, 45 species of plants comprising trees, herbs and shrubs were recorded which included various ornamental and medicinal plants. With regard to fauna, the anurans such as Jerdon's Bull Frog and Martens Bush Frog; the reptiles such as Buffer-striped Keelback and Common ptyas and the birds such as Black headed Oriole, Purple rumbed sunbird and Purple sunbird were characteristic to this area. Several species of spiders, 24 species of butterflies, six species of amphibians, five species of reptiles and 30 species of birds have been recorded.

In Paliyamangalam, Ayilamudichi Hills (Nemmara), four species of fungi, crustose lichens growing on rocks and tree trunks, bryophytes, pteridophytes, monocots and various aquatic plants have been recorded. With regard to fauna, several unidentified species of beetles, 37 species of butterflies, eight species of primary and secondary freshwater fishes and 23 species of birds were recorded. The faunal elements included several species of rare butterflies including *Phalanta phalanta* and *Castalius rosimon,* exotic mollusks (*Achatina fullica*) and *Vaginulus* sp., birds such as Malabar grey hornbill and Wagtails, and mammals such as Sambar deer, spotted deer and wildcat. Of the various ecosystems, the moist deciduous forests contained maximum number of species.

KFRI Research Report No. 284. (Menon A.R.R., 2006).

Biodiversity characterization at landscape level has been carried out in Kerala using IRS satellite data. The study was undertaken jointly with the Department of Space and is part of a major initiative taken up by the Department of Biotechnology under its Network programme for Bioprospecting, commenced in 1997. The programme is a true implementation of "gene to ecosystem" concept in biodiversity conservation and prospecting. This project is a pioneering effort to create geospatial database on vegetation cover types, disturbance regimes and biological richness. The spatial data have been linked to the species database and field data from different strata of vegetation. Detailed sampling was performed in comparatively undisturbed forests of Goodrikal reserves in Ranni Forest Division, with an ecological insight, to understand the forest dynamics. The information system evolved in the present study through multicriteria analysis in GIS, facilitates the rapid assessment of biodiversity and its monitoring (loss and/or gain), assessment of nature of habitats and disturbance regimes, evolving species-habitat relationship, mapping biological richness and gap analysis, and prioritizing conservation and bioprospecting. A very detailed land cover map of the area was prepared using aerial photographs and satellite imageries. The density sliced version of the cover map was also generated using digital mapping techniques and is the basis of the sampling site selection. The vegetation data were gathered and analyzed for 25 selected localities, representing the different forest types and density levels. The slope class map, contour map etc. are also generated from the available terrain information. The structure of the forest vegetation and the distribution of different forest types are described in detail.

Optimization of harvesting and post-harvest technology to economize bamboo resource utilization. KFRI Research Report No.285 (Bhat, K. V. and Varma, R.V., 2006).

A study was conducted to examine the possibility of improving the harvesting and post-harvest technology of two common bamboo species viz., *Bambusa bambos* and *Dendrocalamus strictus*. As an outcome of the study, a simple branch-cutting tool was developed for removing the thorny branches prior to culm extraction. A traditional method to judge the culm age/maturity for harvesting, based on culm tissue colour was examined and was found to be reliable supplementary feature for culm age determination.

It was found that the susceptibility of bamboo culms to *Dinoderus* beetles was dependent on starch content of culms. The beetles and their larvae were found to prefer the inner, starch-rich portion of the culm wall for more productive feeding. The extent of starch content seemed to depend on locality and favourable growth conditions. Within a year, starch content was found low from September to November. The natural borer population and the intensity of infestation were also low during this period. An interesting observation noted during the study was the slow depletion of starch from culms during post-harvest storage due to the activity of amylase enzyme.

Among the traditional methods followed in rural areas for post-harvest protection of bamboo submersion of harvested culms in water for one to three months was found effective in preventing borer damage. Submersion caused degradation of storage starch in culm tissues due to the action of saprophytic microorganisms, a fungus of the genus *Acremonium* and bacterial species belonging to the genera *Pseudomonas* and *Klebsiella*. Other physical treatments such as heat curing/boiling in water were not effective. Similarly, harvesting trials conducted for one complete lunar month did not indicate any influence of the waning or waxing phases of the moon on the extent of borer damage. Among the traditional biological treatments, a preservative formulation of nine biological ingredients used by local carpenters for protection of wood was found to be effective against bamboo borers. Similarly application of neem oil was also equally effective. Brush application of these preservatives/repellants on the cut ends and branch scars of bamboo culms gave protection from beetles.

Based on the results obtained, an integrated pest management strategy to protect bamboos from *Dinoderus* beetle damage is suggested. This involves cutting the bamboo at low starch period, adopting traditional methods like water soaking, application of preservatives and following improved methods of stacking.

KFRI Research Report No. 286 (Mathew, George, 2006)

The prime objective of this project was setting up of a butterfly house to facilitate education of the public on the significance of nature conservation. As a matter of fact, a butterfly garden was established in the KFRI Sub Centre Campus at Nilambur. The garden was a great success in that about 50 species of butterflies were sighted annually, some of which developed local populations. Eight species recorded in this study are protected under the Indian Wildlife (Protection) Act and six species are Western Ghat endemics. The most spectacular result was the multi species aggregation of danaine butterflies (*Danaus genutia, D. chrysippus, Tirumala limniace, T. septentrionis* and *Euploea core*) on *Crotalaria retusa* during the months June to November with 30-40 butterflies roosting per plant. Exhibits depicting butterfly life stages were set up in the garden for providing information on the life of butterflies. The research report also contains information pertaining to the general requirements for setting up a butterfly farm along with a brief discussion on the problems and prospects of this enterprise.

Tracing the origin and spread of teak defoliator outbreaks through a molecular approach. KFRI Research Report No. 287(Sudheendrakumar, V. V., Varma, R. V. and Sajeev, T. V., 2006).

The teak defoliator, *Hyblaea puera*, is the most important pest of teak in India. An understanding of the origin and spread of the outbreaks of this pest is an important prerequisite for developing appropriate control strategies. The present study was undertaken in about 8,500 ha of teak plantations at Nilambur, Kerala during 2001-2002. The area was divided into 19 blocks and 189 Observation Units. The outbreaks were monitored at fortnightly intervals. The populations were classified into 'endemic', 'epicenter' and 'epidemic', based on the time of occurrence and size of infestation. Using the duration of each instar (egg- 1 day; instars I and II -2 days each, instars III to V- 3 days each, pre-pupa- 1 day and pupa- 4 days), the temporal data on outbreaks was examined to see whether each subsequent outbreak could be explained on the basis of previous outbreak. The larval samples of the population suspected to be related were subjected to molecular analysis to confirm genetic relatedness.

A novel method of screening for nuclear and mitochondrial DNA polymorphism using (RAGEPs) was standardized for estimating the genetic variation within and between populations. This method is based on PCR technique using single gene specific primers with nil to moderate level of degeneracy. Based on the criteria of polymorphic content and specificity to the teak defoliator genome, 11 nuclear Random Amplified Gene Encoded Primers (RAGEPs) and 11 mitochondrial RAGEPS were selected from a batch of 57 n-RAGEPs and 37 m-RAGEPs. Using this method, the relationship between different populations was traced out.

The ecological data generated suggested a relationship between endemic populations and some of the epicenter populations and similarly between epicenter populations and some of the outbreak populations. However, the molecular studies did not reveal any relationship between endemic and epicenter populations. The study thus gave little evidence to show that the aggregation of moths belonging to the endemic populations causes the epicenter populations. The study reconfirmed the relationship between epicenter populations and some of the epidemic populations (outbreaks) as revealed through ecological studies. This finding is relevant from the point of view of management of the teak defoliator to some extent by managing the epicenter populations, which occupy comparatively a small area in large-scale plantations.

Evaluation of ecotourism development at a few select sites in the natural forests of southern Western Ghats. KFRI Research Report No. 288 (Muraleedharan, P.K. and Anitha, V., 2007).

The study attempts to estimate the economic potential of ecotourism in Athirappilly-Vazhachal, southern Western Ghats and suggests suitable strategies and action plan.

The visitor flow on an average is 2.3 lakh and 5.3 lakh visitors/year at Vazhachal and Athirappily respectively. The revenue generating potential of the sites indicates a

positive relationship between the revenue, number of visitors and number of vehicles. The total Affected Forest Area (AFA) is approximately 1.33 sq km. Total estimated value of the AFA is equal to Rs 509.124 lakhs. The projected lifespan of Athirappily-Vazhachal is 38 years from 2005, given the present scenario with all things remaining constant, although, there is immense potential for service sector development and private sector involvement. With an average visitor flow of 5,30,000 per year, the rational fee price arrived at is Rs. 12/-.

