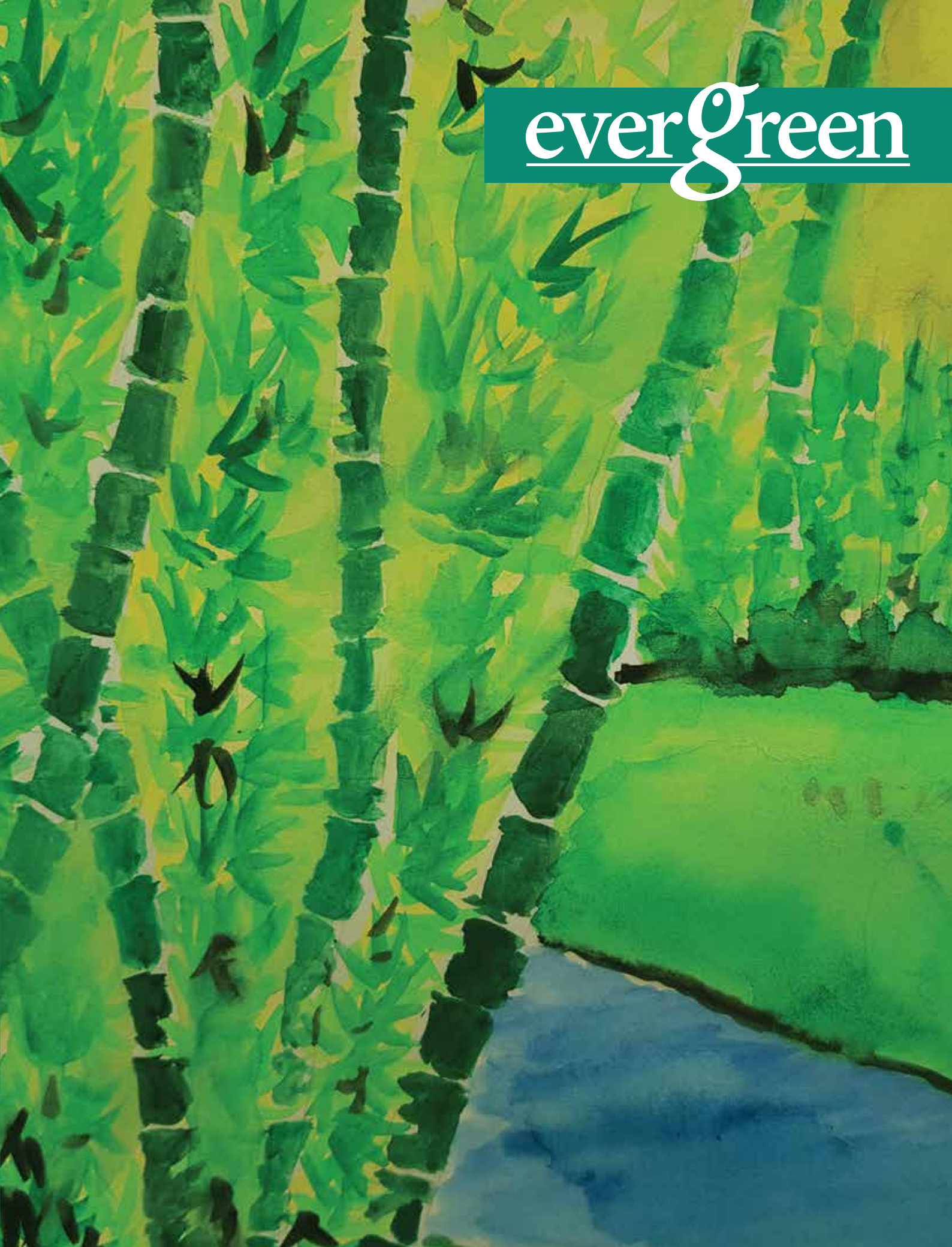
evergreen


ജനജീവിതത്തിനു വനം പ്രയോജനപ്പെടുത്തണം
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കലാഭിരുചിയുള്ള കുട്ടികൾക്കുസഹായം
ഇന്ത്യയിൽ ആദ്യത്തെ വനഗവേഷണ ഇൻസ്റ്റിറ്റ്യൂട്ട്
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Evergreen

Newsletter of

KSCSTE-Kerala Forest Research Institute,
Peechi

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From the Directors Desk

KSCSTE-Kerala Forest Research Institute wish you a productive and insightful year ahead…!

This issue of Evergreen is a special edition featuring a bunch of articles that provide a quick recap of the research carried out at the Institute over the past four and half decades. While these articles cover only selected areas, the issues that follow this one would provide more reviews to fill the information gaps left by the present one. A majority of these invited essays are by the scientists who had served the institute for over three decades and made commendable contributions to the tropical forestry research. Therefore, this exercise allows us to take stock of our past efforts and reorient our mission in the ensuing golden jubilee and beyond.

The priorities of the tropical forestry and forest research have undergone many paradigm shifts (from industrial plantations to ecosystem service oriented forest management and from conventional breeding to biotechnological interventions) during this period. We expect our readers to keep in mind the shifts in the context of research while enjoying this retrospect.

Expecting your continued cooperation and valuable suggestions.

Syam Viswanath

Director, KSCSTE-KFRI

10 January, 2020

Salim Ali during his visit to KFRI in 1980, accompanied by Madhava Menon IAS (thenVice Chancellor, Kerala Agricultural), Dr. Kedarnath (then director, KFRI), KK Nair, Shanmughanathan and Sugathan (*Photo: Subhash Kuriakose*)

Contents

The Kerala Forest Research Institute and the Study of Endemic Birds

SALIM ALI
Bombay Natural History Society.

THE phenomenon of far-flung discontinuity in the geographical distribution of so many diverse taxa of plants and animals inhabiting the Eastern Himalayas and the Indo Malayan region on the one hand and the heavy rainfall areas of the southern Sahyadris or Western Ghats complex on the other (i. e. the Nilgiris, Palnis and associated hills of Kerala), has long attracted comment and speculation from biologists. A plausible explanation of the logistics of this curious discontinuity was suggested by the late Dr. S. L. Hora, a distinguished Indian ichthyologist, as a result of his study of the highly adapted fish fauna inhabiting the torrential streams of these two regions, which showed several genera and species to be strikingly similar or even identical. Since of all animals fishes as a group is the most inescapably dependent for distribution on continuity of a water connection, Dr. Hora's hypothesis offers a clue for similarly disjunct distribution in other plant and animal life. As well it deserves intensive critical study from other scientific disciplines besides biology.

The discussions at a symposium on Hora's 'Satpura hypothesis of the distribution of Malayan flora and fauna to peninsular India' held in Delhi in 1948, published in the *Proceedings of the National Institute of Sciences of India* 15 (8) : 307–422, is a thought-provoking and revealing document. It contains the views of eminent biologists, geologists, palaeontologists, meteorologists and others. Field biologists and other scientists working in the humid biotopes of south India and Sri Lanka should keep it under constant review and study.

Perhaps the best known or—what may be called 'classical'—example of the type of disjunct distribution under reference, is provided by the genus of Mountain Goats known as Tahr (*Hemitragus*), which has a curiously broken and far-flung distribution on the Asian continent. The genus *Hemitragus* has a single species, *H. jemlahicus*, in the Himalayas ranging from the Pir Panjal in the west to Bhutan in the east. After a break of about 2000 km to the south, a second species, *H. hylocrius*, popularly miscalled 'Nilgiri Ibex', makes its appearance in the southern peninsula — in the Nilgiri and associated hills of Kerala. To add to the complexity of the distribution pattern, the occurrence of a third species, the Arabian Tahr (*H. jayakari*), in the mountains of the Oman hinterland is still more puzzling.

A large number of endemic bird species inhabiting the heavy rainfall areas of the southern Sahyadris and Srilanka are in fact relict populations of east Himalayan congeners. Some of them are rare and curiously patchy and parochial in their local occurnences. Exceedingly little is known about their ecology and behaviour, since it is only investigators resident in the area who can first locate the birds in their specialized habitats and then pursue the study of their life history. In this way local bird students can make original and worthwhile contributions to the ornithology of India.

My object in writing this note is to draw attention to these 'mystery' birds, of the biologists who may have the good fortune to be based at the newly established Kerala Forest Research Institute, where, at long last, special facilities are available for studies in wildlife biology under competent guidance. Two of these 'relict' bird species, the study of whose biology I would recommend being taken up on a priority basis are the Frogmouth *(Batrachostomus moniliger)* and the Great Eared Nightjar *(Eurostopodus macrotis bourdillonl)*. Both belong to different families of the Order Caprimulgiformes (Nightjars). They are soft-plumaged, night-flying, insectivorous birds of sober cryptic coloration which affords them perfect camouflage when at rest in the jungle during daytime. This frogmouth *(B. moniliger)*, whose nearest congener, *B. hodgsoni*, occurs in the Eastern Himalayas and the hills of northern Burma and Assam, is found in the heavy rainfall tracts of the southern Sahyadris from about North Kanara to Trivandrum, up to elevation of *c.* 1200 m; also in the evergreen forest biotope of Sri Lanka to *c.* 1800 m. The bird is of the size of a Myna. Its exaggeratedly wide gape and broad swollen horny bill are aptly suggestive of a frog's mouth, giving point to the bird's scientific as well as English names. The male is grey-brown, mottled and vermiculated with white, buff, brown, black and chestnut, blended into an astonishingly obliterative pattern which renders the resting bird completely invisible at short range. The female is a dull rufous overall, boldly spotted with black and white on the wings. During the ornithological survey of the erstwhile states of Travancore and Cochin in 1933-34 I came across the frogmouth only on a single occasion, at Thattakad, and that too when accidentally flushed from its siesta in the jungle. Several transient visits to Kerala since that time have failed to produce a further sighting of the bird, and it is evident that only a persistent search by a resident investigator will succeed in locating its regular haunts. It is crepuscular and nocturnal in habit, resting unobtrusively and statue like during daytime, and may therefore appear rarer as a species than it actually is. All this, no doubt, is largely responsible for the paucity of our knowledge concerning its abundance status and its ecology and breeding biology. The birds spend the day in dense jungle perched individually rather upright on or along a low branch with bill pointing upward and eyes shut, looking deceptively like the snag of a lichen-covered branch. It is a silent bird on the whole, and its nocturnal calls are also imperfectly known and controversial. The frogmouth is believed to be somewhat parochial and non-nomadic: therefore once located it should be comparatively easy to follow its day-to-day activities, albeit that the bird is largely nocturnal.

The south Indian population of the Great Eared Nightjar, *Eurostopodus macrotis bourdillonl* has a very restricted known distribution in the evergreen and moist-deciduous biotopes in the Kottayam, Quilon and Trivandrum districts of Kerala. It has recently been recorded in Goa (Valpoi), and may occur in appropriate facies elsewhere in the humid tracts of the southern Sahyadri complex. It does not occur in Sri Lanka. The disjunct northern subspecies, *E. m. cerviniceps*, inhabits parallel biotope in Meghalaya, Nagaland, Manipur and Bangladesh extending beyond to Burma, Thailand, Malaya and the Indochinese countries.

Bourdillon's Great Eared Nightjar is a large, handsome dark coloured nightjar, slightly smaller than the House Crow, of the cryptic colour pattern of mottled and vermiculated grey, brown, buff, chestnut and black, characteristic of the family. The sexes are alike. Two prominent erectile ear tufts spring from the sides of the head behind the eyes. However, since the bird is largely crepuscular and nocturnal, these details are seldom observable in the field but in overhead flight the large size, longish tail and stately wing beats help in its identification. It roosts during daytime squatting on the ground, or on a prone log, in scrubby undergrowth. From here it issues forth at sundown and may then be seen flying about with leisurely, deliberate wing beats or circling high above the tree tops in the gathering dusk, uttering from time to time its loud beautiful and clear double or 3-noted whistling calls *whi-wheeeew*. These calls are definitive and unmistakable and the surest evidence of the bird's presence in any locality. The only locality where I have consistently come across the Great Eared Nightjar on each of several visits over the years is Tenmalai in what used to be central Travancore. We know next to nothing about the ecology of the bird, and the Tenmalai area—unless it has altered radically in the last ten years or so—is obviously the place where a beginning of the study should be made.

Reprinted from Souvenir released on the occasion of the inauguration of the Institue on 19th February, 1978

Mission accomplished... a long cherished dream come true...!!!

Dr. Jyoti K. Sharma
Former Director, KFRI, Peechi

Peechi

I landed in Trichur (as called then) on 1st November 1978 from Australia (Australian National University) to join KFRI. It was a rude shock for me as Mr Viswanathan, the then Registrar told me that without 2 copies of photographs I could not join my duties that day. Not knowing anything about the town I rushed to Trichur taking a Peechi Transport Bus to town in search of a photo studio where I could get my photographs made. Since, in those days it took 3 days to get the photographs made I could finally join as Scientist C, Scientist- in-Charge Pathology Division only on 4th November and with this my journey started in KFRI.

When I look back I have no regrets as KFRI provided an excellent platform for forestry research in the country and the proof is that after serving KFRI for nearly 20 years during which time I had an excellent productive career as a Forest Pathologist bringing KFRI on the World Map in Forest Pathology. I could publish several research papers in prestigious international journals. I could build up an excellent rapport with my contemporary Forest Pathologists around the world such as Dr. Glen Kile, Dr. Ken Old , CSIRO, Australia, Dr. Mike Wingfield, South Africa, Dr. Chuck Hodges, USA, Dr. Franco Farriera, Brazil, Dr. Eric Boa, UK, etc. Due to our excellent research output at International level I was invited to be an FAO/IPGRI Expert Member in Expert Committee to Frame Guidelines for

Dr. Jyoti K. Sharma addressing august gathering during the foundation stone laying function of the Silver Jubilee Block, Extension and Training Centre and Guest House, 1st April, 2003.

safe movement of Eucalypt germplasm in Bangkok, Thailand (November, 1995) and Pine germplasm in Opocne, Prague, Czech Republic (October, 1996). Working in KFRI, a State Government Institute I could become Chairman/ Coordinator, International Union of Forestry Research Organizations (IUFRO) Working Party 7.02-07 on Diseases of Tropical Plantations, 1990-2000 and organized and chaired WP Symposium on "Management of Diseases of Economic Importance in Tropical Plantations" during XX World IUFRO Congress in Finland, August 1995 and on "Impact of Diseases on the Sustainability of Tropical Forests" during XXI World IUFRO Congress, August 2000, Kuala Lumpur, Malaysia.

Working in KFRI was so valuable that I could get several opportunities to work as International Forestry Consultant, FAO (UN) in several countries such as Vietnam, Myanmar, Nepal, Bhutan, East Timor, Thailand, Indonesia, etc. addressing various forestry problems ranging from Eucalypt diseases in Vietnam, prioritizing forestry research in Myanmar, assessing leasehold and community forestry in Nepal, drafting a project for biodiversity rules for Bhutan, and drafting Forestry Act for Thailand to promote forestry in private lands in Thailand and others.

When I joined as a Research Coordinator, I attended a short term course in Research Management in Malaysia so that I can do justice to the position more effectively and tackle the research management in a professional and scientific way. However, with this background when I joined as Director in July 1999 I had a challenging task to run a prestigious institute known throughout the world as 'KFRI Peechi' and take forward the legacy built by my predecessors with their extraordinary vision to make KFRI a world class Institute. I pledged to complete the unfinished work and decided to dedicate myself for the upliftment of KFRI with my full energy and zeal with the support of all the staff. I realized it was not so easy as there were numerous problems in achieving my goals.