The positive impacts of tourism in Athirappily-Vazhachal measured through employment and income multipliers highlighted that labour intensive investment in tourism will ensure employment security. The economic linkages in the economy indicate higher linkages between the business and recreation sector in the study area. The tourism sustainability assessment highlights that Athirappily-Vazhachal is fast emerging as a potentially sustainable region for ecotourism development and viable alternative to the conservation of forest and enhancing the standard of living of the dependent communities.

The strategies for sustainable tourism in Athirappily-Vazhachal recreation sites focus on the Pro-Poor Tourism strategy as laid down in second World Earth summit on sustainable tourism (2002) giving due weightage the to economic benefits, non-economic benefits and policy reform in the area with special reference to the poor. The study further recommends a site-specific programme, "*One Tourist-One Rupee-Ten trees Program*", towards action plan for ensuring environmental and economic security in the ecotourism based economy.

Calibration of volume prediction equations for different clones of rubber based on random parameter models. KFRI Research Report No. 289 (Meenattoor, R.J., Gireesh, T., Nair, R.B. and Jayaraman, K. 2007).

Attempts were made to develop volume prediction equations for thirteen clones of rubber viz., GT 1, Java 1, PB 235, PB 260, PB 217, PB 28/59, PB 5/51, PR 107, RRII 105, RRII 118, RRIM 600, RRIM 628 and Tjir 1. The data were collected from plantations in different parts of Kerala and Tamil Nadu. The data consisted of gbh measurement of standing trees and the corresponding tree volume calculated from measurements on billets taken after felling. Volume prediction equations were developed for each clone based on data pooled over different locations. Although the predictivity of the models were in general only moderate, models with coefficient of determination higher than 0.7 are suggestible for field use.

Resemblance structure among the clones with respect to the intercept and slope coefficients of the volume equations, was examined using the corresponding parameter estimates obtained through least square analysis. Cluster analysis using average linkage method based on Euclidean distance indicated two broad groups of clones, one consisting of PB 217, PB 28/59 and RRIM 628 and the other group consisting of GT 1, PR 107, RRIM 600, Java 1, PB 235, PB 260, PB 5/51, RRII 105, RRII 118, and Tjir 1. Localizing functions for tree volume equations based on random parameter models were developed for GT 1, RRIM 600 and RRII 105. Other than tree diameter, age of the stand came out as predictor in the mean function. The variation in intercept parameter over locations indicated the need for localizing volume equations.

All the information required for applying the best linear unbiased predictor to generate local volume equations was worked out for the three clones. The predictivity of the localizing functions was evaluated using simulated calibration. A set of five randomly selected sample trees was used for localizing the function for any location. The whole exercise was repeated thirty times. The average R^2 (prediction) was computed using the deviations of observed values from the predicted values. Except for a few cases, the values of R^2 (prediction) were above 0.8 for the cases considered.

Yield prediction models at stand level based on age were worked out for four clones, viz. GT 1, PB 235, RRII 105 and RRIM 600. The data consisted of gbh measurements of trees in plots of size around 20 m X 20 m. The functions contained per hectare volume as the dependent variable and inverse of age as predictor. The R^2 values were reasonable and the functions are recommendable for predicting stand yield. The study has generated useful information for predicting commercial volume of rubber both at tree and stand level and also volume and yield tables for many clones grown in Kerala.

Demonstration of mass production, formulation and application of a baculovirus for management of the teak defoliator, *Hyblaea puera*. KFRI Research Report 290 (Sudheendrakumar, V.V., Varma, R.V., Sajeev, T.V. 2007).

The study addressed mass production of HpNPV and developing and field-testing of an effective virus formulation. Incorporating the concept of spatial separation of experiment and HpNPV production space a laboratory for HpNPV mass production was established. Separate routes of entry for field collected and laboratory reared larvae were provided. In refining the method for rearing the host insect (*H. puera*), a novel insect rearing tube with a detachable diet cup was designed and evaluated.

In standardizing the mass production, virus productivity was quantified with reference to different larval instars, dosage, incubation period and temperature. Of the three larval stages *i.e.*, third, fourth and fifth instars studied, the maximum POB yield per unit diet (3.3×10^9 POBs) was obtained from fourth instar larvae dosed at 10^5 POBs per larva and incubated for a period of 72 h p.i. The

harvestable larvae obtained were as high as 98 %. The temperature turned out to be one of the determining factors in the productivity of the virus. The maximum POB yield was registered at the dosage 1 x 10^5 POBs per larva and the temperature 25 ± 2° C.

The method of inoculation plays an important role in virus mass production. Upon considering the yield/ larva, the cost of HpNPV required for spraying in one hectare at the rate of 1.63 x 1011 POBs worked out to be Rs. 279/- and Rs. 317/- in the case of LR and FC respectively. A marginal difference in the virus yield was found affecting the cost of the virus produced. Seven formulations were developed and tested, of which six were with additives. The unformulated HpNPV retained the original activity of 37.8% after exposure to sunlight for 9 hours. The study indicated that formulation increased the viability of HpNPV under natural sunlight by 2.34 folds. It was also possible to deduce that the WP-FD formulation is more stable to different periods of exposure than the rest of the formulations. Out of the seven formulations developed, WP-FD was field-tested, the performance of which was better than the unformulated HpNPV.

The study also gave an opportunity to understand genetic variability within HpNPV population. Eight HpNPV isolates could be characterized using Restriction Endonuclease analysis wherein Hind III was used as the restriction enzyme. The estimated molecular weights of the genome of HpNPV isolates ranged from 79.37 to 112.14 kbp.

Bamboo sector in Kerala: baseline data generation for developing an action plan. KFRI Research Report No. 291 (Muraleedharan, P.K., Anitha, V., Krishnankutty, C.N., Gnanaharan, R., Vijayakumaran Nair, P., Sankar, S. and Seethalakshmi, K.K. 2006).

The basic information on bamboo sector in the State is inadequate. The study has generated baseline data relating to resources, consumption pattern, socio-economic and livelihood conditions of the bamboo dependents, marketing, and technology and product development.

The study has used both primary and secondary data. The total standing crop of bamboo in homesteads in Kerala is estimated as 13.61 million culms and its green weight is 0.331 million tonnes. There are six species of bamboo available in homesteads including reed of which *Bambusa bambos* is the dominant species, accounting for 96%. This is followed by *B. vulgaris* and reed, constituting 2.23% and 1.38% respectively. There has also been a reduction in growing stock in homesteads from 0.408 (in 1987-88) to 0.331 million tonnes (in 2004-05). Based on 1997 imagery, bamboo resource in forest areas was estimated as 2.63 million. The total consumption of bamboo and reed in the State is estimated as 0.256 million tonnes. The per capita income of the artisans is estimated as less than Rs.6,000, which is significantly lower than that of the State average (Rs.24,053) and thus they live below the poverty line. The traditional bamboo based industry, which was an important source of employment to Marginalised Bamboo Dependents (MBDs) is now on a decline.

Bamboo is sold through primary and wholesale depots in Kerala. There are 95 primary depots located in various districts catering to the local requirements. Whereas the 35 wholesale depots located in Palakkad District fulfill the demand mostly from the neighbouring State of Tamil Nadu. Of the total quantity of 74,000 metric tonnes (green weight) of bamboo marketed through the depots in Kerala during 2004-05, primary depots account for 48% and wholesale depots, the remaining 52%. It is evident that quantity of bamboo exported to Tamil Nadu has been declining considerably.

The main problems in bamboo handicraft/furniture sector are: lack of adequate raw materials, low level of adoption of improved technology, low investment, inadequate marketing facilities, etc. There is scope for using improved technology in handicraft sector without affecting employment. A holistic approach is required for overall development of the bamboo sector in the State and this requires formulation of a bamboo policy and proper planning.

Ethnozoological studies on the tribals of Palaghat and Malappuram Districts of Kerala. KFRI Research Report No. 292 (Padmanabhan, P. 2006).

In Kerala, there are about 3 lakhs of tribals, who continue to use various wild and domesticated animals and plants for food, drugs, customs, game and religious purposes. Ten tribal groups in Palaghat and six groups in Malappuram were subjected to study. They hunt the animals out of bare necessity without tilting the balance of the ecosystem and enrich their diets. The tribals are hardly selective in their animal food except for those connected with religious customs, folklore and myths and this varies widely from one community to another. On the other hand, some of the common animals like wild boar, chital, sambar, cow, tortoise, frog, crab, prawn, insects, mollusks, etc., are by or at the behest of non-tribals are in great demand. As regards to use of animals drugs, there are remarkably similar practices among the tribals depending on the availability of specific animals around their habitats. This indicates indirectly the authenticity of usage of such drugs that evolved through ages in the health care systems of the tribals. About 108 species of animals form the vital source of tribal medicine. Of these, 16 species are invertebrates like insects crustaceans, arachnids, mollusks, etc., and 60 species are vertebrates, which include six pisces, one amphibian, five reptiles, 16 aves and 29 mammals. The diseases cured with the help of animal drugs include tuberculosis, rheumatic and joint pain, asthma, piles, pneumonia, night blindness, impotency, paralysis, weakness, cholera, body ache, etc. Different body parts of various animals are widely used by tribals for a variety of domestic purposes. Dry shell of *Unio* is used for scrapping and hairs of bear and horse for making bangles.

Status, distribution, food and feeding of Malabar Spiny Dormouse (*Platacanthomys lasiurus* Blyth) in the Western Ghats of Kerala. KFRI Research Report No. 293 (Jayson, E.A, 2006).

An investigation was conducted to determine the status, distribution, food and feeding of Malabar Spiny Dormouse (*Platacanthomys lasiurus*)., Kerala. The species was recorded from 10 protected areas in Kerala and from 21 Forest Ranges. It was newly recorded from nine protected areas namely Neyyar, Periyar Tiger Reserve, Thattekkad, Idukki, Chinnar, Eravikulam, Chimmony, Parambikulam and Aralam Wildlife Sanctuaries. The density of the species was found extremely low in the protected areas. Intensive studies on the species were conducted in the Peppara Wildlife Sanctuary, Thiruvananthapuram District. Twenty-three nests were located in the study area at Peppara Wildlife Sanctuary.

The Dormouse is completely arboreal. The home range of the species is about 5 ha and home range of the colonies overlaps. The animal depends on 25 species of plants for food. The more common food plants are *Terminalia bellirica, Persea macrantha, Hydnocarpus pentandra, Tamarindus indica, Bombax ceiba* and *Schumanianthus virgatus.* Its favorite food items include *Piper, Theobroma cacao* and *Anacardium occidentale.* Sexual dimorphism exists in the anti-predator behaviour and females are bolder than males. Two distance-dependent foraging movements are observed; <30 m from the nest and other beyond that. Females display long feeding bouts during foraging movements. The feeding range of the species is about 1 km. The animal spends short periods at a point when the foraging is within 35 m from the nest. But when long periods are utilized for foraging, they intermittently change the feeding points or move to areas with thick canopy. Males only carried out the nest-hole maintenance. All the nests were vertical hollows opening at the bottom. The behaviour of nest-hole maintenance can be attributed to the anti-predator behaviour. *Lagerstroemia microcarpa* was the preferred nesting tree. Birds of prey and owls are the main predators recorded.

Modelling the microhabitat preference of the species indicates that it inhabits not only the evergreen forests but also in the riverine patches of the moist deciduous forests. The animal is highly selective in choosing the nesting site. Preference for canopy cover is an antipredator strategy. GIS modeling showed that the Dormouse preferred the riparian forest at Peppara Wildlife Sanctuary. The species is being used in tribal medicine, for preparing drugs for the cure of acute asthma, and is detrimental to its survival.

KFRI Extension Report No. 89. (Swarupanandan, K., Pandalai, R.C. and Menon, A.R.R. 2006).

The Kottuli wetland is a 103 ha (262-acre) aquatic landscape situated within the city limits of Kozhikode and its suburbs, inundated by seawater through Canolly canal. It is a natural habitat for estuarine flora and fauna including migrant birds and a few endangered animals. Of the 103 ha of the wetland, 65 ha are in private possession and 39 ha Government-owned. Despite the fact that the Kottuli wetland provides a variety of environmental services to the entire public, encroachment of the wetland is very active there and recently, traders have targeted this environmentally fragile ecosystem for tourism resorts/water theme park.

The multi-disciplinary conservation plan proposed for the wetland by CWRDM has been approved and financed by the Ministry of Environment and Forests. An important component of the conservation programme is mangrove afforestation. The plants currently growing in the wetland are characteristic of the mangroves; therefore, the area is suitable for afforestation with mangroves. A list of suitable mangrove species and strategies for afforestation are given in the report. In the recent past, the extent of saltwater incursion to the Kottuli wetland has been limited due to obliteration of its connectivity to the Canolly Canal. Maintenance of the Canolly Canal and creating a number of culverts in specified locations across the canal bund would facilitate growth of mangroves.

The ownership of 39 ha of the wetland is now vested with the Kerala Water Authority. Unfortunately, it did not implement any wastewater management programme there; instead, it reclaimed a portion of the land, thus limiting the seawater incursion to the wetland. The Water Authority does not have any ongoing programme or any permanent structure there. The Kerala Forest Department has established a temporary aid-post there.

The Kottuli wetland is right in the heart of the Kozhikode Corporation and it is best suited for establishing a Mangrove Information-cum-Study Center. By virtue of the environmental expertise and the experience in mangrove afforestation, the Kerala Forest Department is the most suitable agency that can establish and sustain the Study Center. Ownership transfer of the Government-owned-wetland to the Forest Department would facilitate the effective implementation of the venture.

KFRI Consultancy Report No. 105. (Swarupanandan, K., Pandalai, R.C., Menon, A.R.R., Chacko, K.C. and Sharma, J.K. 2006).

A high-speed road has been proposed for connecting the International Container Transhipment Terminal (ICTT), Kochi and the National Highways NH17 and NH47 - the Vallarpadam-Cheranellur Link Road (the Link Road). As per the request of the National Highway Authority of India (NHAI), KFRI has prepared a plan for mangrove afforestation in an area of 3.5 ha. Of reclaimed backwater, in compensation to the natural mangrove patches that would be lost during the construction of

the Link Road. The study recommends that the species for afforestation should be selected from the mangroves of Kochi. The species suggested are *Rhizophora mucronata, Avicennia officinalis, A. marina, Bruguiera cylindrica, B. gymnorhiza, Sonneratia caseolaris, Kandelia candel,* etc. A mangrove nursery has to be raised in or around the afforestation sites, to produce the required planting stock. The afforestation sites have to be provided with at least two sluice culverts in order to maintain the regular inundation of brackish water required for the growth of mangroves. The identified backwater areas adjoining the proposed road should be reclaimed by filling before planting. One-year-old seedlings are ideal for planting and a 1.5 x 1.5 m spacing is suggested. Causality replacements will be carried out in the second and third year to ensure total stocking. The afforested sites will be protected against human and animal interference through fencing and regular watch and ward. Targeted awareness programmes are to be extended focusing the households in the neighbourhood of the afforestation sites. The sanitation facilities and the solid waste disposal in the neighbourhood have to be managed for bringing about the congenial environment required for the successful mangrove afforestation. The NHAI may facilitate the afforestation work and monitor the progress through annual reviews and interaction with the implementing agency.

Biodiversity of Thrissur District, Kerala State. KFRI Extension Report No. 20. (Nair, K. K. N., Ansari, R., Ramachandran, K. K., Jigi K. Joseph, Francis Xavier, Rajasekaran, R. and Neelakadan V. N., 2007).

Thrissur District covers an area of about 3030 km^2, extending from sea shore to an altitude of approximately 1420 m asl, in the Western Ghats of India. The District represents all the three physiographic zones of the State, namely the lowlands, midlands and the highlands. Kole wetlands, mangroves and the forest ecosystems represented by moist deciduous, semi-evergreen, evergreen and shola forests and the grasslands are the major characteristic habitats of biodiversity in the District.

In this documentation of biodiversity, available data were gathered from various sources including Floras and Faunas, scientific papers, research reports, doctoral theses, livestock registers, records of various Departments, handbooks, and so on. Primary data were also generated to a limited extent, especially with regard to distribution of species, conservation status, traditional and indigenous knowledge, etc. Accordingly, 3,003 taxa of plants and 2,672 taxa of animals are reported from the District with up to date nomenclature, synonyms, local names, habit, habitat, conservation status, indigenous/traditional knowledge, uses, etc., wherever available, along with basic references pertaining to the datasheet of each taxon.

The database includes taxonomic, environmental and administrative modules with their ramifications. For more than 60% of the species included in the database, photographs are provided. Combined map outputs are also provided for total diversity, its components, animal diversity and plant diversity, and various other aspects of the District like Grama Panchayaths, Block Panchayaths, Forests Divisions, Forest Ranges, bioclimate, landuse pattern, river basins, soil, geology, land form, altitude, and so on. The map outputs of one indigenous plant species (*Vateria indica* L.) and one wild animal species (*Elephas maximus* L.) on various types of map outputs mentioned, are also provided as examples, and similar map outputs can be generated for all the plants and animals included in this documentation. Data deficiencies, mainly with regard to species locations within the District, traditional knowledge, conservation status, etc. need to be addressed in detail during the preparation of People's Biodiversity Register (PBR).