Since, the financial condition of the Institute was not so comfortable even for paying staff salaries and arrears what to think of repairs the first and foremost task was to harness sufficient financial grants. For building corpus which we could use during rainy days it required judicious efforts. From research project overheads to additional funding from the Government under Plan and Non plan all were explored in right earnest. We used to reach the Secretariat in Trivandrum on the last day of the financial year in the night to transfer any unused grants by other departments in an effort to build our corpus funds.

Lack of adequate financial support was also a big lacunae for modernizing research infrastructure and augmenting the existing facilities to provide world class research atmosphere in the Institute without which no research Institute can perform to its capability. One of the daunting tasks which needed to be addressed on priority basis was repair of existing dilapidating and leaking buildings with cheap construction technology not fit for a research institute to last at least for 100 years. The staff quarters were also in the same pathetic condition. Since there was no boundary wall around the campus encroachments by locals were rampant from all sides in the main campus at Peechi as well as sub-centers.

Equally important was to obtain research funding through sponsored research projects. Although KFRI already had good relations with the State Forest Department but there was a need to be proactive in providing research assistance/ support to KFD in field forestry and also obtain research funds for projects for field – based research of practical importance directly applicable in the field. Through the World Bank Forestry Project of KFD under the charge of late Mr. Balachandran Thampi, IFS and with the support of Mr. Ershad Khan IFS, a World Bank Forestry Expert to KFD KFRI could obtain funding of several research projects, including construction of a Teak Seed Centre in KFRI with a provision of a Range Officer on deputation to KFRI. With this support from the KFD we had no dearth of funds for research in KFRI.

Since, there was little chance to procure additional funds from the State Govt. funding was explored

from the Centre, especially Planning Commission for developing infrastructure in KFRI. I developed good rapport with the then Planning Secretary who after my presentation on dilapidating and leaking buildings gave me immediate grant for urgent building repair work in KFRI. He only suggested to try to obtain funds from the Planning Commission Govt. of India. During my official visits to Delhi, especially for attending meetings in MoEF and DBT and DST I started to visit Planning Commission and made good contacts in the Forestry Section, especially with Dr. RC Jhamtani, Sr. Advisor. When he was convinced that I am genuinely asking for Planning Commission's financial support for KFRI he suggested me to prepare a detailed Project proposal to address research needs which will require upgradation of equipments and infrastructure in KFRI.

For developing the project proposal we had detailed consultations with all the scientific staff and we prioritized the research focus, including equipments needed and new infrastructure as well as upgradation of the present infrastructure required. In all the meetings for infrastructure development Registrar, Dr. Thulasidharan Nair and the Engineer, late Mr. KR Mukundan were also involved in consultations, in addition to Heads of all the Divisions. Once we had prepared the project proposal for about ca Rs. 20 crores and scheme of implementation with phasing it was submitted to Shri KC Pant, Vice Chairman, Planning Commission by the Chief Minister of Kerala through the Secretary Planning and Economic Affairs, State Planning Board, Kerala Government.

Once our Project proposal reached the Planning Commission, I frequently met Dr Rajan Katoch, Jt. Secretary attached to Shri KC Pant and Dr. RC Jhamtani for pursuing the proposal. I also met Mr. Pant and appraised him of the need for financial support and he was very sympathetic to our request. I was told by a reliable official that Dr. DN Tiwari, IFS who was in charge of Forestry in the Planning Commission was not in favour of our project as it was a State Govt. research Institute. On my suggestion Dr. Jhamtani constituted a three member committee consisting of Prof CR Babu, Pro Chancellor, Delhi

Audience - Foundation stone laying Ceremony, KFRI Silver Jubilee Block on the 1st of April, 2003

University, Dr Shyamsundar, PCCF Retd., Karnataka and Dr Ram Prasad, PCCF, MP to look into our request. The committee was approved by Mr KC Pant himself (I made sure that when Dr. DN Tiwari was absent in the office). The committee members visited KFRI and interacted with the scientists. I made a presentation on proposal and the budget was discussed threadbare and finally reduced to Rs. 12 crores and recommended to the Planning Commission.

The grant was transferred to the State Government as it could not be disbursed directly to KFRI. I met Dr. Vinod Rai IAS, the then Pr. Finance Secretary and appraised him of the whole efforts gone into for obtaining the Planning Commission grant. He gave me assurance that the whole money will be transferred to KFRI in three installments on submission of utilization of disbursed grant. We received the grant in installments as promised from the State Government. When Mr Vinod Rai moved to the Centre as Secretary Finance the new incumbent Mrs. Sudha Pillai, IAS was equally helpful and she also transferred the remaining grant to KFRI within the given time frame.

Once we got the grants we moved ahead according to our planned development. Separate committees were constituted for monitoring the progress of implementation, including procurement of equipment, furniture, vehicles, construction of new buildings, and upgradation of existing buildings, corridors, staff quarters, etc. For construction of new buildings such as Silver Jubilee Block, International Guest House and Training and Extension Centre architectural designs were invited through all India advertisement. The main criterion for selection was on Kerala architecture, and also that it merged with the surrounding forests and undulating hilly terrain. I always believed in excellence and never compromised with best quality and I made sure that whatever we do in KFRI it should be world class.

Along with the construction of buildings and boundary walls at Peechi, the construction of buildings and boundary walls were also taken up in Palapilly (staff quarters) and Nilambur (Research block and Dormitory). Several new equipments were processed and procured during the implementation period, the prominent being the Universal Testing machine in Wood Science Department for quality testing of wood, a facility first of its kind in any research institute in Kerala.

Once all the buildings were constructed, all the existing buildings were refurbished with new flooring, etc. and new corridors were laid the buildings were inaugurated by the then Chief Minister of Kerala Shri Oommen Chandi in the presence of the then Executive Vice President of KSCSTE, Dr. A E Muthunaigam. It was a big day indeed in the history of KFRI and a mission accomplished which I dreamt while taking over as Director of KFRI.

In addition to buildings and infrastructure development the other research activities were establishment of a Palmetum in the narrow strip of land opposite KFRI, establishment of Arboretum in the forest patch in between staff quarters (Type II) and western boundary of the Institute.

Having travelled to many forestry research Institutes in the world I was convinced that research in KFRI needed thorough reorganization to address the current needs of the forestry sector, especially the forest department and forest-based industry. The division-wise concept was compartmentalized and outdated and did not provide an opportunity to multidisciplinary research. With due deliberations at length and with the concurrence of scientists research was reorganized into Departments and Divisions bringing a fresh approach to research in KFRI.

Another hallmark of my tenure was establishment of the Bioresources Park at Nilabur Sub Centre (initially supported by DBT and State Planning Board) which I conceptualized on the pattern of Nature trail in Edenborough Botanic Garden which I visited during my Finland trip during 1995, organizing the Silver Jubilee International Symposium where Chief of CSIRO, Australia presented a plaque to KFRI on 3000 yrs old Wood of 'Kauri' tree for excellent work done by KFRI in tropical forestry and release of a

from the old leaves

Evergreen 2004-05

New Infrastructure For KFRI

Silver Jubilee Block- A boost to research and conference facilities
Inaugurated by Hon'ble Chief Minister Shri Oommen Chandy on 29 January 2005.

The Trainees Hostel – Provides modern boarding and lodging facilities to trainees and guests. Has 12 a/c double rooms, 4 non a/c rooms, two dormitories each with 25 a/c cubicles.
Inaugurated by Hon'ble Chief Minister Shri Oommen Chandy on 29 January 2005

First Day cover by the Post Master General, Kerala. Similarly, organization of an International Conference on Quality Timber Products of Teak from Sustained Forest Management (2-5 December 2003) attended by several teak researchers from around the world which showcase our strength in teak research was very satisfying.

Another feather on the cap of KFRI was added was added when a total of 7 scientists, including me participated in IUFRO World Forestry Congress in Finland and presented papers and chaired sessions and later when JAICA invited KFRI to visit Japan. I along with four of the scientists, Dr Jose Kallarackal, Dr K C Chacko and Dr K Swarupanandan visited several forestry research laboratories in Japan to explore possible research linkages.

Some time I wonder that how come we did all this? Of course it was not possible for me alone without the wholehearted support I got from all my staff, scientific, technical, and administration. Only one regret I had and still I have that before leaving KFRI I could not fulfill the dream of providing well deserved pension to KFRI staff..!!!

jyothikumarsharma@gmail.com

Access to genetic resources and benefit sharing: challenges

Dr. R.V. Varma

Chairman, EC on ABS,NBA & Formerly Chairman,Kerala tate Biodiversity Board
and Foremer Chief Scientist & Programme co-ordinator,KFRI, Peechi

Introduction

Biodiversity in nutshell is the variety of living things in which they inhabit and the interactions between them.The essential ecosystem services that we gain because of these interactions are food production,climate regulation,soil productivity,carbon storage etc.,which facilitate human well being. In the recent past we have lost much of our biodiversity due to anthropogenic factors and consequently the service providing capabilities have been negatively impacted. Climate change impacts are a recent addition and invariably the weaker sections of the socities are the worst affected

In this context,it is worth looking at the Biodiversity Act,2002 and its relevance to the equitable sharing of benefits arising out of the utilization of the genetic resources.

The CBD has clearly sets out principles and obligations of Parties, under article 15, on access to genetic resources and fair and equitable sharing of benefits, when utilised on the basis of Prior Informed Consent (PIC) and Mutually Agreed Terms (MAT) and conditions. A few countries have started working on the implementation of ABS and India too is a forerunner in the effective implementation of ABS principle in accordance with the Nagoya Protocol, 2010.But in that process, we face several challenges.

Nagoya Protocol

The Nagoya Protocol on ABS was adopted on 29th October, 2010, by the Conference of Parties at the 10th meeting in Nagoya, Japan. The essence of the Nagoya Protocol is to regulate the utilization of the genetic resources and associated TK for commercial and research purposes by requiring the users of these resources to share the benefits with the Country/ Community as the case may be. This protocol provides a strong basis for legal certainty and also transparency to both providers and the users of the genetic resources. It is also significant to note that there is also provision to support the TK holders, whose knowledge, if utilised for commercial purposes, will be suitably rewarded. In pursuance of the Nagoya protocol, Govt. of India (National Biodiversity Authority-NBA) also brought out ABS regulations in 2014.

ABS, as per the BD Act, 2002

The BD Act stipulates that a foreigner cannot get access to the bioresesources and associated TK, or claim any Intelectual Property Rights(IPR) based on Indian bioresources,without the approval of NBA. However, Indian Institutions/individuals of Indian origin can get access to bioresources for the above purposes by getting an approval from the concerned State Biodiversity Boards (SBB), from where the bioresorces are accessed. Though in the Act it says *"with prior intimation to SBB",* for all practical purposes an approval from the SBB is needed. This and many other similar ambiguities will get clarified in course of time by legal experts, when we actually get into the business of ABS. It is certain that when ABS is implemented at State level, many issues will be referred to the Court of law and further clarifications on specific issues will emerge. Same will be the case with matters related to IPR and TK. There is also a feeling among the traders and multi national companies, that the BD Act is mainly used as a weapon to block trade and commerce .This contention is not true and what NBA and most of the SBBs are trying is to play the role of a facilitator, within the purview of the Act and rules and see that the bioresources are utilised in a sustainable manner.

ABS regulations, 2014

There are four forms - Form 1 for access to bioresources for commercial utilisation, bio survey and bio utilisation. These applications are to be sent to NBA or SBB, as the case may be depending on the status of the

applicant, foreigner or Indian. Form 2 is for transfer of research results relating to bioresources to non-Indians. Form 3 is applicable to everyone for obtaining IPR rights either foreigner or Indian and Form 4 for transfer of biological material for non-commercial research or for research for emergency purposes outside India by Indian researchers/ Government Institutions.

In the case of Form 1, the benefit sharing obligation on the part of the trader shall be in the range of 1 to 3 per cent of the purchase price of the biological resource .For the manufacturer; it shall be in the range of 3 to 5 per cent of the purchase price of the biological resources. When it is accessed for commercial utilisation, the applicant shall have the option to pay the benefit sharing, ranging from 0.1%, .0.2% and 0.5% on annual ex-factory gross sale of the product, depending on if the sales are up to Rs. 1

മുള ഉൽപന്നങ്ങൾക്ക് ഭൗമസൂചിക പദവി: ചർച്ച നടത്തി

പീച്ചി • മുള ഉൽപന്നങ്ങളുടെ ഭൗമ സൂചിക പദവി ലഭ്യമാക്കുന്നതിനു സാധ്യതതേടി സംരംഭകർ ഗവേഷകരുമായി ചർച്ച നടത്തി. പീച്ചിയിലെ കേരള വനഗവേഷണ കേന്ദ്രത്തിൽ നടക്കുന്ന മുള-ചൂരൽ അധിഷ്ഠിത ഉൽപന്ന നിർമാണ സംരംഭകരുടെ പരിശീലന പരിപാടിയിലാണ് കെഎഫ്ആർഐ ഡയറക്ടർ ഡോ.ശ്യാം വിശ്വനാഥന്റെ നേതൃത്വത്തിൽ ചർച്ച കൾ നടന്നത്. ഇടുക്കിയിലെ ആദിവാസി ഊരിൽ നിർമിക്കുന്ന കണ്ണാടിപ്പായക്കു ഭൗമ സൂചിക പദവി ലഭ്യമാക്കുന്നതിനു ശ്രമിക്കുമെന്നു കെഎഫ്ആർഐ ഡയറക്ടർ ഡോ. ശ്യാം വിശ്വനാഥ് പറഞ്ഞു. ഡോ. സി.ആർ.ബാബു ക്ലാസ് നയിച്ചു.

മുള-ചൂരൽ അധിഷ്ഠിത ഉൽപന്ന നിർമാണ സംരംഭകരുടെ പരിശീലന പരിപാടിയിൽ കാർഷിക സർവകലാശാലയിലെ മുൻവിസ്തരണ വിഭാഗം മേധാവി ഡോ. സി.ആർ.ബാബു ക്ലാസ് നയിക്കുന്നു.

News report on workshop organised by KFRI on geographical indication for bamboo products

crore, between Rs.1 to 3 crores and above Rs. 3 crores, respectively. In the case of IPR, when the applicant himself commercialises a product, the benefit sharing shall be in the range of 0.2 to 0.1 %, which shall be worked out on the annual gross ex-factory sale minus government taxes. As per Clause 15(1) of the ABS regulation, when approval has been granted by NBA for research or for commercial utilization or for IPR, the mode of benefit sharing shall be- a) 5 per cent of the accrued benefits to NBA, out of which half of the amount shall be retained by NBA and the other half to the concerned SBB for administrative charges and b) 95 per cent of the accrued benefits shall go to the concerned BMC and /or benefit claimers.

Benefit sharing options

There are provisions for both monetary and non-monetary modes of benefit sharing.Under non-monetary, the major provisions are providing institutional capacity building, training, infrastructure, transfer of technologies education and training on conservation and sustainable use of biological resources and taxonomic research.