China now number one in carbon emissions; USA number two

A recent analysis of the carbon dioxide emissions proves that China stands first in the matter!

China's carbon dioxide (CO_2) emissions in 2006 were greater than those of the United States!, according to an analysis by the Netherlands Environmental Assessment Agency. With this, China tops the list of carbon dioxide emitting countries for the first time. In 2005, CO_2-emissions from China were still two percent below those of the United States. In 2006, they were eight percent higher. Cement clinker production is a major source of CO_2 emissions in China which has a large share in global cement production (about 44 percent in 2006). Nationally the cement industry's share in China's CO_2 emissions is almost nine percent (550 megatonnes out of a total of about 6200 megatonnes of CO_2). In 2006, the total of China's CO_2 emissions from fossil fuels increased by nine percent. In the USA in that same year, emissions decreased by 1.4 per cent, compared to 2005. In the 15 European Union countries, in that same year, CO_2 emissions from fossil fuels remained more or less constant. The use of fossil fuels and industrial processes is the dominant human sources of carbon dioxide, which is the most prevalent greenhouse gas. Gases from burning of coal, oil and gas are increasingly blanketing the earth, preventing the radiation of the Sun's heat back into space. Of all the industrial processes, cement clinker production is the largest source of carbon dioxide release. Globally, it contributes around four percent to the total of CO_2 emissions from fuel use and industrial activities. Globally, CO_2 emissions from fossil fuel use increased in 2006, by about 2.6 percent, which is less than the 3.3 percent increase in 2005. The increase in 2006 is mainly due to a 4.5 percent increase in coal consumption.

Jose Kallarackal
Sustainable Natural & Plantation Forest Management Division

New Research Projects Initiated

Plan Projects

KFRI 498/2006: Improving livelihood of bamboo artisans and bamboo farmers in ten clusters through technological interventions (Seethalakshmi, K.K., Sankar, S., Pandalai, R.C., Muralidharan, E.M., Dhamodaran, T.K. Apr 2006-Mar 2009).

KFRI 499/2006: Improving the yield and reducing the rotation age of teak plantations through superior clonal teak (Surendran, T., Muralidharan, E.M., Chacko, K.C., Sharma, J.K., CCF (Plan., KFD), CF (WP & R), DCF (Res., N), DCF (Res., S). Apr 2006-Mar 2011).

KFRI 500/2006: Rehabilitation of 50 ha of sandal reserve in Marayur with improved planting stock resistant to spike disease and high oil content (Balasundaran, M., CCF (Plan.), DCF (Res., S), DFO (Marayoor). Apr 2006-Mar 2011).

KFRI 501/2006:Strengthening and enriching Institute Central Nursery (Pandalai, R.C., Pillai PKC Apr 2006-Mar 2009).

KFRI 502/2006: Strengthening and enriching Bambusetum (Pandalai, R.C., Unni K.K. Apr 2006-Mar 2007).

KFRI 503/2006: Strengthening the ex-situ conservation of evergreen trees (Unni, K. K. Apr 2006-Mar 2007).

KFRI 504/2006: Publication of a field guide to the birds of Kerala (Jayson, E.A., Sylva C.D. Apr 2006-Mar 2008).

KFRI 505/2006: Strengthening and documentation of Wildlife Museum (Ramachandran K.K., Jayson, E.A., Padmanabhan, P. Apr 2006-Mar 2009).

KFRI 506/2006: Strengthening of floristic diversity in the KFRI Subcentre campus through planting and weed management (Chandrashekara, U. M. Apr 2006-Mar 2009).

KFRI 507/2006: Transfer of technology of biological control of the teak defoliator pest to the Kerala Forest Department for field implementation and entrepreneurs for commercial production (Sudheendrakumar, V.V., Sajeev, T.V., Varma, R.V. Apr 2006-Mar 2009).

KFRI 508/2006: Establishment of three model Bioparks through participatory approach for promoting awareness on Nature conservation (Mathew, George Jan 2006-Dec 2006).

KFRI 509/2006: Identification of *Santalum album* and *Osyris lanceolata* through morphological and biochemical characteristics and moleclular markers to check adulteration (Bhat, K. V., Balasundaran, M. Balagopalan, M. Jan 2006-Oct 2007).

KFRI 510/2006: Model watershed: Maintenance, monitoring and outreach (Sankar, S. Apr 2006-Mar 2008).

KFRI 511/2006: Information Compendium on Kerala forestry sector (Jayaraman, K., Krishnankuttty, C.N., Menon, A.R.R., Nair, P.V., Sivaram, M., Rugmini P.Apr 2006-Mar 2008).

KFRI 512/2006: Capability development in instrumental methods of analysis(Balagopalan, M. Apr 2006-Mar 2009).

KFRI 513/2006: Developing a safer (biological) preservative against bamboo borer, based on traditional knowledge (Varma, R.V. Apr 2006-Dec 2007).

KFRI 514/2006: Management and monitoring of growth of coppice crop in the experimental plantations of *Eucalyptus tereticornis* (Kayampoovam & Punnala) and *E.grandis* (Sooryanelli & Vattavada) (Sankaran, K.V., Pillai, P.K.C. Apr 2006-Mar 2007).

Sponsored Projects

KFRI 515/2006: Post harvest protection of bambnoo from insect borers by a technique enhancing starch hydrolysis (Bhat, K.V. May 2006-Oct 2007).

KFRI 516/2006: Species recovery of *Dipterocarpus bourdillonii* and *Humboldtia bourdillonii*, two critically endangered endemic trees of Western Ghats (Swarupanandan, K., Muralidharan, E.M., Indira, E.P., Pandalai, R.C. Mar 2006-Feb 2011).

KFRI 517/2006: A handbook of the butterflies of Nilgiri Biosphere Reserve (Mathew, George. Jul 2006-Jun 2009).

KFRI 518/2006: Processing storage and supply of forest tree seeds through KFSC (Pandalai, R.C. Jul 2006-Jun 2007).

KFRI 519/2006: Ecosystem structure and dynamics, biodiversity, human dimensions and their linkages of Eringol Sacred Grove in the Western Ghats of India (Nair, K.K.. Menon, A.R.R., Ramachandran, K.K., Thomas, T.P., Anitha V., Sivaram, M., Jayson, E.A., Mathew, G., Nair, P.V., Yesodharan, K. Aug 2006-July 2009).

KFRI 520/2006: Linking conservation and forest management with sustainable livelihoods and resource use conflict in Agasthyamalai Biosphere Reserve (Anitha, V. Aug 2006-July 2009).

KFRI 521/2006: Species recovery plan for *Semecarpus kathalekanensis*: a critically endangered fresh water swamp species of the Western Ghats (Nair, P.V.K., Pandalai, R.C. Sept 2006-Aug 2009).

KFRI 522/2006: Tolerance of indigenous forest species to degraded lateritic soils of Kerala (Sujatha, M.P. Oct 2006-Sep 2009).

Consultancy and Extension Projects

KFRI Cons. 105/2006: Mangrove afforestation in five areas of reclaimed backwater along the proposed Vallarpadam-Cheranallor Link Road, Kochi. (NHAI). (Swarupanaandan, K., Pandalai, R.C., Menon, A.R.R., Chacko, K.C., Sharma, J. K. 2006).

KFRI Cons. 106/07: Strengthening TEAKNET (FAO) (Bhat, K.M., Sarojam, N. 2007).

KFRI Ext. 89/2006: Conservation and afforestation of the Kottuli wetland (Swarupanandan, K., Pandalai, R.C. and Menon, A.R.R., 2006.).

KFRI Ext. 107/07: Regional Workshop on Processing and marketing teak wood products of planted forests (ITTO project) (Bhat, K.M., 2007).

Publications 2006-07

Balagopalan, M. and Geetha, T. 2006. Distribution of organic matter and forms of sulphur and their relationships in different elevations in the Kerala part of Western Ghats, India. *Adv. Plant Sci.*,17: 91-95.

Balagopalan, M. and Geetha, T. 2006. Variation in soil organic matter and different forms of sulphur in relation to vegetation types and their relationships in Kerala, India. *Adv. Plant Sci.,* 19: 93-98.

Bhat, K. M. 2006. Wood and non-wood product chains of planted forests and the regional development in the tropics. *J. Indian Acad. Wood Sci.,* 3(1):1-15.

Bhat, K. M. 2006. Development of effective training programme for specialists of developing countries in wood science. *Internat. Coop. Centre Agric. Educ. Bulletin*, (Japan), 6(3): 43-143.

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

Chandrashekara, U. M, Muraleedharan, P. K and Sibichan, V. 2006). Anthropogenic pressure on structure and composition of a shola forest in Kerala, India. *J. Mount. Sci.,* 3(1): 58-70.

Chandrashekara, U. M. and Sibichan, V. 2006. Logs and snags in a shola forest of Kerala, India. *J. Mount. Sci.,* 3(2): 131-138.

Chandrashekara, U.M. and Sreejith, K. A. 2006. Assessing recovery of humid tropical forests after selective logging in the Western Ghats of Kerala, India. *Current Science,* 91(4): 421-423.

Chandrashekara, U. M. 2006. Effects of pruning on radial growth and biomass increment of trees growing in homegardens of Kerala, India. *Agroforestry Systems,* 69 (3): 231-237.

Dhanya, M. B., Balagopalan, M., Rugmini, P., Geetha, T. and Kumar, C. N. 2006. Variation in soil organic carbon and micronutrient status in teak plantations under different rotations in Kerala. *J. Soils Crops,* 16: 17-24.

Indira, E. P. 2006. Provenance variations in *Gmelina arborea* with particular reference to tree form. *J. Trop. For. Sci.,* 18(1): 36-50.

Indira, E. P. and Renuka, C. 2006. Effect of provenance and progeny selection in *Calamus andamanicus* Kurz for fast growth. *J. Bamboo and Rattan* 5(1&2): 61-66.

Jayakumar, R. and Nair, K. K. N. 2005 (2007). Flora of New Amarambalam resrved forests in the Western Ghats of India. *J. Econ. Tax. Bot.,* 29(1): 113-172.

Kallarackal, J., Bhat, K. V. and Seethalakshmi, K. K. 2006. Characterisation and functioning of an exuding blister on the teak tree (*Tectona grandis L.f.*). *Phytomorphology* 56: 1-9.

Renuka, C. and Thomas, J. P. 2006. An evaluation of the nutrient contents of the edible shoots of four species of rattans from India. *J. Non Timber For. Prod.,* 13(3): 173-177.

Renuka, C., and Sreekumar, V. B. 2006. *Calamus rivalis* Thw. *ex* Trim. (Arecaceae): A new record for India. *J. Econ. Tax. Bot.,* 30(2): 277-279.

Rugmini, P. and Jayaraman, K. 2006. Analysis of repeated measures: A comparison of alternative methods. *Indian J. For.,* 29(4): 423-428.

Sreekumar, V. B., Renuka, C., Suma, T. B. and Balasundaran, M. 2006. Taxonomic reconsideration of *Calamus rivalis* Thw. *ex* Trim. and *C. metzianus* Schlecht. (Arecaceae) through morphometric and molecular analysis. *Botanical Studies*, 47: 443-452.

Sunanda, C. and Jayaraman, K. 2006. Prediction of stand attributes of even-aged teak stands using multilevel models. *For. Ecol. Manage.,* 236(1): 1-11.

Varma, R. V., Shetty, A., Swaran, P. R., Paduvil, R. and Shamsudeen, R. S. M. 2006. Establishment of *Pareuchaetes pseudoinsulata* (Lepidoptera: Arctidae), an exotic biocontrol agent against the weed, *Chromolaena odorata* (Asteraceae) in the forests of Kerala, India. *Entomon,* 31(1): 1-3.

Varma, R. V. and Swaran, P. R. 2006. Do subterranean termites attack exotic forest plantation species in preference to native species? A case study from the Kerala State, India. *Hexapoda* 13 (1&2): 38-42.

Varma, R. V., Sajeev T. V. and Sudheendrakumar, V. V. 2007. Pest susceptibility in Teak under intensive management. *J. Trop. For. Sci.,* 19 (1): 46-49.

Yesodharan, K. and Sujana, K. A. 2006. Ethnomedicinal plants used by the tribals of Parambikulam Wildlife Sanctuary, Kerala, to cure cuts and wounds. *J. Econ. Taxon. Bot.,* 30: 365-369.

Yesodharan, K. and Sujana, K. A. 2007. Wild edible plants traditionally used by the tribes in the Parambikulam Wildlife Sanctuary, Kerala, India. *Nat. Prod. Radiance*, 6(1): 74-80.

Papers in Books/Proceedings/Newsletters

Bhat, K. M. 2006. Good plywood manufacturing practice: What's happening in labs? *Wood Talk* (Newslet. Western India Plywoods Ltd.), 1:10.

Bhat, K. M. 2006. What's happening in labs? PLY WALL. *Wood Talk* (Newslet. Western India Plywoods Ltd.), 1: 11.

Chandrashekara, U. M. and Sankar, S. 2006. Ecological and socio-economic dimensions of homegardens of Kerala, India. Pages 381-389. *In*: M. Conan and Chen Wangeng (eds.). *Contribution of Gardens to Cilty Life and Culture (in Chinese).* Wuhan Univiersity Press, Wuhan, China.

Balagopalan, M. 2006. Impact of changes in vegetation on sustainability of land resources. Key Note address. *In: National Conference on New Vistas in Microbiology and Plant Sciences*. Gurukul Kangri University, Hardwar, 19-20 Sept. 2006.

Balagopalan, M., Menon, A. R. R. and Rugmini, P. 2006. Impact of fire on ecosystem recovery with special reference to vegetation in the evergreen and dry deciduous forests in Kerala. Paper presented (MB) in the National Conference on *New Vistas in Microbiology*

and Plant Sciences held at the Campus of Gurukul Kangri University, Hardwar during 19-20 Sept. 2006.

Jayaraman, K. 2006. Use of random parameter models for tree volume prediction. *In*: *Abstracts of the International Conference on Statistics and Agricultural Informatics,* 27-30 Dec., 2006. IASRI, New Delhi.

Meenattoor, R. J., Gireesh, T., Nair, R. B. and Jayaraman, K. 2007. Timber yield of different clones of rubber. *In*: *Extended Abstracts, 19th Kerala Science Congress 2007*, 29-31 Jan. 2007. Kerala State Council for Science, Technology and Environment, Thiruvananthapuram.

Indira, E. P., Prabha, S. S. and Nair, P. N. 2006. Use of microsatellite markers in seed orchard management in Teak. Pages 45-50. *In*: K.V. Mohanan (Ed.), *Proc. National Seminar on Recent Trends in Crop Science Research (Gregor Mendel Foundation).*

Jayson E. A. and Jayahari, K. M. 2006. Conservation status of rodents in India. , *Pages* 387-398. *In*: Shakunthala Sridhara (Ed.). *Vertebrate Pests in Agriculture - the Indian ScenarioScientific* Publishers, Jodhpur.

Jayson, E. A. and Sivaperuman, C. 2007. Status and conservation of bird fauna in the Vembanad- Kole Ramsar Ste, Kerala, India. Pages 286-298. *In*: Gupta V.K. (Ed.). *Perspectives in Animal Ecology and Reproduction, vol. 4. M/S Daya publishing House, Ansari Road, Darya Ganj, New Delhi.*

Jayson, E. A. and Ali, M. S. 2007. Status of the critically endangered Malabar Civet *Viverra megaspila civettina* in the southern Western Ghats. Pages 45-49. *In: Proc. of the National level seminar on Management and Conservation of Nature-Nilgiri Biosphere Reserve*, Emerald Heights College, Ooty.

Nandakumar, U. N. 2006. Managing Forests for Fuelwood,Fodder,Medicinal Plants,Timber and other NTFPs,Biofuel through Multitier Forestry: A case study from Kerala. *In: Proc. of 11th Silvicultural Conference*, FRI Dehra Dun.

Padmanabhan, P. 2006. Documentation of mammalian diversity in Kerala. *In: Proceedings of the National Seminar on Wildlife Biodiversity*, Pondichery University.

Prabha, S. S., Indira, E. P. and Nair P. N. 2007. Contemporary gene flow in natural teak forest of Kerala using microsatellite markers. Pages 142-144. *In: Proc. 19th Kerala Science Congress* 2007.

Renuka, C., Thomas, J. P and Sreekumar, V. B. 2006. *Calamus nagbettai* Fernandez & Dey – A promising species for raising large scale plantation in Kerala. Pages 44-48. *In: Sustainable natural resources development.* Western Ghat Cell, Planning and Economic Affairs Department, Government of Kerala.

Renuka, C, Thomas, J. P. and Rugmini, P. 2006. Cultivation of rattan for edible shoots - a source of additional income for the farmers of the Western Ghats. Pages 49-59. *In: Sustainable natural resources development.* Western Ghat Cell, Planning and Economic Affairs Department, Government of Kerala.

Swarupanandan, K. and Arun Bose, K. 2006. Strategies for mangrove ecosystem redevelopment in Kerala: An analysis of some cardinal issues. Pages 427-428. *In: Proc. 18th Kerala Science Congress*, Centre for Earth Science Studies, Thiruvananthapuram.