Intellectual Property Rights(IPR)

Gives exclusive rights to the creator to commercialise their creation for economic gains and is transferable for a limited period ad after that it becomes a public property,with exclusive rights to none.The very purpose of IPR is to motivate innovation and there are different forms of IPR such as patents, copyright,trade marks,geographical indicators,designs,plant varitey protection etc. India, being a signatory to the two important international agreements,CBD and TRIPs of the World Trade Organization and the,three important legislations made under this are the BD Act,PPV &FR Act and its ammendments and the patents Act (1970).As already mentiond as per the BD Act no person shall apply for any IPR(Indian or non –Indian) for any invention based on research/TK of any bioresouce obtained from India without getting prior approval from NBA. The exception is only for those coming under the PPV &FR Act.There is also coordination with the Patent office in India and such applications will be redirected to NBA by the Patent Office.The applicant has to apply to NBA in form III for IPR,with all the relevant details,including the geographical location of the bioresource collected. Normally the benefit sharing upon commercialization for individuls will be in the range of 0.2 to 1% of the gross ex-factory sale. Thus the BD Act provides necessary framework for regulations on commercial use of biological material and their conservation.

Traditional Knowledge(TK)

TK will certainly play a major role in shaping the life style of the modern society.As such there is no well accepted definition for TK. India has crated a data base on TK called **TKDL**(Taditional Knowledge Digital Library), based on documented information on TK and is maily used by the patent office.They reject the applications for patent, if it is already documented in TKDL.We have other forms of TKs which are orally transmitted from generations to generations which is associated with a group or community who are maintaing, practising and developing it in the traditional cultural context.The TK being collected in People's Biodiversity Registers(PBRs) belong to this category.In the Wayand District of Kerala, many of the PBRs provide very intersting information on TK, especially from the tribal communitie.Several varities of rice,tubers and medicinal value of many plants have been noted.What to do with this data? Certainly we have to protect them,but at the same time some of the promissing ones have to be scientifically validated for efficacy and later should be of use to the society.The greatest challenge would be to prevent misappropriation of such TKs.In order to improve the socio economic conditions of such knowledge holders, Prior Informed Consent (PIC) may be obtained and mechanisms to enter into Mutually Agreed Terms and Conditions (MAT) shall be implemented.There is mechanisms for benefit sharing under BD Act,but for other TKs at grassroot level, we have to develop appropriate measures. In India, there is no specific law to protect TK.There is an urgent need to have a strong legislation to prevent misuse

of TK by commercial groups and to facilitate social and economic benefits of the traditional communities for preservation,promotion and management of TK.

The Medicinal Plant Sector

More than 80 per cent of our medicinal plants are procured from the forests.Habitat wise ,may be only about 24 per cent are trees in forests, and the remaining are herbs and shurbs which constitute the bulk of our medicinal plant resouirces.Though in paper we often see many of them as colllected from cultivated source, it is difficult to believe such claims. Apart from the health care, the medicinal plants are also a source of income generation for the rural flock/tribals and thus fall under the ambit of ABS.The traditional knowledge associated with several medicinal plants are still available with many communities which are not documented and are orally transmitted from generation to generation.

In India,nearly 8000 plants are known to be of medicinal use, under Ayurveda, Siddha, Unani and Homeopathic.The demand for medicinal plant based raw materials for making medicines is on the increase.Increase in human population and reliance of public on plant-based medicinal products are challenges that we face in recent times.Many a time, because of the lack of sustainable harvesting techniques, we lose many species and spurious materials come to the market. This is the place where intervention should take place and through a decentralised approach,through BMCs, the levey charged on medicinal plants can be shared among the tribals and village flock.However,the regulatory mechanisms either through SBB or BMC is not taking place for want of guidance and awareness

A few examples of Benefit Sharing

The seaweed, *Kappaphycus alvarezii* / *Euchemia cottonii* is grown by the fishermen community in the coastal districts of Ramanathapuram,Tuticorin,Pudukkottai and Tanjore in Tamil Nadu and exported to the tune of 2000 metric tonnes to countries like Malaysia, Philippines and Indonesia by M/s. Pepsico India Holidays Pvt .Ltd. A royalty of Rs.39.09 lakhs was paid to the NBA by the exporter. The Tamil Nadu Biodiversity board is planning to distribute its share form NBA under benefit sharing to about 754 families in the coastal districts.

The Red sandal wood auction had taken place in Andhra Pradesh which has high economic value

Director, Dr. Syam Viswanath providing the details of Bamboo Products exhibited on Bamboo day at FRC to Dr. T. K. Narayanan, Vice Chancellor, Kerala Kalamandalam

and huge demand in countries like China, Japan and East Asia on account of its multifarious uses. Each tonne of red sanders fetches about Rs.25 lakhs in the international market. During the first phase of global auction of seized Red Sanders, the Andhra Pradesh Government got nearly Rs.860 crores during December, 2014 and during the auction in 2015, the income was over Rs.1000 crores.From the Red Sanders auction, a royalty of Rs.15 crores was given to NBA by the successful bidder. This is a classical example and similar instances in future would generate enough monetary gains which have to be distributed appropriately and the benefit should reach the deserving. A similar approach can be taken while auctioning the sandal wood in States like Karnataka and Kerala.

ABS System at State Level

All the State Biodiversity Boards can chalk out their own ABS policies and a few States in India have already in the process of implementing the same at State level. Kerala State is a forerunner and the ABS polices and guidelines have already been prepared and the ABS process is on. Since Kerala State has BMCs in all the LSGs, the implementation of ABS would be more effective and meaningful. The State Biodiversity Board has already made the State Biodiversity Fund rules and on similar terms, the local biodiversity funds at BMC level will also have to be made. Only when some of these basic formalities have been completed as per the Act, then only the money accrued through ABS mechanism could be channelled at State/local level for various purposes. As far as the State of Kerala is concerned, the two major sectors like the Ayurvedic Manufacturers and the Marine food exporters have to willingly contribute towards this effort for flourishing their business on a continuous basis and sustainable manner. In Madhya Pradesh, litigation in the High Court is pending against the ABS proposed by the MP Biodiversity Board on soybeans extracting industries. This is questioned in the court on the grounds that soybeans is a traditional crop and listed under the Normally traded commodities(NTC) for which there is exemption as per section 40 of the BD Act. Many technical / legal loopholes can be brought out by various industries to evade payment under the ABS. The concerned authorities may also look at the possibilities of bringing the industries under ABS through a process of negotiations and try to avoid embarking on legal battle.

It is pertinent to mention that both NBA and SBBs are looking at the plant resources or plant based industries and there is an urgent need to look at critically as to what is happening in the animal and fish sectors in terms of ABS.

Conclusions

Compared to many countries, the current scenario on ABS in India is somewhat satisfactory. However, there are areas for improvement and the system would evolve to perfection in course of time. Both NBA and SBB have to play the role of a facilitator and at the same time the Act and rules and the ABS regulations have to be implemented strictly. Processing of the applications can be speeded up and the procedural hurdles reduced to the minimum. Like the plant bioresources, both animal and fish resources have to come under the ABS system. It is a sad reality that the benefit sharing is yet to reach the communities at village level. Unless this is achieved the people will not realise the importance and involve in the conservation of our genetic resources. Awareness at various levels supported by sufficient legal experts is essential to achieve the objectives of ABS. The monetary gains achieved through ABS have to be distributed in a flawless manner and the benefit sharing at local level to be ensured. There should also be a monitoring mechanism to oversee the effectiveness of the distribution process and corrective measures taken wherever needed. There is also a need to develop innovative models of ABS, which can be replicated. The 2014 ABS guidelines/ regulations are being revised and the proposed 2019 ABS regulations would ease out some of the issues.

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Reminiscences of research in ecophysiology

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Measurement of photosynthetic efficiency of some nursery plants using the chlorophyll fluorescence instrument. The shade requirement of nursery plants can be determined physiologically.

Having joined KFRI by end of 1987 as Scientist C and leading the Plant Physiology (later named Tree Physiology) Division, my biggest challenge identified by Dr. C.T.S. Nair, the then Director of KFRI was to find a solution to the controversy brewing in Kerala and also elsewhere regarding the "excessive" water use due to introduction and planting of eucalypts and some other exotic trees in the State. Having got a reasonable background training in ecophysiology from Professor John Milburn at the University of New England, Australia and Professor Ewald Komor at the University of Bayreuth, Germany, I was very enthusiastic to find a solution to the above problem which was certainly important to the Forest Department and the society alike. Soon the enthusiasm gave way to expectations, when I realised that there were no funds in KFRI to set up a field research facility for doing this study which required several expensive equipments such as a pressure chamber, portable infra-red gas analyser, porometer, leaf area index meter, soil moisture meter, automated weather station, etc. The only alternative left for me was to apply for external funding from different funding organisations, which was certainly taking my valuable time. Any scientist would get disappointed in such a situation, however, the work culture and ambience in KFRI was something special, which would enthuse anyone aspiring to do research. Taking a walk in the scenic long corridor of the Institute and the forest surroundings used to help me to regain my spirits for pursuing

Making measurements of shade tolerance of underground vegetation in a tropical moist deciduous forest as a part of the project work.

found that nearly 30% of the trees in Conolly teak plantation was affected by this problem. It causes considerable loss of recoverable timber from the teak tree. Another interesting fact was the observation of a diurnal cycle of flow of a brown fluid from the blister, with more fluid flowing during night compared to day time. We monitored the pattern of flow for several months and also analysed the chemical content of the liquid. We realised that it contained all the chemicals that are usually found in xylem fluid but with much higher concentration. It had no sugar in it, so phloem source was out of question. Further dissections of the affected trees showed us that the tree develops a split inside the wood into which the root pressure fluid drains. This fluid gets enriched later by the flavanoids and other chemical substances which leaches from the wood. When pressure builds inside the crack, the fluid comes out of the wood after developing a blister on the tree trunk. Although a small project, this project was well-planned and researched by our team mainly with the discussion provided by one of my previous gurus, Professor John Milburn who visited us during this time.

While the work on this project was going on, I received a major external funding for my eucalypt problem from the Ministry of Environment and Forests, Govt. of India. My first approach was to estimate the water consumption of the two eucalypt species cultivated in Kerala, namely, *Eucalyptus tereticornis* and *E. grandis*. Thanks to the project funds I bought several of the equipments which I have already mentioned, and started field work along with my colleague Dr. C.K. Somen. As a new scientist in KFRI without much field knowledge, I was helped by two of my experienced colleagues Dr. S. Sankar and Dr. K.C. Chacko to identify the study locations. The measurements had to be done on tree top for which we got a couple of scaffold towers constructed in the plantations at Wadakancherry and another at Muthanga, Wayanad. We used the Penman-Monteith model for the estimation of water use which takes into account the weather data and several physiological parameters also. I still remember the trouble we had to undergo in measuring the pre-dawn water potentials for which we had to be in the field by 5.30 a.m. and also making measurements on the tree top accessed by the scaffolding. Finding a place for overnight stay in the remote locations was always a challenge. We completed the project in time and published two papers in high impact factor journals. Our finding was *E. tereticornis* is an excessive consumer of water, but it could be reduced by planting this species at 1250 trees per hectare (the Forest Department was planting at 2500 trees per hectare).This report along with two international publications gained acceptance in the Forest Department especially with the recommendation from Mr. Norman Jones who was the Silviculture adviser to the World Bank which was funding some social forestry projects in Kerala. Having found values of water loss from the two eucalypt species, we were quite confident, but it opened up more problems. As scientists, we may be happy to wind up a project finding a solution for the problem, but good science *will* and *should* open up many more problems.

The question now was how does the water consumption of eucalypts compare with our native tree species and also some other exotics we have been growing for two or three centuries. The Kerala Forest Department World Bank Project supported our proposal to study this problem with generous funding. I could expand my field research facilities further by acquiring more sophisticated equipments. In the meantime, the Alexander von Humboldt Foundation, Germany (I am a lifetime Fellow of this Foundation) also sanctioned me several laboratory equipments to continue my research work. Soon we started to estimate the water consumption of eucalypts comparing them with teak, cashew and acacia by establishing several field experimental sites in different locations. Interestingly, we found that cashew trees consume water just like eucalypts, sometimes more, but at the same time acacia trees have good stomatal regulation to control

Plantations of eucalypts in Kanthalloor area near Mannavan Shola. The people of Marayoor have complained that these plantations create the water shortages in their town.

water loss. Teak is certainly a non-water consumer during summer (leafless period), but do consume quite a lot of water during the post-monsoon season. The details of this research were again published in a good journal.

Although eucalypts are not damaging to the water resources if managed in the right way, the criticisms invited by this genus are enormous. I doubt if any other plant genus has invited this many court cases in India, some of which are still active in different States (almost treated like a notorious criminal!!). So my next problem was to search for a eucalypt species which is suitable for the tropics and at the same time economical in water consumption. This proposal was again supported by the MoEF (presently MoEF&CC). Fortunately for us, thanks to our Silviculture Division, there was a plot with more than 20 different eucalypt species (at least 10 trees for each species) in the KFRI subcentre campus at Nilambur where we did the work on six selected species. By measuring the water use and photosynthesis of the above species we could work out their water use efficiency (WUE). This showed that *E. urophylla* is a species which is very economical in its water consumption. This could be very well grown in the tropics. We should know that this is one of the two eucalypt species which has its origin outside Australia, in Timor Island with very tropical climate. I understand that the Forest Department later took up this species for raising trial plantations at several locations.

This does not mean that the research on water consumption by trees was over. In the late 1990s, we had a good collaborative project with CSIRO, Australia for which Dr. K.V. Sankaran played a leading role. The project generously funded by the ACIAR gave opportunity to several of the KFRI scientists to get training in CSIRO labs in Australia. I was one of them, I got training in the use of sapflow gauges in CSIRO, Perth to measure the water flow through the trunk of

trees, which is still the most advanced method of measuring water flow through the trees. Besides, I got training in a CSIRO field project site in China using this technology. Back in India I could use the same technology in the field stations in Kerala and arrive at determined values of water use by eucalypts, the previous values were only estimates!

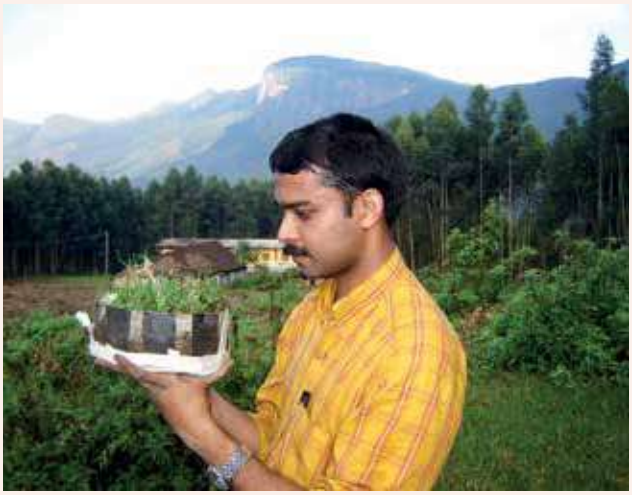
Another project with a social and an environmental impact was a eucalypt problem reported from Marayoor in Idukki District. Here the locals complained to the then Chief Minister Mr. A.K. Antony in 2004 that they were having acute shortage of water due to the eucalypt plantations uphill at Kanthalloor. The eucalypt plantations were all privately owned. The CM asked the Forest Department to investigate. The Department directed KFRI to submit a report, and I was assigned the task. Based on my previous research experiences on eucalypts in Kerala, I submitted a report, however, the Department did not accept this report, they insisted me to conduct a study in Kanthalloor for two years and then report. They provided the support funding also. I measured the *E. grandis* water use round the year in a couple of locations at Kanthalloor using the sapflow technique. Besides, I monitored the stream flow at different locations in the Chengalar which is the main stream of Mannavan Shola draining into Pambar river, one of the east flowing rivers in Kerala. Two years intense observations and measurements showed that eucalypts here were transpiring just like anywhere else, but the stream flow did not show any reduction after it passes through all the eucalypt areas. So my conclusion was that eucalypt plantations were not damaging to the water flow in the river. Probably there was a bad drought in 2004, which really created the water shortages in Marayoor areas. However, I recommended that the Government should encourage farmers to go for temperate vegetable crops rather than eucalypts, as Kanthalloor and the surrounding areas are good for cultivating temperate vegetable and fruit crops. After many years, now, I understand that this recommendation is getting implemented at Kanthalloor and surrounding areas. The project had much social implications as more than 6000 poor families were depended on work in the eucalypt plantations here. In spite of all these, I still feel that there is no need to make a big hue and cry about eucalypts damaging the water resources. In fact they occupy only less than one per cent of the State area, and I do not believe that this will drain all the water resources of Kerala. However, the present trend, mainly due to environmental activism is to remove the eucalypts from everywhere. I will be the happiest man if this will solve the water scarcity of Kerala! Let us be aware that no tree is bad if it is planted in the *right way* at the *right place*.

Collection of weather data and their storage is an important activity for forestry and environmental research. KFRI had no recording of weather data. I started collecting daily weather data starting 1989 at KFRI using some borrowed equipments because we did not have funds for this. In the first two years I had to go myself every day early morning to record the data from a manual weather station located in KFRI campus. However, collecting data and displaying them daily in a display board in front of the Institute was something which I really enjoyed. Later in the years we got several automated weather stations to study the weather data from four of our Wildlife sanctuaries. This was a challenging project, however, it was short-lived for three years, after which no fund was made available from the Forest Department. Several years later we received plan funds to set up automated stations in different remote locations in Kerala with the facility of collecting data using a mobile phone sitting in the Institute. What a development of technology within a matter of two decades! However, this facility also stopped after my retirement from the Institute. Weather data collection is a very important activity for all environment related research especially when we are in the midst of a climate change. I feel that the KSCSTE should initiate a network of weather stations, especially in different geographical regions of Kerala setting up facility for sharing this data among all the different research institutions. Without long term data many of our researches on environmental problems will become meaningless. I understand that KFRI has recently set up long-term monitoring plots. Let us hope that this project will continue.

Another interesting project which involved a lot of international contacts and communications was an AusAID funded project on Rehabilitation of degraded forests through landscape based participatory approach. This project had eight KFRI scientists and three senior forest officers as investigators with myself as the Coordinator. The project gave the investigators an opportunity to get trained in different forest research methodologies in some of the best places in Australia which included Melbourne University, CSIRO, etc. I got the opportunity to lead a team of senior scientists and

forest officers from India to visit several scientific institutions in Queensland, New South Wales and Victoria in Australia as part of fixing the training for scientists. Besides several Australian scientists visited KFRI and imparted training to scientists here also. The role played by Dr. Sadanandan Nambiar (CSIRO Division of Forestry, Canberra) and Professor Ian Ferguson (School of Forestry, Melbourne University) in making this project a big success is unforgettable. In fact the project gave a very new approach to our research outlook in the sense that rather than an ecosystem approach we were asked to look at forests from a landscape ecology level. This involved looking at the biodiversity from a scientific and social angle with humans forming an important component in it. I feel that many of our ecological reports fail to get acceptance from the general public because many of them approach the subject of environmental conservation from a purely ecocentric viewpoint without regard for humans and their livelihood. Moreover, any environmental report should be participatory and therefore inclusive rather than exclusive, trying to forcefully implement the recommendations on the community. We should know that the opinion of the stakeholders is most important rather than the opinion from a few experts who have no stakes. A scientist's aim should be to alleviate the hardship of the people. I remember the words of Professor P.S. Ramakrishnan (ecologist and previous Advisory Committee Member of KFRI) who always used to tell us, "Please see that there is always a human dimension to what you do in ecology".

In one of my projects I had the opportunity to work outside Kerala in three States, namely, Karnataka, Andhra Pradesh and Maharashstra. The Department of Biotechnology, Govt. of India was sponsoring a major project on introducing noble clones of oil palm in India and they chose the above States for the trial. I was asked to monitor the physiology of the newly introduced plants including the growth and water use and irrigation requirements. KFRI authorities allowed me to take up this project although it was a bit away from forestry and also outside Kerala. The work involved frequent travel to these three States carrying several heavy field equipments. But it was a really rewarding work because we could show that in Maharashtra, the water stress caused maleness in the plants (oil palm has environmental control of sex differentiation). The trial was successful only in Andhra Pradesh. Interacting with many farmers and officers of the



Transpiration from the grasslands being measured using a simple lysimeter.

Horticulture Departments in these States was an enjoyable experience. I found the officers extremely helpful to farmers in Karnataka and Andhra Pradesh. I would not have been able to complete this project without the hard work done by two of my research fellows, P. Jeyakumar (presently Professor of Plant Physiology Dept., TNAU) and Suman K. George (presently Scientist with CSIRO, Australia). Jeyakumar completed his Ph.D. with me in this project. Suman completed his doctorate in University of Western Australia.

Doing ecophysiological research in a natural forest is very challenging in the sense that here the experimental plots are not laid down with statistical analysis in mind. At the same time, it is possible to do very meaningful research if we choose the experimental plots carefully. One such project was on the water use of several native tree species in a moist deciduous forest, which I took up along with Dr. U.M. Chandrashekara. We chose a location at Pattakarimbu in Nilambur North Division. Here I studied six tree species belonging to different canopy layers using sapflow gauges. It is interesting to note the flow of water through the tree trunks diurnally and in different seasons with lot of differences between species. The vapour pressure deficit of the atmosphere had an important role to play in regulating water use in this type of forest. It also involved reaching this elephant-inhabited forest area in the very early morning before sunrise to take the water potential measurements of the trees. P. Shajeesh Jan, Deepak Jolly George, K.T. Vivek and V.J. Aneesh deserve special mention here for their untiring enthusiasm as research fellows to get the work done in this difficult terrain.

Sapflow measurements being done in a eucalypt tree trunk to understand the water consumption. Sensors and heat pulse generators are inserted into the wood to measure the velocity of sap flow.

In the above paragraphs I have narrated briefly some of the important projects that I have completed with several of my scientist colleagues and research fellows. Several more projects were also completed with the cooperation from many of the colleagues. As a matter of fact, doing a project in KFRI was always an enjoyable task, although many a times we had to travel through the rugged terrain in the Western Ghats forests of Kerala. The Mahindra Jeeps were not as comfortable as the air conditioned vehicles which the KFRI scientists are using today. I really remember with gratitude the pains taken by some of our drivers in taking us during the early mornings and leaving the field late in the evening. For me most of my field studies needed instrumenting the site with automated weather station and the like. There were a couple of occasions when the instruments were damaged by wild elephants and sometimes by antisocial elements. However, we circumvented all these eventualities with calm and the KFRI office was very helpful on these occasions. There will be no Government office in Kerala which has not gone on strike for some or other reasons. Except for a day's *sathyagraha* demanding pension for employees, I am not aware of any other strike in KFRI during my 21 years of service starting 1987. This does not mean that we were provided with everything. This really meant that we had a very peaceful atmosphere, without any interference by political parties, which usually happens in Kerala. We have been able to build excellent infrastructure facilities in KFRI, especially when Dr. J.K. Sharma was the Director. In the matter of establishing a local area network (LAN) we were one of the foremost institutions in the State. This helped all the scientists to become computer literate even at an early stage. We were able to use email and browse the internet when many other institutions in Kerala were unaware of such facilities. There are innumerable such achievements for this Institute.

It is because of the above reasons that I decided to continue my research in KFRI even after my superannuation in April 2009. CSIR, New Delhi provided me an Emeritus Scientist position to continue my research for three years doing a project. After this period KSCSTE provided me an Emeritus Scientist position for another three years. In total I spent six years in KFRI after my superannuation, doing projects, and as a silent spectator of other events happening in KFRI. After leaving KFRI finally by end of 2015, I still continue my research as an independent researcher with several overseas collaborators and publishing papers including two books on climate change impacts. I also get opportunity to visit and do research in some German universities, especially Kassel University and Bayreuth University as a Humboldt Visiting Scientist. When I look back at the 21+6 =27 years in KFRI, my heart fills with satisfaction of having spent a good part of my career in a very lovely and prestigious Institute which nurtured many of my dreams as a scientist. I do not have any regret that I left two jobs before joining KFRI, first in Delhi University and second in Rubber Research Institute of India.

Having said much about the wonderful time I had in KFRI, let me scribble a few words of criticisms, without the intention of paining anyone. I feel Golden Jubilee is an occasion to look back and evaluate our performance during the last 50 years. KFRI has produced more than 500 research reports (or is it more?) by now. This is incredible! However, many of the results are unpublished in journals, which is certainly not a good scientific trend. Completing a project by publishing a report without any peer reviewed papers can definitely bring down the quality of our work. In fact a lot of time was wasted even in our days by publishing very colourful reports, which do not have much value now. The present trend of over-dependence on plan fund for the research projects is also not a good practice. Externally funded projects make a scientist more competitive and peers will certainly criticise such projects to improve the quality. It is also important to

Sapflow velocity being monitored in a field computer attached to the sapflow system on the eucalypt trees.

of specialisation as the scope for this kind of research is increasing day by day. We have very little information on the resilience of our biodiversity to climate change.

When KSCSTE was formed in 2003, we were very hopeful on many things. Certainly, free flow of funds for research (plan funds) was there, but very little was done for the service benefits of the employees. One of the first things that happened was the reorganisation of the divisions in KFRI. The existing scientific divisions were reorganised into Programme Divisions, with each such PD having 3-5 Departments. This was to promote more inter-disciplinary projects with more integrated approach. A lot of time was spent for this exercise, but unfortunately, it did not show any special advantages. This is because the scientists realised that the new positions of Programme Coordinators and Head of Departments created during this process was purely non-statutory without any special privileges or powers. As a matter of fact, the existing system in KFRI was good, and modifying a good system did not make it any better. In fact, KFRI was already having several inter-disciplinary projects. I understand that this reorganised form does not exist now. I wish if the same efforts had been taken to conduct the assessment of scientists in time, it would have done more to enhance the research ambience in KFRI. I hope the authorities will remember that for any hard working scientist it is most important to give him/her the assessment promotion due and in time. The five-yearly assessments were conducted with several years delay causing a lot of demoralisation especially among scientists. The only statutory position for a scientist in KFRI is his grade, such as B, C, E1, E2, F and G. A true scientist is not very fond of administrative positions, because he or she would like to do science more than administration. Also, it is surprising that none of the authorities managing KSCSTE thought of introducing a pension scheme for its employees so that they have a secure life after superannuation. Besides, no networking has been set up although there are several institutions under the umbrella of KSCSTE. Digital library, automated weather data, sharing of sophisticated instruments, consultancy groups, interdisciplinary projects, etc. are some of the facilities and networks which should have been in place under the KSCSTE umbrella. I hope the authorities will pay more attention to the above drawbacks at least in the future.

I would like to conclude this article by quoting Ellen DeGeneres, an American actress and writer, "If we're destroying our trees and destroying our environment and hurting animals and hurting one another and all that stuff, there's got to be a very powerful energy to fight that. I think we need more love in the world. We need more kindness, more compassion, more joy, more laughter. I definitely want to contribute to that." Let us keep the common man interested in environmental conservation. Let the Almighty inspire KFRI to do more to protect our forests and the environment.

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Sustainable management of renewable natural resources should be inherently be based on using resource increments (representing interest earned), and not consuming capital. The rate of harvest of living resources should not exceed rates of regeneration.

(Evergreen No. 44, 2000)

–Dr. C. Chandrasekharan IFS (Retd.), Founder Director of KFRI.

Diverse studies on Indian palms

Dr. Renuka C.
Formerly Scientist F and Head, Forest Ecology and Biodiversity Conservation Division, KFRI, Peechi

One of the major fields selected for scientific studies in KFRI is Indian palms, because they are a vital component of forest and agricultural eco systems, providing a wide range of economic products necessary for daily life. The members of palm family is highly variable and exhibits a tremendous morphological diversity and are most common in the under storey of tropical humid forests. They are distributed throughout tropical and subtropical regions comprising about 2450 species under 183 genera.

Palm family is the world's third most important useful plant family, after grasses and legumes. They are ecologically and economically most important in forest ecosystems and are useful to rural populations providing economic products traded at local, regional and global scales. They are considered as a keystone resource for pollinator and frugivore communities. The ancient and traditional use of palms has deep roots in indigenous communities in the Indian history and most of the palms have multipurpose uses ranging from building material, beverages, food, fuel, handicrafts, medicines and rituals, ornamental plants and structure and shelter. Majority of the palm species inhabits tropical rainforests with high rainfall ranges; others extended to arid regions and few species are restricted to coastal areas in association with mangroves as well. They occur in various ecological as well as altitudinal ranges and are distributed from 0-2500m elevation and each species has its own ecological and altitudinal preferences.

Calamus lakshmanae Renuka

Calamus stoloniferus Renuka

The increasing demand of the world's natural resource pose a serious threat to palm biodiversity and the main two reasons for the decline of the palm natural resources are overexploitation and habitat destruction. Rattans (canes) are economically important for the furniture industry and the over exploitation of this group caused dramatic population decline which in turn has had severe impacts on local and international markets. Palms are among the most threatened plants in India and most of the threatened species identified are rare or with restricted distribution. The species *Corypha taliera,* endemic to West Bengal, is treated as extinct in the wild. The natural habitat of *Hyphaene dichotoma* in the west coast of India, *Phoenix paludosa* in the mangrove swamps and coastal belt of Orissa and many of the cane species throughout India are under severe threat due to alarming rate of land conversion for massive urbanization and industrialization programs. The natural calamities like tsunami caused irrecoverable lose of the valuable genetic diversity of palms in Andaman and Nicobar Islands.

With this background KFRI initiated scientific studies in Palms during the early part of 1980s which will help in their sustainable utilization and conservation. An initial field survey revealed that many of the Indian palms were not well documented and the available taxonomic floras were not sufficient to identify them, especially rattans (canes). As a first step, KFRI started a project on palms seen in Kerala Forests. During this study two new species, *Calamus vattayila* and *C.dransfieldii* and one new record, *C. metzianus*, were published. Anatomical and physical properties of the species collected were also studied and recorded. This initial study led to several scientific projects on Palms.

Since the researchers, forest officials and students were finding it difficult to identify palms, especially rattans, with the available floras, a field identification key for rattans of Kerala was prepared with easily recognizable characteristics with suitable photographs. As a next phase, the studies were extended to whole of Western Ghats and Andaman and Nicobar Islands.

During the year 1999 – 2000 the Ministry of Environment and Forests, Government of India, launched 'All India coordinated projects on Capacity Building in Taxonomy' (AICOPTAX) and KFRI was selected as the coordinating centre for the studies on palms. This enabled us to extend the studies to whole of India.