Swarupanandan, K. 2006. Forest fire research and management: An analysis of the problems and possibilities under the framework of the 'General Succession Theory' – A Kerala Experience. Pages 146-153. *In:* Negi, S.S., Srivstava, P.K., Thapliyal, M. and Singh, O. (Eds.). *Proc. XII Silvicuture Conference*, Forest Research Institute, Dehra Dun.

Swarupanandan, K. 2006. Conservation of mangroves for coastal protection and livelihood improvement. *Abstracts of the Seminar on Conservation and management of natural resources for environmental protection of the Coastal Zone.* Kerala Forest Research Institute, Peechi.

Varma, R. V. 2007. Invasive alien species of weeds and insects: The agriculture-forestry nexus, examples from India. Pages 111-118. *In:* S. Appannah *et al.* (Eds.). Developing an Asia-Pacific Strategy for Forest Invasive Species. *RAP Publication 2007/02.* FAO Bangkok.

Congratulations! Winners of Sports and Games Meet-2006

KFRI participates every year in the annual Kerala Forest Sports and Games Meet organized by the Kerala Forest Department, as a separate circle – the KFRI Circle. The *Kerala Forest Sports and Games Meet-2006* was held at Kottayam from 15 to 17 of November 2006. Thirty staff members (including project staff) from KFRI participated in the meet in items like Volley Ball, Cricket, Power Lifting, Weight Lifting, Swimming, Table Tennis, and other track and field events. KFRI secured five Gold medals, four Silver medals, and four Bronze medals in the Meet, as given below.

Mr. Vivek won *Gold Medal for Table tennis* (Singles, Men Open).

Mr. NS Vinod obtained a *Silver Medal for Table Tennis* (Singles, Men Open).

Mr. Vivek and *Mr. NS Vinod* bagged *Gold Medal for Table tennis* (Doubles, Men Open).

Dr. Mammen Chundamannil obtained a *Silver medal for Table Tennis* (Singles, Men Veteran).

Miss. J. Bindu secured a *Bronze medal in Shot Put* (Women Open).

Mr. M. Achuthankutty won *three Gold Medals* for the Institute, *viz*, Weight Lifting (Senior Veteran), Power Lifting (Veteran and Senior Veteran).

Dr. K. Mohandas bagged five medals. *Two Silver medals*, one for Swimming Backstroke and the other for Free Style. The *three Bronze medals* secured by him were on Power Lifting and Swimming (Butterfly and Brest Stroke).

Evergreen congratulates the winners on their grand success.

Seminars/Conferences/Workshops/Trainings organized by KFRI

Training course on Experimental designs in forestry research, for the Tamilnadu Forest Department staff, 19-28 Apr. 2006.

Training course on Biodiversity Documentation, Evaluation and Monitoring (MoEF), 11-15 Sept. 2006.

Conservation and Development of Medicinal plants and Benefit sharing with Local communities (MoEF), 13-17 Nov. 2006.

National Workshop on Bamboo Location Trial, Bambusetum and Vegetative Propagation, 21-22 Dec. 2006.

Training Parogramme on Propagation, management, and post-harvest technology of bamboos and rattans, 3-12 Jan. 2007.

Tree Farming in Agroforestry systems and Wastelands for Tamilnadu Forest Department staff, 4-11 Feb. 2007.

Training Parogramme on cultivation and Management of teak: new trends, 13-22 Feb. 2007.

Recognitions/Honours/Awards

Dr. Jose Kallarackal has been *Nominated as a Member in the Faculty of Environmental Studies*, Cochin University of Science and Technology for a period of 4 years from Oct. 2006.

Dr. R. V. Varma has been *Nominated as a Member of the Faculty of Environmental Studies* of CUSAT for a second term from Oct. 2006 Sept. 2010.

Dr. R.V. Varma, has been *Nominated as a Member of the Task Force on "Biopesticides and Crop Management"*, of DBT, Govt. of India for a period of 3 years from Aug. 2006.

Dr. M. Balagopalan received the APSI International Plant Scientist Award-2005, by the Academy of Plant Sciences, India (APSI). The award carries a Citation and a Gold Medal.

Dr. M. Balagopalan, has received the *Fellow Membership - FICCE award-* by the International Congress of Chemistry and Environment, India.

Dr. R.V. Varma, received an award for his contributions to Forest Entomology from the Entomologist Forum, Chennai in Dec. 2006.

Dr. K.M. Bhat was re-elected as *Deputy Coordinator of IUFRO* Division 5 (Forest products) and as a Member of *Executive Board of IUFRO* for the period 2006-2010.

Dr. K.M. Bhat was also elected as *Board Member of the International Academy of Wood Science* for the period 2006-2012.

Dr. K.M. Bhat served as External Expert in the Assessment Committee Meeting held for assessing the scientists of Rubber Research Institute of India (RRII), Kottayam on 22 Sept. 2006.

Visits abroad

Dr. Jose Kallarackal visited the Department of Ecology and Physiology, University of Bayreuth, Germany on an Alexander von-Humboldt Foundation revisit programme from 1 Nov. 2006 to 31 Jan. 2007. Collaborative research on forest evapo-transpiration from Eddy correlation data and also physiology of phloem transport was done during this period.

Dr. Jose Kallarackal visited the Bioenergentics Laboratory, University of Geneva, Switzerland on 15 Dec. 2006 and acquainted with the work on chlorophyll fluorescence by Professor Reto Strasser.

Dr. C. Renuka attended the *International workshop on Sustainable Development of the Global Rattan Sector, 22-29 July 2006 at Beijing*, China. Presented a paper on Sustainable development of rattans in Asia-Priorities and technology needs

Training received

Dr. U.N. Nandakumar, attended a series of training programmes for solid waste management and Energy conservation for state level faculties under Clean Kerala Mission and Energy Security Mission (Apr. 2006-Mar. 2007).

Dr. K. Yesodharan attended an *International Training and capacity Building on Medicinal plants* conservation and sustainable utilization based on Indian Experience from 4- 18 Oct. 2006 at FRLHT, Bangalore.

Staff on deputation

Dr. T. K. Dhamodaran, Scientist, Forest Utilisation Division was deputed for one year with effect from 28 Mar. 2007 to Kannur University to coordinate the post graduate course in wood science and technology.

Ph.D. awarded

Mr. Sivaperuman was awarded doctorate degree by the FRI University in 2006 for his work on the *Ecology of wetland birds in the kole lands of Thrissur, Kerala.* He did this work under the guidance of Dr. E.A. Jayson, Wildlife Biologist, KFRI.

The Kole wetlands are low lying tracts (0.5 to 1 m below MSL) with an extent of 13,632 ha spread over Thrissur and Malappuram Districts of Kerala. The wetlands remain submerged for about six months in a year and serve as a nesting, roosting and wintering ground for birds.

The study examines the status and distribution of avian fauna in the Kole wetlands, food and feeding habits of the birds and their habitat preferences and analyses the threats to the fauna.

A total of 4,32,663 birds belonging to 182 taxa under 50 families and 16 orders were recorded. Hundred species were resident, 81 migrants and one straggler. Among the migrants, 49 species were trans-continental and 32 local. Out of the 182 species, 48 were new records for the area. One vulnerable and five near threatened species were recorded. Habitat-wise classification revealed that 25 per cent were water birds, 21 waders and 54 terrestrial. Feeding guild analysis showed that majority of the species were insectivores (51) followed by omnivores (43) and aquatic feeders (42).

Species richness of birds varied in different localities and months of the year; it increased during the migratory season and decreased during the southwest monsoon. The highest diversity index was recorded in December (3.01) and lowest in October (2.11). The highest density of birds was recorded in December (29,158 birds/ha) followed by November (24,373 birds/ha). A significant negative correlation was found between rainfall, water depth, paddy height and bird population parameters. The highest number of birds was recorded during the replanting season and the sowing period of paddy.

The period from September to March in all the years provides ideal microhabitats for the birds and higher production of benthic and macro fauna. The rainfall and the water depth are the major climatic factors influencing the abundance. The appearance of mud flats attracts large number of waders during the migratory season.

As the Kole wetlands come under the 'Central Asian - Indian flyway' and one of the Ramsar Sites in India, protection of migratory bird species is of highest priority.

Mr. Sujanapal was awarded doctorate by the FRI University for his work on *Vascular flora of Parambikulam Wildlife Sanctuary.* He worked under the guidance of Dr. N. Sasidharan, NWFP Division.

Parambikulam Wildlife Sanctuary (272 km^2) is part of the Anamalai High Ranges and lies in the Palakkad District of Kerala. About 30 per cent of the forest area of the Sanctuary is occupied by teak plantations.

Altogether, 1521 taxa of vascular plants under 801 genera belonging to 170 families were collected. Though the Sanctuary forms only about 0.7 per cent of the total land area and 2.9 per cent of the total forest land of the State, it supports 37.5 per cent of the vascular plant species. Angiosperms form 94.5 per cent (1438 taxa) and pteridophytes, 5.35 per cent (81 taxa). Gymnosperms are represented by two taxa. Fabaceae is the largest family with 117 taxa under 52 genera followed by Poaceae with 87 taxa under 59 genera. Among the 170 families, 47 families are represented by single species each. Among the 801 genera, as many as 93 genera are represented by one species each.

Three species, *viz. Medinilla anamalaiana, Pteroceras monsooniae* and *Zingiber* sp. collected during the study are new to science. Another nine species *viz. Argyreia osyrensis* (Roth) Choisy, *Chlorophytum malabaricum* Baker, *Cocculus hirsutus* (L.) Diels, *Dalechampia scandens* L. var. *velutina* (Wight) Muell.-Arg., *Heliotropium bracteatum* R.Br., *Heterophragma quadricularis* (Roxb.) K. Schum., *Meyenia hawtayneana* (Wall.) Nees, *Monothecium aristatum* (Wall. *ex* Nees) T. Anders. and *Triumfetta rotundifolia* Lam. are new records to Kerala. Two rare and endangered species, considered as 'possibly extinct', *Haplothismia exannulata* Airy Shaw and *Syzygium palghatense* Gamble were recollected for the first time after their type collections.

About 380 taxa collected from the Sanctuary are endemic to Peninsular India, of which 28 are exclusive to the Anamalai High Ranges. One monotypic genus and two species are so far known only from the Sanctuary. Among the 57 endemic genera, 13 were recorded from the Sanctuary. There are three genera exclusive to the Anamalai High Ranges. The Sanctuary abodes 114 species belonging to various threat categories of which 10 are considered as 'possibly extinct'.

Red listed taxa such as, *Atuna travancorica, Piper barberi, Pothos crassipedunculatus* and *Taeniophyllum scaberulum* considered restricted to southern Kerala, are found extending up to Palakkad Gap. About 303 species of wild relatives of economically important plants were recorded during the study.

Welcome to the delegates of the Regional Workshop on

Processing and Marketing of Teak Wood Products of Planted Forests

25-28 September 2007, Peechi, Kerala, India

Teak (*Tectona grandis* L.*f.*) is being grown in plantations in more than 36 tropical countries across the globe although its natural occurrence is limited to India, Laos Myanmar and Thailand. Of the estimated 187.1 million hectares of global forest plantations in 2000, about 5.7 million hectares (3%) were of teak, representing about 75% of the world's high-quality tropical hardwood plantations, the major producers being India, Indonesia, Mynamar and Thailand in the Asia Pacific region.

In pursuance of sustainable development of teak wood sector in the Asia Pacific Region, the workshop intends to provide an international forum for developing a regional project on *processing and marketing of quality products of planted teak from sustainable tropical forest management.* It is envisaged that participation of major Asian teak producer countries, viz., India, Indonesia, Malaysia, Myanmar and Thailand together with the importing countries will accomplish the task as project partners. The major outputs anticipated from the Regional Workshop are: 1. Clear understanding of national policies and programmes of the producer countries as project partners particularly in promoting the trade from further processing and marketing of teak products. 2. Identification of the lead countries in relevant areas of research and training as well as networking to cater to the needs of the international stakeholders 3. Establishment of working relationships with necessary commitments from among the project partners for developing a regional project on teak.

The Workshop is being organized by Kerala Forest Research Institute (KFRI) under the auspices of International Tropical Timber Organisation (ITTO) and the Ministry of Environment and Forests, Government of India. The Teak Wood Working Party of The International Union of Forest Research Organizations (IUFRO 5.06.02) will also provide technical support in organising the workshop.

Nearly 120 participants from over 20 countries would assemble in the sylvan environment of the Kerala Forest Research Institute and spend two days discussing the various aspects of processing and marketing quality products of teak. Country profiles, productivity, investment, economics, policy issues, yield and quality of planted teak, wood processing, industry, timber price, marketing and teak networking are going to be discussed in the workshop.

Contact :
Dr. K. M. Bhat
Convener, Regional Teak Workshop 2007
Kerala Forest Research Institute
Peechi 680 653, Kerala, India
Tel: +91-487-699037, 699061-64, 699365
Fax: +91-487-2699249 Cell: +919447878838
Email: kmbhat@kfri.org URL: www.kfri.org

Farewell

Since the establishment of the Kerala Forest Research Institute in 1975, the first generation of its staff has started retiring. The retirement of the staff has started in the preceding year and the process will extend over the coming 4-5 years, the maximum number retiring between 2009 and 2012. This year (2006–07) four of our staff have superannuated.

Mr. V.S. Neelakantan, Senior Attendant, retired from the service of the Institute on 28 Feb. 2007, after 27 years of service.

Mr. P.M. Vasu, Attendant, retired from service on 28 Feb. 2007. He joined the Institute way back in 1979 and has completed 28 years of service. In addition to his service in the Head Quarters at Peechi, he also served at the Subcenter, Nilambur, for a few years.

Mrs. T.V. Chandrika, Senior Special Grade Typist, retired from service on 31 March 2007. Starting from April 1980, she has had a service of 27 years.

Mr. M. Cherukunhan Nair, Senior Typist, was one among the staff who joined the Institute during the initial years of its inception. Starting from 1976, Mr. Nair had a service of 30 years when he retired. Most of his service years were at the Subcenter, Nilambur, while at the career end he was at the Head Quarters.

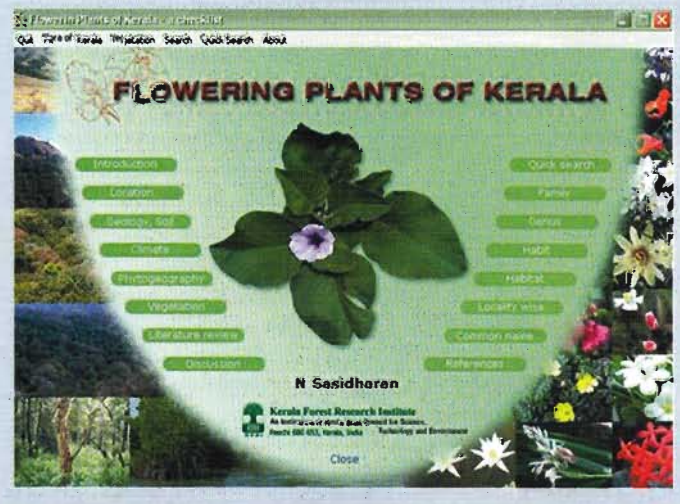
V S. Neelakantan
Senior Attendant

PM. Vasu
Attendant

TV. Chandrika
Sr. Spl. Gr. Typist

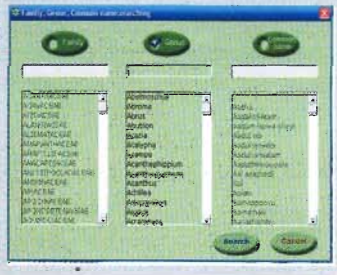
M. Cherukunhan
Nair, Senior Typist

'Flowering Plants of Kerala' in Digital Format



KFRI has produced many CDs on specialized topics in forestry. The CD on the '*Flowering Plants of Kerala*' is a recent addition to the list. It is a checklist of the State's botanical wealth, a summarization of all relevant and contemporary information in one place.

Information on 4,801 taxa including 619 exotics (introduced as well as naturalized), are systematically arranged. Nine hundred and forty taxa recorded from Kerala after the publication of the *Flora of the Presidency of Madras*, are collated into the botanical register of the State. Out of these, 327 are *taxa nova* (species, subspecies or varieties) and 613 new records. One can find information on 483 taxa belonging to various Red Listed Categories there.



As a result of updating nomenclature since the publication of *Flora of the Presidency of Madras,* one may find name changes of as many as of 1,259 species. The textual information is supplemented with over 5,250 photographs pertaining to 2,250 species. About 11,000 botanical names and as many as 6,000 common/local names make the checklist a botanical dictionary.

Information on individual taxa contains details on location(s), geography, geology, soil, climate, characteristic features and typical species associates. Indications on important agri-/horti crop relatives are also given. The correct name of the species with author and literature citation is followed by basionyms and synonyms. Reference to *Flora of British India, Flora of the Presidency of Madras* and relevant monographs and revisions are also given. The CD also contains information on habit, habitat, status, distribution (including district wise distribution map) and images (up to 4) of the species. There is also facility for quick search, family wise, genus wise, habit wise, habitat wise, locality wise and common name wise.

Copy of the CD can be obtained from The Librarian, Kerala Forest Research Institute, Peechi – 680 653, Kerala, India. The Price of the CD is Rs.300 (in India) and US $30 (outside India).