Calamus vattayila Renuka

Genetic variations exist between populations of the same species. In order to conserve all these variations, extensive collection of seeds were done from throughout India and germplasm plots and seed stands were established at Nilambur, Achenkoil and Peechi. Species trial studies also were conducted. For these studies nursery and silvicultural techniques were also standardized. For conservation activities a basic knowledge of genetic diversity, reproductive biology and cytology is essential for formulating the

Daemonorops rarispinosa Renuka & Vijayak.

Daemonorops rarispinosa Renuka & Vijayak. 2

conservation measures and these studies were also conducted.

Rattan shoot is a traditional dish in some Asian countries. The tribal populations in the North Eastern States and in the Western Ghats use this as food as well a medicine. In countries like Laos and Thailand small diameter rattans are cultivated in large scale in open areas for shoot production. Rattan shoot farming is a new area in India which has immense potentialities in the rural sector. A project was taken up to study the feasibility for large scale cultivation for shoots in Kerala and to evaluate their nutrient content. The study revealed that rattan shoots contain considerable amount of protein when compared to other palm shoots and leafy vegetables. Among mineral nutrients, calcium, manganese and iron contents were higher.

The extensive studies throughout India revealed that at present India is represented by 22 genera and 105 species of palms. They are mainly distributed in 3 geographical regions viz., the Peninsular India (Western Ghats, Eastern Ghats and Deccan Peninsula), forest areas of Northern India (Indo-Gangetic Plains, Himalayan Foot Hills and Assam ranges) and Andaman and Nicobar Islands. A small number of palms occur elsewhere also.

Peninsular India

Western Ghats: - The Western Ghats is represented with 32 species of palms fewer than 11 genera mainly confined to evergreen, semi evergreen and shola forests with high species richness. There are three widely cultivated species, coconut, arecanut and oil palms. The dominant genus in the wild is *Calamus* (rattan) with 21 species, distributed even outside the forest areas in marshy swamps, sea coasts and sacred grooves (*C.metzianus*) to high shola forests at 2000m (*C. gamblei*).Palms like Kudappana, Karimpana and Aanappana or Choondappana are also common in agro- eco systems where as *Bentinckia Condapanna* (Kattu Kamuku) is restricted to high altitude high rocky steep slopes in the southern parts of Palakkad gap. Hillocks of this palm can be seen at Muzhiyar in Kerala. The main diversity centers of palms

Daemonorops wrightmyoensis Renuka & Vijayak. 2

are Agasthyamala hills, Nilgiri – SilentValley and Wayanad – Kodagu forests.

Eastern Ghats and Deccan Peninsula

Compared to Western Ghats, Eastern Ghats harbour only few palm species. Only 4 genera are reported from here, *Phoenix, Calamus, Borassus and Caryota.* Population of *Calamus rotang* (Cheru chural) in Eastern Ghats is highly fragmented to certain pockets, especially in open cultivated lands .Habitat destruction, 'podu' cultivation, spread of invasive weeds, grazing by domestic animals and fuel wood collection and the main threats to this species. In Deccan Peninsula, only *Phoenix* and *Caryota* are seen.

Northern India

Indo-Gangetic Plain :-Three genera are reported from this region. *Hyphaene dichotoma,* an endemic palm, grows in low land open savannas in Gujarat and Maharashtra and also in west coast from Goa to Gujarat. *Phoenix and Borassus* are also represented in these regions.

Himalayan Foot Hills:- The forests of Himalayan foot hills are rich in palms like *Trachycarpus, Plectocomia, Pinanga, Caryota and Wallichia.* The rare palms *Pinanga gracilis, Phoenix rupicola and Wallichia oblongolia* are also found in this region.

Assam Ranges (Naga hills – Khasi Hills) :- The major palm genera seen in this region are *Trachycarpus, Pinanga, Wallichia, Calamus* and *Plectocomia.*

Andaman and Nicobar Islands

The islands represent 33 palm species under 15 genera. The islands possess high rate of endemism and species like *Phoenix andamanensis* and *Calamus baratangensis* are strictly endemic to Andaman group of islands while *Bentinckia nicobarica* and *Rhopaloblaste angusta* to Nicobar group of islands. The islands are rich with 11 species *of Calamus*, 5 species of *Daemonorops* and 2 species of the genus

Korthalsia. *Nypa fruiticans* grows in soft muddy banks of brackish estuaries and the tidal stretches of rivers and brackish swamps.

Palmetum

The increase in demands on the world's natural resources and habitat destruction pose serious threat to palm biodiversity. Conservation of this resource assumes great importance in the context when forest wealth of the country as a whole has been on the decline. Although conservation and sustainable utilization of this resource assume great importance, conservation attempts have not received significant attention. Hence a Palmetum was established at KFRI's main camps at Peechi in a partially open forest area. Two muddy ponds were constructed for planting marshy palms like *Nypa*. As and when the seeds / seedlings were collected during the study period, they were planted in the Palmetum. Seeds/ seedlings were procured through exchange basis from other institutions also. In addition, some of the common exotic palms seen in Indian gardens were also planted here. The palmetum serves as a facility for scientific studies as well as for educating the public.

At present, in India, as per our observation, out of the 105 species of palms so far reported, 8 are critically endangered, 16 endangered, 20 vulnerable and 2 are near threatened. Of the 56 commercially important rattans, 4 are critically endangered, 9 endangered, 12 vulnerable and 16 are near threatened as per IUCN criteria.

With the completion of studies a field guide to palms was published including 105 palms under 22 genera with GIS maps and colour photographs for the easy identification of palms in the field. One of the final outcome of these projects, a 'Taxonomic manual of Indian Palms' will be published soon.

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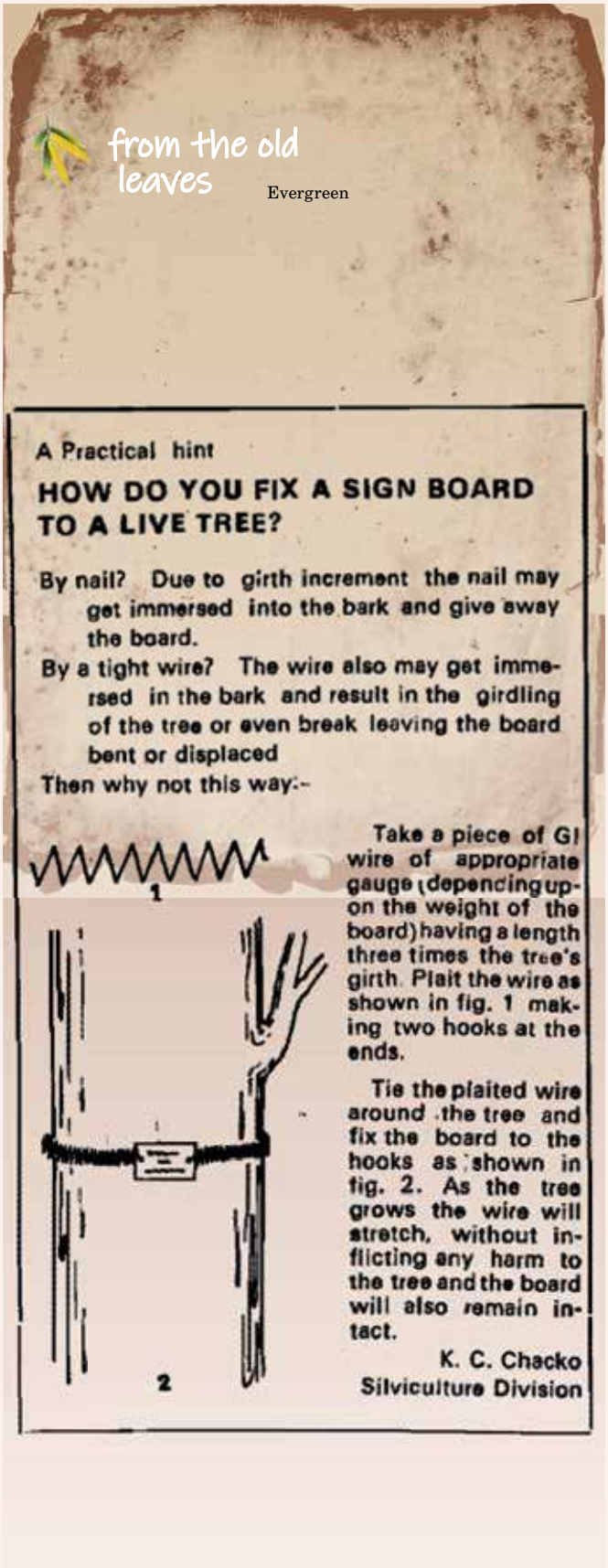

from the old leaves

Evergreen

A Practical hint

HOW DO YOU FIX A SIGN BOARD TO A LIVE TREE?

By nail? Due to girth increment the nail may get immersed into the bark and give away the board.

By a tight wire? The wire also may get immersed in the bark and result in the girdling of the tree or even break leaving the board bent or displaced

Then why not this way:-

1

Take a piece of GI wire of appropriate gauge (depending upon the weight of the board) having a length three times the tree's girth. Plait the wire as shown in fig. 1 making two hooks at the ends.

Tie the plaited wire around the tree and fix the board to the hooks as shown in fig. 2. As the tree grows the wire will stretch, without inflicting any harm to the tree and the board will also remain intact.

K. C. Chacko
Silviculture Division

2

Butterfly Farming for Conservation and Awareness Creation

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Butterflies are highly fragile organisms with diversified habits, and require specific ecological conditions for survival. Natural forests, grasslands, canopies of trees as well as wet areas along the banks of rivers and streams are the typical habitats of butterflies. Habitat loss, commercial collection, and incidence of parasites and predators are the major threats for the survival of butterflies. It has been stated that extinction of a single species would eventually lead to extinction of about a dozen or more species that are linked with it, which in turn, can affect the functioning of natural ecosystems. Management and conservation of butterfly fauna are practiced by *in–situ* and *ex–situ* methods. In the former, the natural habitats are enriched through introduction of suitable butterfly host plants, while in the latter, stocks of butterflies are maintained through captive breeding and are reintroduced into the suitable habitats.

Habitat enrichment can boost local butterfly fauna for *in–situ* conservation. The role of butterfly farm (garden) for ex–situ conservation and for promoting environmental education is well recognized. A prototype of the garden was set up in a 0.5 ha patch of degraded deciduous forest in the Kerala Forest Research Institute campus at Peechi, mainly to standardize methodologies for establishing such gardens elsewhere in Kerala. The vegetation of this area included a few trees of *Bombax malabaricum, Ailanthus triphysa, Tectona grandis, Grewia tiliaefolia* and *Terminalia bellerica* along the slopes. The terrain was undulating and hilly in nature comprising of steep slopes and with a more or less plain ridge, which was more or less barren and devoid of trees. There was good ground vegetation mostly comprising of *Lantana camara* and *Chromolaena odoratum*. Foraging and breeding are the important activities of butterflies, and hence, due consideration was given to the habitat preferences of various groups of butterflies while designing the components of the garden. Openings with bright sunshine, shade, lianas, damp areas and hedges were set up. Plants introduced in the garden included nectar plants such as *Ixora* species, *Cassia* species., *Allamanda cathartica, Hibiscus rosa–sinensis, Cuphea miniata, Zinnia haageana*, Marigold, *Mussaenda luteola, M. laxa* and *Clerodendrum capitatum* as well as larval host plants such as *Michelia champaca, Cinnamom zeylanicum, Zanthoxylum rhetsa, Aegle marmelos*, *Citrus aurantia, Wattakaka*

A view of the butterfly garden at Kerala Forest Research Institute, Peechi

volubilis, Thottea siliquosa, Tylophora indica, T. camosa, Asclepias species, *Calotropis giganteum, Carissa carandus, Ruta graveolens, Aegle marmelos, Albizia lebbeck, Cassia* species, *Murraya koenigii, Kalanchoe blossfieldiana* and *K. pinnata*.

Regular monitoring of butterfly populations was carried out by making transect counts during June 1998 to November 2000 to evaluate the effect of habitat enrichment. The number of species and individuals of butterflies sighted in the garden along with data on weather parameters such as temperature, humidity and rainfall were noted. The monthly seasonal index of butterfly citation was used as an index to compare the population trends of butterflies.

As a result of introduction of appropriate larval and adult host plants, there was sharp increase in the number of butterflies visiting the area. During the first half of this study (after 15 months), there were 4509 sightings of individuals belonging to 43 species. During observations after 30 months, 5993 sightings of individuals belonging to 50 species of butterflies were made. At the end of 36 months, 23 additional species of butterflies were recorded. Thus, the total number of species of butterflies spotted in the garden was 73, compared to a dozen species recorded prior to the introduction of host plants. The butterflies recorded in this study included eight species endemic to Western Ghats and 10 species having protected status under the Wildlife (Protection) Act of Government of India (GOI 1972) and subsequent amendments.

Several butterflies that are fond of bright sunshine such as *Troides minos, Papilio demoleus, P. polytes, Pachliopta hector and Pachliopta pandiyana (Papilionidae); Catopsilia species and Eurema species (Pieridae); Jamides species, Talicada nyseus, Castalius rosimon and Everes species (Lycaenidae);*

Another view of the butterfly garden at Kerala Forest Research Institute, Peechi

Euploea core, Tirumala limniace, Danaus genutia, T. septentrionis and Parantica aglea (Danaidae) as well as *Junonia hierta, J. altites, J. iphita, J. precis and Hypolimnas misippus (Nymphalidae)* are found in open habitats. Among them, danaids formed large aggregations with populations ranging from 100–200, on *Crotalaria retusa* and *Heliotropium keralense*. These plants are known to contain pyrrolizidine alkaloids, essential for the development of pheromone–producing glands.

The area having tall native trees providing cool shade mixed with sunlit patches offered favourable habitats for several papilionids (*Papilio buddha*, *P. polymnestor, P. helenus, P. paris, Troides minos, Pachliopta pandiyana and Chilasa clytia*), which were observed to fly rapidly amid bushes and treetops frequently feeding at the flower–heads of *Clerodendrum paniculatum, Mussaenda and Ixora* species. The cool, shaded areas amid dry leaves are occupied by satyrids (*Orsotrioena medus* and *Melanitis leda*).

Butterfly families such as Papilionidae and Pieridae showed a more or less continuous population trend for most part of the year with resident population in the study area, while others such as Danaidae, Lycaenidae, Satyridae, Nymphalidae and Hesperiidae were seasonal. Some of the butterflies that have colonized the area following the habitat enrichment and host plant introduction were as follows: *Chilasa clytia* (Papilionidae); *Acraea violae* (Acraeidae); *Elymnias caudata* (Satyridae); *Talicada nyseus, Rathinda amor* (Lycaenidae); *Parantica aglea, Tirumala septentrionis* (Danaidae) and *Gangara thyrsis* (Hesperiidae).

Rearing of butterflies and moths has been in practice since long for commercial and conservation–oriented programmes. During the 19thcentury,

collection of butterflies became a serious vocation for many people in the West, which led to the collection, identification and cataloguing of butterflies. Subsequently, butterflies were maintained in glass–houses and opened to the public as butterfly houses. Although butterflies have high fecundity, this potential is hardly realized under natural conditions. Because of the natural mortality factors due to unfavourable climatic conditions (drought, wind, temperature etc.) and incidence of parasites and predators, survival rate of the butterflies in the wild is estimated to be only around 2%. However, by shielding butterflies from such adverse conditions, a successful butterfly farmer will be able to enhance the survival rate as high as 90%.