N. Sasidharan
Forest Utilization Division

Priced KFRI Publications

		Rs.	US $
I.	**Bamboo**		
1	An Annotated Bibliography on Bamboos of the World	550	50
2	Bamboo Resource Development and Utilization in Kerala	25	10
3	Bamboo: A Crop (CD-ROM)	250	25
4	Bamboos of India	2250	100
5	Commercial Bamboos of Kerala	50	10
6	Edible Bamboo Shoot Recipes	30	10
7	Edible Bamboo Shoots: Collection and Processing (Malayalam)	10	10
8	Field Identification Key to Native Bamboos of Kerala	100	10
9	Information Resources for Bamboo and Cane Development in Kerala	75	10
10	KFRI CD4: An Annotated Bibliography on Bamboos of the World	200	20
11	Micropropagation of Bamboo and Rattan	50	10
12	Nursery and Silvicultural Techniques for Bamboos	150	15
13	Policy and Legal Issues in Cultivation and Utilization of Bamboo, Rattan and Forest Trees in Private and Community Lands	400	40
II.	**Rattan (Cane), Palms**		
14	Preservative Treatment of Bamboo and Bamboo Products	50	10
15	A Manual on the Rattans of Andaman and Nicobar Islands	175	20
16	Annotated Bibliography on Rattans of the World	350	35
17	Commercial Rattans of Kerala	50	10
18	Field Identification Key for Rattans of Kerala	125	15
19	Nursery and Silvicultural Techniques for Rattans	50	10

Priced Publications

		Rs.	US $
20	Oil Curing Technology for Value-added Rattan (Cane) Products	50	10
21	Palms of Kerala	200	20
22	Protection of Rattan against Fungal Staining and Biodeterioration	50	10
23	Rattan Management and Utilisation	300	30
24	Rattans of the Western Ghats: A Taxonomic Manual	100	10
25	Structure and Properties of South Indian Rattans	75	10
III.	**Teak**		
26	KFRI CD2: Bibliography on Teak	500	50
27	Quality timber products of teak from sustainable forest management (Seminar Proceedings)	1000	80
28	Teak Bibliography (Print)	700	70
29	Teak (Information Bulletin)	25	10
30	Teak (Seminar Proceedings)	200	20
31	The Teak Defoliator (CD-ROM)	250	25
IV.	**Plantation Management**		
32	Compost for Container Seedlings Production in Forest Nurseries	100	10
33	Litter Dynamics, Microbial Associations and Soil Studies in *Acacia auriculiformis* Plantations in Kerala	75	10
34	Plantation technology: *Colophyllum polyanthum* (Kattu punna)	50	10
35	Plantation technology: *Dysoxylum malabaricum* (Vella akil	50	10
36	Plantation technology: *Garcinia gummi-gutta* (Kodampuli)	50	10
37	Plantation technology: *Gmelina arborea* (Kumbil)	50	10
38	Plantation technology: *Grewia tiliaefolia* (Chadachi)	50	10
39	Plantation technology: *Haldina cordifolia* (Manjakadambu)	50	10
40	Plantation technology: *Lagerstroemia microcarpa* (Venthekku)	50	10
41	Plantation technology: *Melia dubia* (Malaveppu)	50	10
42	Plantation technology: *Vateria-indica* (Vellapayin)	50	10
43	Root Trainer Technology for Mass Production of Clonal Planting Stock	250	25
V.	**Natural forests**		
44	A Handbook on Statistical Analysis in Forestry Research	500	50
45	Biodiversity Documentation for Kerala. Part 1: Algae	150	15
46	Biodiversity Documentation for Kerala. Part 2: Fungi	300	30
47	Biodiversity Documentation for Kerala. Part 3: Lichens	150	15
48	Biodiversity Documentation for Kerala. Part 4: Bryophytes	150	15
49	Biodiversity Documentation for Kerala. Part 5: Pteridrophytes	200	20
50	Biodiversity Documentation for Kerala. Part 6: Flowering Plants	600	60
51	Flowering Plants of Kerala : A Checklist (CD)	300	30
52	Biodiversity Documentation for Kerala. Part 7: Insects	300	30
53	Biodiversity Documentation for Kerala. Part 8: Freshwater Fishes	800	70
54	Biodiversity Documentation for Kerala. Part 9: Amphibians	150	15
55	Biodiversity documentation for Kerala. Part 10: Reptiles	150	15
56	Biodiversity Documentation for Kerala. Part 11: Birds	150	15
57	Biodiversity Documentation for Kerala. Part 12: Mammals	100	15
58	Ecodevelopment of Western Ghats	200	20
59	Field Guide to Animal Signs	100	10
60	Forest Trees of Kerala	75	10
61	History of Forest Management in Kerala	150	15
62	Impact of Diseases and Insect Pests in Tropical Forests	500	50
63	KFRI CD1: KFRI Research Reports 1-200	1000	100
64	Manual of seeds of forest trees, bamboos and rattans	750	75
65	Shola Forests of Kerala: Environment and Biodiversity	800	70
66	State Biodiversity Strategy and Action Plan (SBSAP) for Kerala	300	30
67	Three Decades of Research in KFRI	200	20
68	TreeID: Tree Identification Key for Kerala (CD)	300	30
69	Tropical Forest Ecosystem Conservation and Development in South and South-East Asia	200	20
70	Tropical Forestry Research: Challenges in the New Millennium	500	50
VI.	**Wood and Non-Wood Forest Products**		
71	Manual of the Non-Wood Forest Produce Plants of Kerala.	450	45
72	Upgradation of Rubber Wood	75	10
VII.	**Weeds**		
73	Alien Weeds in Moist Tropical Zones: Banes and Benefits	400	40
74	Field Trials for Controlling *Mikania* Infestation in Forest Plantations ...	150	15
75	Integrated Management of the Alien Invasive Weed *Mikania micrantha* ...	150	15
VIII.	**Socio-Economics**		
76	Basic Readings in Forest Economics	150	15
77	Socio-economic Research in Forestry	300	30

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

ISSN 0254-6426

Dr. K. Swarupanandan
Dr. K.V. Bhat
Mr. K.F. George

Evergreen, the Newsletter of the Kerala Forest 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 the 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: + 91-487-2699062-64
E-mail: kfri@kfri.org

Printed at
Lumiere Printing Works,
Thrissur 680 020

KFRI Training Programmes in Tropical Forestry

KFRI offers specialised 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 and Forests, Government of India for the training courses and workshops for the officers of the Indian Forest Service. Also, various state forest departments have sponsored candidates for several training courses in the past. Overseas participants from Myanmar, Srilanka, Bangladesh, China, Nepal, Ethiopia and Uganda have attended different training courses.

The Institute has 58 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.

Training courses are conducted in the Training and 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, nurseries and live collection of bamboos, rattans, palms, medicinal plants and tropical tree species. Kerala Forest Seed Centre, Teak Museum and Bioresources Nature Park are other attractions for the visitors. Accommodation is provided in the Trainees' Hostel having modern facilities.

23-27 Oct. 07, 12-16 Nov. 07: Tropical Forest Study Tour
Basic lectures on tropical forest ecosystem and rich plant and animal diversity; study tours to evergreen, moist deciduous, mangrove and shola forests; plantations and nurseries of teak, eucalypts and indigenous trees, wildlife sanctuaries and national parks, tribal cooperatives, historic and cultural centers.

7-11 Jan. 08: Scientific Writing and Presentation
Principles of scientific writing, notations and abbreviations, guidelines for presentation of data in tables and graphs, preparation of scientific papers, reports, oral and poster presentations, use of modern audiovisual equipments.

14-23 Jan. 08: Remote Sensing and GIS in Forestry for Natural Resource Management
Introduction to GIS and remote sensing, map projections, computer based cartography, geographical analysis, digital elevation models, GPS surveys, satellite image analysis, classification of images, resampling techniques.

13-22 Feb. 08: Modern Trends in Teak Cultivation and Management
Seed handling and nursery practices, clonal and tissue culture technology, site selection and preparation, planting and aftercare, pest and disease management, production and use of NPV for defoliator control, growth and yield of crop, harvesting and post harvest technology, economics of teak cultivation.

12-21 May 08: Molecular and Biotechnological Techniques in Tree Improvement
Modern methods of biotechnology, micropropagation (tissue culture), molecular marker technology, type of markers, use of molecular markers, genetic engineering and development of transgenics, biological and immunodiagnosis.

For further details please contact:
Programme Coordinator
Extension and Training Division
Kerala Forest Research Institute, Peechi - 680 653 Thrissur, Kerala, India
Ph: +91 487 2699037, 2699061-64, Fax: +91 487 2699249
Email: training@kfri.org