As compared to vertebrates, butterflies require only little space for farming, and they reproduce rapidly. Most commercial butterfly–houses are of walk–through heated glass–house type. It is expensive to construct and maintain. Such 'free–flight' butterfly–houses are very common in Europe, North America, Japan, Australia, Singapore, Malaysia, Hong Kong and Kenya. However, such technologically–sophisticated structures and capital requirements are not necessary in tropical conditions. The technological simplicity of butterfly farming, therefore, minimizes the strain on under–developed or developing countries to establish butterfly–breeding and farming programmes. Butterfly–breeding techniques are also relatively simple, which can be readily conveyed to the farmer with simple demonstrations.

Tropical butterflies require daytime temperature of 25°C and 85%–95% relative humidity. Some tropical species require almost 100% humidity to mate. Night temperature can drop to around 15°C. Butterflies should have access to moist sand, for which spraying the ground with a mist of water is the most–suitable way. Many of the butterflies need to bask under radiant heat sources to bring their body temperatures up to 32°C–35°C for oviposition. Appropriate larval host plants should be provided in the cage. Eggs laid should be surface–sterilized by treating with 0.1%–0.2% sodium hypochlorite (up to 10 min) or 10% formaldehyde (up to 30 min). Eggs can be stored either in small plastic tubes, loosely plugged with cotton wool, or in small plastic bottles having

School students visiting the butterfly garden at Peechi

perforated lids. Reagent–grade sodium chloride as saturated solution may be used to maintain 75%–77% relative humidity.

Continued supply of nectar plants for the adults and food plants for the larvae are essential for the butterfly–farming. As caterpillars are highly voracious, they may finish off the host plants in a short period, and therefore, sufficient quantity of host plants should be available in the feeding chamber. Larvae can also be reared on artificial diet. The larvae, when fully mature, undergo pupation by attaching to a substratum with the help of fine silken filaments. After hardening, the pupae may be transferred to an emergence cage or to a pupal rack. They may be surface–sterilized using 2%–5%sodium hypochlorite solution to avoid microbial infestation. The adults that emerge can flutter within the hatchery until the wings become hardened, after which they may be maintained in the butterfly–release area provided with nectar and oviposition plants for mating.

Important factors to be considered while choosing nectar plants are the feeding preferences of the butterfly species and the length and timing of flowering. Lycaenids and pierids with short proboscis prefer smaller flowers (e.g. Compositae). Larger papilionid butterflies prefer flowers having a long pistil such as Hibiscus, Ixora and *Clerodendrum capitatum*. Species such as *Clerodendum capitatum,* Cuphea, Marigold, and Ixora species, which flower almost throughout the year, are the commonly–used plants in butterfly farms.

Adequate number of nectar plants in bloom should be maintained in the butterfly–release area. When there is scarcity of flowers, artificial feeding may be attempted. Usually, sugar/honey solutions (10%) are presented as soaked pads of cotton wool or in a tube fitted with a coloured corolla. Butterflies often have strong species–specific colour preferences. As these colour preferences may change with age, it is important to provide a wide range of flowers. When given a choice of abundant floral and artificial nectars, butterflies show a preference for the natural substance. Moreover, for display purposes, it would be more appealing to observe butterflies exhibiting their natural feeding behaviour.

Some butterflies show preferences for substances such as fruits, berries, sap, dung and carrion. Rotting fruits, to which about 10% honey or toddy is mixed to allow fermentation, are ideal to get the species attracted to the fruits. For many species, use of mud or sand mixed with salt or animal excreta are important for mud puddling.

The most common cause of failure of Lepidoptera captive–breeding programmes is the inability to secure pairings and fertile eggs. Most of the butterflies require a suitable environment for the display of elaborate courtship behaviour. Suitable dimensions for a flight arena relate to the wingspan(x) of the species as: length 20–25 x, height 10–15 x, depth 10–15x. Large cages are to be avoided as some species tend to disperse to the roof and sides, and ignore potential mates. The presence of the larval host plants within the rearing cages stimulates the pairing in many butterfly species.

The principles emerging from scientific research into ecology have led to the view that it is impossible to conserve a species in its wild state without conserving the whole environment. For reasons mentioned above, current conservation strategy gives priority for protecting the entire ecosystem than single species. Butterfly gardening is an approach that partially fulfils this aspect of conservation. Such farms also serve as centres of conservation and awareness creation among the younger generation. However, the approach is different for a single species, which is in danger of extinction. In such cases, direct and immediate actions are required to identify the causes of the threat and to modify the conditions that endanger the species. Captive breeding and reintroduction of stock in the wild is a method adopted in such cases. Captive–breeding programmes have been successfully adopted for a number of species such as the heath fritillary *Melicta athalia*, the large copper butterfly *Lycaena dispar* and the swallow tail *Papilio machaon britanicus*.

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Roadless

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"Recreational development is a job not building roads into lovely country, but of building receptivity into the still unlovely human mind — Aldo Leopold"

Forests of Kerala are already fragmented and under pressure from growing population and human needs. The remaining forests need to be protected for non-marketable benefits which sustain this fragile State. The Government of India through the Forest Conservation Act of 1980 has made the EIA process even more mandatory when highways pass through natural forests, protected areas and tribal habitats.

Developing road connectivity through forest lands has a lot of negative impacts. These impacts if not investigated genuinely can be very harmful to the existence of forests.

Dr.S. Sankar with Dr. Balasubrahmanian, studying impact of selection felling in Nelliyampathy (1981)

Forest management today has to meet a number of objectives. Planning, design and development of multi-functional forest roads is a necessity if the aims of the sustainable forest concept are to be met. Construction of roads damages the natural environment unless it is prudently thought out.

Working in Kerala Forest Research Institute for over three decades I had the golden opportunity to lead a team of investigators in conducting Environmental Impact Assessment projects which involve roads, Hydroelectric Projects, Tourism projects including pilgrimage and railway.

I attempt to share with the readers the experience and acquired vision in this regard.

The Government of Kerala has an ambitious project named HILL HIGHWAY starting from Kasaragode and ending in southern border with Tamil Nadu. This 600 and odd stretch passes at some places through forest areas and hence an EIA exercise

was mandatory. The NATPAC at Trivandrum was in charge of the project and they approached us to do EIA in forest links which they termed missing links.

From North to South the missing links were:

The Panome-Kunhome transect passes through the most dense evergreen forest formation of the Periya Range of the North Wayanad Forest Division

The Chooralmala-Vaniampuzha link passes through Nilambur Kovilakam notified as the core area of Nilgiri Biosphere Reserve.

The link between Kakkadampoyil to Akampadam traverses mostly through human areas

The Anavayil-Mukkali transect is an incomplete link as the connection from Karuvarakundu toNelliampathy to Vazhachal transect passes through Parambikulam Tiger Reserve and evergreen transects of Vazhachal Division.

Pooyamkutty to Mankulam traverses old Aluva to Munnar road destroyed during floods of 1924.

Thulappilly to Pamba hill top via Kisimum is an alternate road to Sabarimala via the left bank of river Pamba from Kisimum through forests of Ranni Division,

Erumeli to chalakkayam (second stage) via thulappilly from Naranamthodu to Eramankulam replacing the existing road from Alappad city to Plappilly through teak plantation of Ranni Division.

Trivandrum Tirunelveli via Ambasamudram in place of existing highway via Nagercoil but cutting across through Agasthya malai reserve forest.

The next to roads were in Parambikulam Tiger Reserve. Parambikulam Tiger Reserve is currently accessible through a lone road leading from Sethumadai in Tamil Nadu. To reach Parambikulam, one has to traverse through the Indira Gandhi Wildlife Sanctuary and National Park before re-entering Kerala at Anappadi.

With the aim of accessing Parambikulam entirely through Kerala, a proposal for developing roads from Chemmanampathy to Thekkady and Kuriarkutty to Nellaiampathy was assessed using EIA techniques

Champanampathy to Parambikulam TR and

Kuriarkutty (Parambikulam TR) to Nelliampathy.

METHODS

Flora and fauna of the region were compiled from literature sources and earlier studies conducted in this region. Plots were laid along the transect to study the vegetation and analysis was carried out. Direct and indirect sightings of fauna were also recorded along the transect.

SOI topographical maps of 1:50,000 scale were used to prepare the base maps on a GIS platform. A map depicting the affected watershed, detailed drainage, existing roads and land cover was thus generated. To know the present status of the area, a satellite imagery was used and the base maps overlaid on it. Global Positioning System (GPS) was used to record the coordinates along the proposed road. The position of important landmarks and features were recorded and plotted on to the maps.

The methodology for Environmental and Social Impact Assessment and the attributes selected for the study are given below. (Sankar, 1999, Sankar et al., 2000, Sankar et al., 2002 a, b).

Environmental Attributes

The environmental attributes identified under two classes biotic and abiotic are:

Flora
Forest cover
Fauna
Migration corridor
Breeding grounds
Water holes
Soil quality
Watershed services
Water table
Water quality
Air quality

Flora

Flora is considered as an attribute in a broader sense. The term intends to cover all kinds of plant life in general including introduced and indigenous, cultivated and wild plants in homesteads and wilderness. All kinds of construction activities are expected to make a negative impact on the flora to a varying extend.

Forest cover

Forest cover has been identified differently from flora as the natural climax vegetation of the locality. Forest cover is distinguished from flora considering the importance of multiplicity services provided by the forests. Human dependency on forests on large scale for biomass, conversion and alteration of topography is considered detrimental to this biotic attribute of local Ecology.

Fauna

Similar to that of flora, the category fauna also serve a general purpose of indicating all kinds of faunal groups of the locality. Large-scale alteration of abiotic components such as soil, air, and water by any project activity is considered detrimental to the local fauna.

Migration corridors, breeding grounds and waterholes

There are certain attributes of biotic components that need additional emphasis. These include migration corridors, Breeding ground, water holes that are important for the wild animals. Any project activities, which in short or long period affect the quality or access of any of these, are considered detrimental from the viewpoint of wildlife conservation.

Soil quality

Being one of the primary determinants of the ecological productivity, soil quality is important and is often affected by development activities. Soil quality is a general terminology used for indicating a variety of factors including nutrient status, particle size, porosity, moisture retention capacity etc. Erosion of nutrients, finer particles and organic matter takes place due to excessive run off in disturbed soil. External inputs and waste materials also change the biological environment of the soil considerably. Soil quality is affected temporarily during construction phase, where as in certain other cases, soil pollution, the external input reduces soil quality permanently.

Watershed services

Uplands in high rainfall regions play an important role in deciding the hydrology of down streams. The hydrological services provided by the watersheds such as percolation, regulation of run off, maintenance of water table and checking of the soil erosion are crucial as far as the water resources and agro-economy are concerned. Construction activities result in reduced percolation and large volume of runoff affecting watershed services adversely.

Water table

This is another crucial attribute associated with land. Maintenance of a high water table is the most desired outcome as far as local people are concerned. But most of the construction and other development activities result in lowering of water table.

Water quality

Water quality is an important attribute among the abiotic components in any ecosystem. Water quality may be temporarily affected during the construction phase and it may be permanently affected if lotic (flowing) system is converted to lentic (standing) system. Similarly external inputs in the system such as petroleum products, pesticides and sediments also alter the water quality of the system temporarily or permanently.

Air quality

Air quality is affected by a number of activities such as traffic, construction activities etc. Some of these have local impact were as some other activity have wider geographical impact. Noise pollution is also considered as a part of the air quality.

Social Attributes

Development activities are accompanied by a number of positive and negative impacts on the social environment. A total of 11 social attributes are selected for representing the impacts of the social environment they are:

Employment
Mobility
Health
Infrastructure & services
Culture
Traditional livelihood
Social security
Access to basic resources
Knowledge/Awareness
Quality of landscape

These attributes are desirable characteristics of the social environment some of them already existing and others which are of high priority to the local people. All these attributes are looked at from the viewpoint of local people. Viewpoint of the tourist is not included as it is only a post development phase i.e. a consequence of the project activities. The local people-view point is considered by assuming that project activity cannot be globally sustainable unless it is locally equitable. Equitable in terms of incentives and resource access.

Employment

Additional employment generated as a result of the project activity may be short term, usually limited to the construction phase. Financial gains in long term is often limited to vending etc. This situation can be considerably improved by providing training programme and by conducting workshops for local people on capacity building and skill development.

Mobility

Mobility by means of improved public transport facilities is a desirable outcome of any developmental activity, which open up markets and bring in new employment opportunities. Though project activity often increase traffic and ultimately leading to vehicular congestion. Such events do occur in the study area during the peak of Sabarimala pilgrimage season.

Health

Health care is another desirable outcome expected in any development projects. Tourism development may bring in new health care facilities to the locality. But it is important for local people to have access to such facilities.

Infrastructure and services

This represents a wide variety of desirable economic inputs for the local people such as power supply, street lighting, taxi service, comfort stations, bus stations, communication facilities, water supply etc. It is important to make these facilities available to local people.

Culture

One of the important attributes of the social life is maintenance of a certain degree of social inertia at the midst of social change. But this is easily disturbed while interacting with other cultures. Cultural changes do not necessarily mean they are socially detrimental; there can be cultural changes that are socially beneficial also. But the period of change is very often turbulent, mostly affecting the social interaction, and bringing down the efficiency and toppling the existing production relations adversely. Cultural impacts could be short term as well as long term, beneficial as well as detrimental.

Traditional livelihood

Traditional livelihood is one of the sensitive social attribute especially in the highlands of Kerala were tribal population exists. Traditional livelihood practices are based on folk knowledge of sustainable mode of resource use accumulated through centuries. But it is easily disturbed once the village economy is opened up for market forces. Once displaced from this social niche, people who followed traditional livelihood become cultural refugees who are incapable of adapting to emerging social scenario. This is more

than human tragedy as it brings in more danger to the natural resource base by forcing these refugees to extract more from the resource base.

Social security

Increasing numbers of petty cases are a common phenomenon once a locality is exposed to tourist influx. Impact on social security may be long term and in certain cases be beneficial as well.

Access to basic resources

Forests, grasslands, water bodies and fishing are shared resources in the traditional subsistence. To a certain extend this is true in case of rural communities also. These shared resources are proved to support the poor at the time of their greatest vulnerability.

Ownership pattern and access to the resources are often affected by the socio-economic and political changes. So access to basic resources is an important attribute of social life if adequate policies and property right arrangements with a keen insight into the local social situation is not made, conflicts and violence may result and may result in loss of tourist value of the location.

Knowledge/Awareness

Exposure of local culture to an out side culture may have adverse impact yet there are certain attributes of society that are benefited from this interaction of cultures. Awareness is one such attribute on which tourism has a positive impact.

Quality of landscape

Quality of landscape is a matter of aesthetic sense, which is subjective and thus varies from person to person. However, certain generalization can be arrived considering salient features of the local culture and social situation.

SCORING

The matrix was constructed by placing the project components on the vertical axis and the ecological and social attributes on the horizontal axis. Qualitative aspects of each interacting project component and the attribute is marked by +ve sign if the impact is beneficial, -ve sign if the impact is detrimental. The time factor of the impact is grouped into two, the long term and short-term impacts. The short term is indicated by a single * and long term by two * marks in the table.

Weighting of individual impact is also attempted. The information provided in the proposed project, as it is given in the document, is inadequate to consider for a detailed impact analysis and assessment. So an attempt was made to identify potential impacts and comment on each possible impact. An attempt is made to express the weightage of each impact in relative terms on a 3 point scale where as a relatively high negative impact is weighed as -3 and the medium impact -2 and low impact as 1. 0 indicates negligible Impact. Potential positive impact is indicated using +ve sign. In order to reach the final score of each project component, tabulating and summing the scores is carried out to derive the grand total. For long-term impacts the score has been multiplied by a value of two. This score is not used for deciding whether project component is to be abandoned or to be implemented. Instead the score is used as an easily referable indicator to invite the attention of planners for remodelling the project so as to mitigate the impacts and, if possible, to adopt alternative projects as suggested in this impact identification procedure.

Our conclusions- Of the 11 roads we examined we gave recommendation to only one ie the Erumeli to Chalakkayam. We strongly believe that:

Roadless areas are critical because they represent the least human-disturbed habitats in an almost universally disturbed landscape. These wild areas give us reservoirs of genetic material, and are benchmarks for experimental restoration efforts in an intensively managed landscape. This is a conscious choice made with an eye toward the future, As e witness the march towards urbanization and development of wild places, we can take comfort in the knowledge that we have given at least some of our remaining and undeveloped land —a piece of our traditional heritage-lasting protection. Through that choice we pay tribute to those who have come before and preserve their legacy for those who will follow.

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Floristics and computer aided taxonomy studies

Dr. N. Sasidharan
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Floristic studies: The forest flora of Kerala were extensively studied particularly the protected areas like Wildlife Sanctuaries and National Parks. Flora of Thrissur forests, Shenduruny Wildlife Sanctuary, Periyar Tiger Reserve, Peechi-Vazhani Wildlife Sanctuary, Chinnar Wildlife Sanctuary, Parambikulam Wildlife Sanctuary, Aralam Wildlife Sanctuary and Medicinal Plant Conservation Areas. The floristic exploration studies resulted in the description of 23 new species and one new variety; several new records of occurrence to south India as well as to Kerala state. Relocated most of the plants belonging to the RET categories recorded from Kerala.

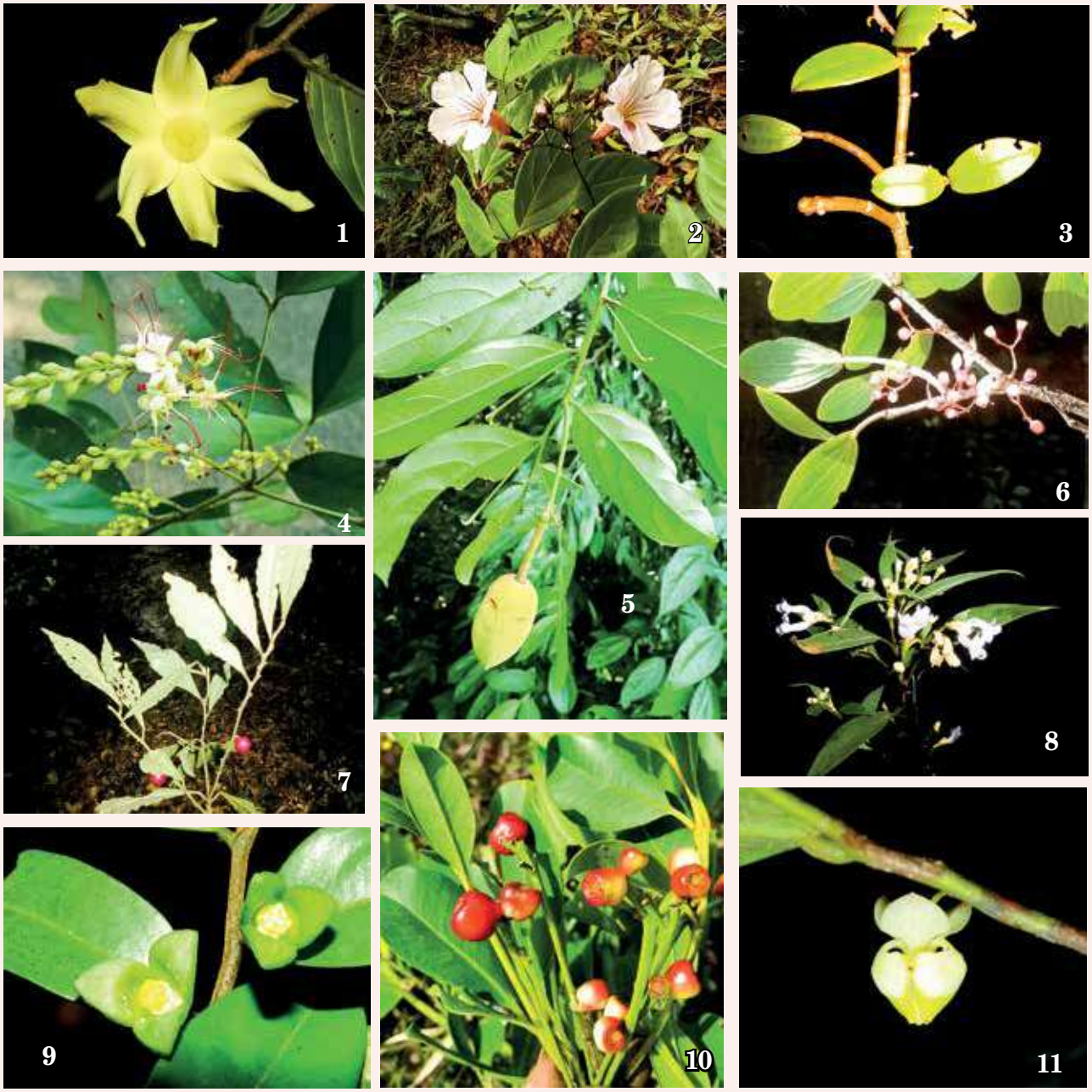
Tree systematics: A field key to the identification of 340 indigenous trees of Kerala forests was prepared for the use of forests and field botanists. The key is entirely based on vegetative characters such as leaf, bark, blaze exudation buttress etc.

Computer Aided Identification packages

The CD on Computerized Tree Identification was designed to identify 652 trees in Kerala with easily observable field and vegetative key characters through a multi-entry, menu driven program (*TreeID*). Correct nomenclature with author citations, reference to monographs, revisions and floristic studies pertaining to Kerala, detailed description, local name(s), habitat(s), geographic distribution, occurrence in Kerala, altitude, phenology and images of trees depicting vegetative as well as floral characters are also provided.

The CD *Flowering Plants of Kerala - ver. 1.0* contains brief write-ups on location and phytogeography of the state, geology and soil, climate, characteristic features and typical species of vegetation types, important agricultural and horticultural crops. The correct name of the species with author citation and literature is followed by basionyms and synonyms, if any, habit, habitat, status, geographical distribution, district wise distribution (map) and images of species. There are 2247 images of 1424 species belonging to endemic, red listed as well as interesting plants. There are 10,398 botanical names and 4044 common/ local names.

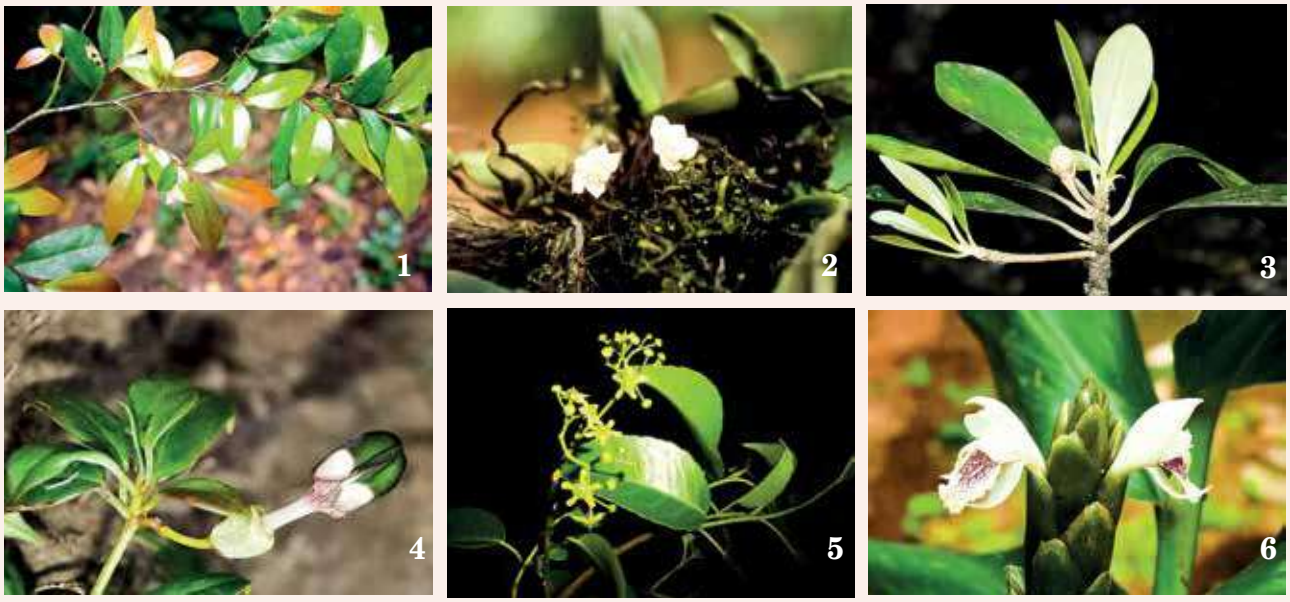
The DVD *Flowering Plants of Kerala – ver. 2.0* is an updated version of the CD of flowering plants of Kerala. In the new DVD there are 35 search categories. Apart from taxonomic categories, user categories like medicinal plants, edible fruits, vegetables, weeds, garden plants etc. are included. The DVD is designed to identify plants by selecting a few easily observable features or user categories even for people not familiar with the botanical terms. All



1. *Polyalthia shendurunii* 2. *Stereospermum colais var. shendurunii* 3. *Medinilla anamalaiana* 4. *Humboldtia sanjappae* 5. *Hydnocarpus longipedunculatus* 6. *Medinilla sahyadrica* 7. *Ardisia stonei* 8. *Strobilanthes agasthyamalana* 9. *Miliusa wayanadica* 10. *Syzygium sahyadricum* 11. *Orophea sivarajanii*

permutations and combinations are possible among the search categories. There are 5,094 taxa (4604 species; 110 subspecies; 370 varieties; 8 forma). In the DVD, there are 18,950 images of plants including RET as well as interesting species, 11,435 scientific names (5,094 correct names + 6,342 synonyms) and 6,838 local/trade/common names.

Prepared *A Handbook on the red listed species and their conservation status in Kerala*. The Conservation status of 553 species of flowering plants were assessed as per as per IUCN 2013 ver. 2 categories and criteria. The analysis of the evaluated species shows that 143 species are Critically Endangered (CR); 295 Endangered (EN); 102 Vulnerable (VU); 11 Low Risk/ Least Concern and 2 Extinct in the Wild (EW) (Table



1. *Orophea malabarica* 2. *Pteroceras monsooniae* 3. *Palaquium ravii* 4. *Ceropegia manoharii* 5. *Cassine kedarnathii* 6. *Zingiber anamalayanum*

1). The present evaluation necessitates changes in the conservation status of some of the Red listed species. With regard to the *In–situ* conservation, as many as 449 are occurring in the Protected Areas in Kerala and some in Tamil Nadu and Karnataka. Among the 553 species evaluated, 158 are occurring only in one PA each and others in more than one PA.

New species described

1. *Aglaia malabarica* Sasidh.
2. *Ardisia stonei* Sasidh. & Sivar.
3. *Cassine kedarnathii* Sasidh. & Swarup.
4. *Ceropegia manoharii* Sujanapal, Salim, Anil & Sasidh.
5. *Curcuma peethapushpa* Sasidh. & Sivar.
6. *Fimbristylis hyalina* Govind. & Sasidh.
7. *Fimbristylis perspicua* Govind. & Sasidh.
8. *Habenaria periyarensis* Sasidh. et al.
9. *Humboldtia sanjappae* Sasidh. & Sujanapal
10. *Hydnocarpus longipedunculatus* Robi, Sasidh. & Jose
11. *Medinilla anamalaiana* Sasidh. & Sujanapal
12. *Medinilla sahyadrica* Sujanapal & Sasidh.
13. *Miliusa wayanadica* Sujanapal, Ratheesh & Sasidh.
14. *Orophea malabarica* Sasidh. & Sivar.
15. *Orophea sivarajanii* Sasidh.
16. *Palaquium ravii* Sasi. & Vink.
17. *Polyalthia shendurunii* Basha & Sasidh.
18. *Pteroceras monsooniae* Sasidh. & Sujanapal
19. *Stereospermum colais* (Buch.-Ham. ex Dillw.) Mabb. var. *shendurunii* Sasidh.et al,
20. Strobilanthes agasthyamalana Sasidh., Dantas & Robi
21. *Syzygium periyarensis* Jomy & Sasidh.
22. *Syzygium sahyadricum* Sujanapal, Robi & Sasidh.
23. *Tarenna trichurensis* Sasidh. & Sivar.
24. *Zingiber anamalayanum* Sujanapal & Sasidh.

New Records of occurrence for India

1. *Desmodium uncinatum (Jacq.) DC.*
2. *Ficus caulocarpa Miq.*
3. *Ficus costata Ait.*
4. *Ophioglossum pendulum L.*

New Records of occurrence for South India

1. *Eleutheranthera ruderalis (Sw.) Sch.-Bip.*
2. *Gymnema khandalense Sant.*
3. *Hedyotis pinifolia Wall. ex G. Don*
4. *Heterostemma deccanensis (Talb.) Swarup. & Mangaly*

5. *Oberonia recurva Lindl.*
6. *Symplocos monantha Wight*
7. *Zeuxine affinis (Lindl.) Benth.*

General Floristic Studies

Flora of Thrissur Forests

The forests of Thrissur fall within three Administrative Divisions of the Kerala Forest Department, viz. Thrissur, Chalakkudi and Vazhachal and covers an area of 1041 km^2. During the study 1,217 species of flowering plants belonging to 701 genera under 129 families are collected and described. From Thrissur four new species, viz., *Orophea malabarica* Sasi. & Sivar., *Tarenna trichurensis* Sasi. & Sivar., *Palaquium ravii* Sasi. & Vink and *Aglaia malabarica* Sasi. were published. A few species like *Eleutheranthera ruderalis* (Sw.) Sch.-Bip., *Hedyotis pinifolia* Wall. ex G. Don, *Diospyros crumenata* Thw., *Heterostemma deccanense* (Talb.) Swarup. & Mangaly, *Gymnema khandalense* Sant. and *Oberonia recurva* Lindl. are new record of occurrence for South India. Another interesting fact is the presence of several species that were considered to be endemic to 'Travancore & Tinnevelly' areas, as well as many rare and threatened species here.

Flora of Shenduruny Wildlife Sanctuary

Shenduruny Wildlife Sanctuary lies along the Arienkavu-Kulathupuzha Valley, in Kollam (Quilon) Revenue District of Kerala and has an area of 100 km^2. The Arienkavu-Kulathupuzha Valley is the type locality of several endemic species, many of which are currently placed under various threat categories and some are considered extinct. During the study 951 taxa (species and infraspecific) were collected and described. This include 309 Western Ghat endemics and 100 species belonging to the threat categories including 10 considered as possibly extinct ones were collected. Two new species viz. *Polyalthia shendurunii* Basha & Sasi and *Ardisia stonei* Sasi & Sivar. were described from the Sanctuary during the present study. *Zeuxine affinis* (Lindl.) Benth. ex Hook. f. is a new record for South India and species such as *Bulbophyllum xylophyllum* Par. & Rchb., *Calamus nagbettai* Fernandez & Dey, *Cissampelopsis ansteadii* (Tadl. & Jacob) Jeffrey & Chen, *Marsdenia raziana* Yoga. & Subram. and *M. tirunelvelica* Henry & Surbram., collected from the Sanctuary are new records of occurrence for Kerala.

Flora of Periyar Tiger Reserve

Periyar Tiger Reserve lies along the Western Ghats in Idukki Revenue District. The Tiger Reserve which has an area of 777 km^2 including the Periyar lake. During the study, 1980 taxa (species and infraspecific) were collected and described. These includes 515 species that are endemic to Western Ghats and 150 species that have been placed under various threat categories could be collected, including 17 species categorised as 'possibly extinct'. Two new species viz. *Habenaria periyarensis* Sasi. *et al* and *Syzygium periyarensis* Jomy & Sasi. were described from the Tiger Reserve. *Vanda thwaitesii, Symplocos obtusa* var. *pedicellata, Ficus costata* and *F. caulocarpa* are new records for India. *Eulophia sanguinea* is a new record for South India. Species like *Achyranthes aspera* var. *pubescens, Alternanthera paronychioides, Arthraxon meeboldii, Brachiaria brizantha, Bulbophyllum macraei, Cyperus oatesii, Dimeria mooneyi, Fimbristylis aestivalis, F. bisumbellata, F. dura, F. glabra, F. monticola, Glycosmis angustifolia, Lobelia zeylanica, Oxalis latifolia, Polygala jacobii, Premna paucinervis, Rotala ritchiei, Scleria annularis, S. pergracilis, Setaria verticillata, Strobilanthes consanguineus, Strobilanthes jeyporensis, Tragus biflorus* and *Tripogon pauperculus* are new records of occurrence in Kerala.

The occurrence of 1980 species in an area of 777 km^2 indicates the richness and diversity of flora of the Tiger Reserve. So far, from nowhere in the subcontinent such a large number of flowering plants have been reported from an area comparable to that of Periyar Tiger Reserve.

Flora of Chinnar Wildlife Sanctuary

The Sanctuary is located in the rain shadow region of the W. Ghats in the Idukki district. During

the study, 965 species of flowering plants were recorded. There are 114 peninsular Indian endemics which constitute about 11.8% of the plants of the sanctuary. *Albizia lathamii*, *Kalanchoe olivacea, Chrysopogon velutinus, Cryptocoryne consubrina, Knoxia sumatrensis* var. *linearis* and *Theriophonum sivaganganum* belong to the endangered category. *Exacum anamallayanum,* brought under the rare category could be collected. *Ipomoea mombassana* collected from the sanctuary was a new record to India. *Lepisanthes senegalensis, Decalepis hamiltonii, Chloris roxburghiana, Enneapogon schimperanus, Enteropogon monostachyos, Oplismenus undulatifolius, Oropetium thomaeum* and *Tragus roxburghiana* are some new records to the flora of Kerala. The sanctuary is a treasure house of medicinal plants with 335 species out of 964 recorded from the sanctuary. The tribes of the sanctuary, Hill Pullayas and Muthuvas, make use of some medicinal plants and their uses are specific for each group and many of such uses are not hitherto properly recorded.

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from the old leaves

Evergreen

Dr. Kasturirangan, renowned Space Scientist, former member of the Rajyasabha and member of the Planning Commission, Govt. of India during his visit to KFRI on 30th January 2010, accompanied by then director Dr. K.V. Sankaran. He visited various Laboratories and had discussions with the Director on the research activities of KFRI.

Decades at KFRI to understand the Giant Grass

Dr. K.K. Seethalakshmi

Formerly Chief Scientist, SFM Division and Former Coordinator, Bamboo Technical Support Group,KFRI, Peechi.

The giant grass –Bamboos are a very special group of plants gifted by nature to the living world to meet all their basic requirements, especially– food, clothing, shelter, recreation and provide them with healthy and safe environment. The word "bamboo" originated from Dutch and Malay - mambu and bambu and is seen in history from 16th century onwards. Another view is that it originated from the Kannada term *bambu*, which was introduced to English through Indonesia and Malay. In India, Vedas (5000 years ago) mentioned bamboo as a source of fire. Use of bamboo as surgical instruments had been mentioned in many ancient medical texts. In *Kaudilya's Arthasastra* bamboo is referred as a source of income (300 B.C). Medicinal uses of bamboos such as Tabasheer were mentioned in *Hortus Malabaricus*. Chinese people planted and used bamboos as early as sixteenth century B.C (Shang Dynasty 16th-11th century B.C). Before the Eastern Han Dynasty (25-220) when paper was not invented, strips of bamboo had been used for writing. Interestingly it was recorded that carbonized filament in the first light bulb made by Thomas Edison was from bamboo and he used bamboo for reinforcement of concrete in his swimming pool.

Dr. K.K. Seethalakshmi

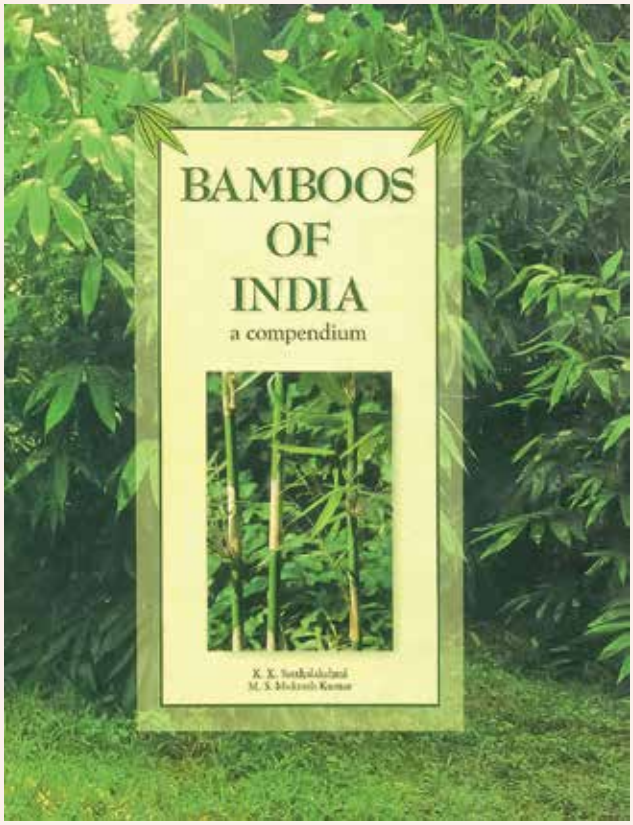
The major advantages of bamboos are its diversity with regard to species and growth forms, adaptability to grow in suitable as well as problematic sites and innumerable uses it can be put into in modern as well as traditional industries along with environment protection. Due to this, bamboos have many titles as green gold, poor man's timber, brother, plant with thousand faces and wood for 21st century etc. Ecologically bamboo plays an important role in the balance of oxygen and carbon dioxide in the atmosphere, lowers light intensity and protects against UV rays. It prevents soil erosion on river banks, deforested areas in places prone to landslides and creates an effective watershed. Bamboo grows in a wide range of soil conditions from perennially poor to perpetually rich and known to adapt soil moisture conditions from drought to drowning. It is an important species for landscape as bamboo provides shade and acts as

windbreak and has aesthetic beauty. According to the recent report of International Network of Bamboo and Rattan (INBAR), bamboo forests can help to mitigate global warming by sequestering carbon at sites that have been deforested or degraded more quickly and at a higher rate than many plantation tree species. It will also help to reduce dependence on fossil fuels by providing an alternative, renewable energy source. Bamboo, while naturally growing in forest areas, can be cultivated as a commercial plantation crop and can be mixed with agro-forestry systems. Establishing bamboo plantations is a viable option for conserving and protecting forests by an alternate supply of raw material for the wood and cellulose industries. Bamboo and bamboo products such as composites are extensively used in construction. The strength-weight ratio of bamboo supports its use as a highly climate resilient material against forces created by high velocity winds and other natural disasters. Potential of bamboo to develop as a plantation crop is very high. Out of the 146 species belonging to 28 genera in India many are commercially important. The employment potential from production to utilization such as nursery development, establishment of plantation and management, harvesting and processing and value addition is very high.

Peculiar nature of gregarious flowering followed by death in most of the species along with indiscriminate human interventions that resulted many natural disasters and destruction of natural vegetation affected bamboo grooves also. Search for an alternative to the increasing usage of timber is pointing to bamboo as a plantation species of high potential. It grows almost anywhere and there are many species to select that tolerates adverse effects of climate change with limited attack of pests and diseases.

Kerala Forest Research Institute (KFRI), as early as 1979 recognized the importance and relevance of bamboo and considered it as one of the priority areas for research. Studies carried out for about four decades have lead to considerable contributions in the fields of growing stock estimation, taxonomy and phylogeny, flowering and reproductive biology, ecology, physical, anatomical and chemical properties, micro and macro-propagation, plantation establishment and management, fertilizer requirements, harvesting and post harvesting techniques and tools, pests, diseases and their control measures, conservation and value added utilization. Some of the recent studies covered carbon sequestration potential, molecular markers facilitating identification at juvenile stages, hybridization etc. As early as 1987 collection of different bamboo species (bambusetum) from all over the country and outside was initiated by KFRI and this is one of the most popular and useful repository of more than 70 species. Another area in which KFRI became a pioneer was in compilation and dissemination of information through the establishment of an Information Centre known as BIC- INDIA in 1997. BIC- INDIA brought out several important publications like bibliographies, information bulletins, and a comprehensive species-wise compilation of information “Bamboos of India a Compendium”. An international Journal of Bmboos and Rattan is also published from KFRI. During last decade KFRI successfully established a Centre with all machineries for mechanized processing of bamboo and value addition at FRC, Velupadam. From 2000 onwards KFRI is actively involved in capacity development through technology transfer programmes on production, mechanized processing and value addition and more than 5000 beneficiaries were trained.

At this juncture, when KFRI is completing forty five years, it is a privilege to unveil the history of bamboo research, document some of the milestones and share the significant achievements made through sincere, committed and strenuous team work of scientists on this diverse plant group. The financial support given by several funding agencies such as International Development Research Centre (IDRC) and later INBAR (International Network of Bamboo and Rattan (INBAR), Food and Agricultural Organization (FAO), Ford Foundation, Natural Resources Institute (NRI) UK, Indian Council for Forestry Research and Education (ICFRE), Departments of Science and Technology and Biotechnology (DST



and DBT), Ministries of Environment, Forest and Climate Change (MoEnF & CC) and Textiles, United Nations Development Programme (UNDP), Council of Scientific and Industrial Research (CSIR), Forest Departments of Andhra Pradesh, Rajasthan, Goa, Maharashtra, Kerala and Tamil Nadu, Department of Industries (Kerala), Kerala State Council for Science Technology and Environment (KSCSTE), Hindustan Newsprint Limited (HNL), Gwalior Rayons and many Local Self Governments (Panchayaths) provided necessary handholding for R&D and extension projects throughout.

In its early years, the research areas addressed by KFRI need to be identified by senior forest officers from Governing Body (GB) and Executive Committee (EC) and through the time bound project based approach was the means for solution Two problems projected on bamboos were production of planting stock of different species and storage of harvested bamboos. There was very limited information about species available and their biology, seeds and different propagation methods. Since bamboo extraction from forest areas were closed for two months during rainy season, it was a period of unemployment and poverty for bamboo dependent weavers and storage of harvested bamboo was very relevant. Under the magnanimous and able guidance of the then director late Dr. P N. Ganapathy, Scientists of two divisions, Physiology and Entomology worked on propagation and storage respectively. These two projects laid the foundation of bamboo research at KFRI. Dr. R. N. Chibbar, the first HOD of Plant Physiology Division was an expert on vegetative propagation of forest trees, contributed during the initial phase of the project and encouraging positive responses for rooting of cuttings was obtained.

One of the GB members, Late Y.M.L. Sharma was very much interested in bamboo and he was impressed by the work carried out at KFRI. His presentation at the World Bamboo Congress, Japan including some of the photographs of the work at KFRI invited the attention of a major international funding agency, International Development Research Centre (IDRC), Canada. By that time IDRC had already identified bamboo as resource of future and conducted two international workshops – first in Singapore in 1980 and second in China in 1984. The Pogramme Officer of IDRC Mr. Karim Oka visited KFRI in 1987 and developed two multidisciplinary projects - one on bamboo and the other on rattan. During the interaction that followed, KFRI could win full confidence of IDRC and got a chance to organize the third International Bamboo Workshop. Since the facilities at Thrissur were limited, it was organized at Malabar Hotel, Cochin in November, 1988. The idea of Bamboo Society of India originated in this meeting and Karnataka Forest Department happily took up the responsibility. IDRC supported KFRI for about one decade with four projects on Silviculture, Management and Utilization of Bamboo and Rattan Resources in Kerala, Southern India and one project to establish the Bamboo Information Centre. By undertaking focused multidisciplinary research in priority areas, many problems of practical relevance pertaining to bamboo have been addressed by KFRI

during this initial phase. These projects also helped to develop a multidisciplinary team of competent human resource with sound knowledge in the subject and national as well as international exposure. The leadership of Dr. P.M.Ganapathy, Dr. S. Kedharnath, Dr. K.S.S. Nair, Dr.C. T. S. Nair, Dr. S Chand Basha, Sri S.Shanmuganathan, Dr. K M Bhat and Dr.R. Gnanaharan was very successful in mending an excellent team. In the meanwhile Mr.Karim Oka left IDRC and Dr. Ramanuja Rao joined. As an offshoot of IDRC an exclusive agency, International Network of Bamboo and Rattan (INBAR) to address research on bamboos and Rattan was specifically formed in 1997. INBAR is coordinating bamboo and rattan research globally. Currently INBAR has 43 Member countries with headquarters in China and regional offices in India, Ghana, Ethiopia and Ecuador.

As a result of one decade of research on bamboo and rattan (1987 to 1997) KFRI was equipped with basic information and developed a knowledge base through publications. There was a small gap of multi-disciplinary projects during which KFRI got some specific projects from NRI, UK for Agroforesty and FREE (Forest Research Education and Extension) projects for propagation and genetic improvement which sustained the activities with involvement of a few Scientists. In 1999, impressed by the progress achieved in China in the bamboo sector, India which is second only to China in the resources, also envisaged a holistic development of the sector at the National level. For this an integrated project was launched on World Environment Day by the Prime Minister. Based on the up to date status report compiled by Planning Commission for which KFRI also contributed, a strategy and action plan was developed at National level.

After initial IDRC phase, KFRI got another major project supported by Development Commissioner (DC) Handicrafts, Ministry of Textiles and United Nations Development Programme (UNDP) on Bamboo and Rattan used for handicrafts. It was an integrated project addressing production, processing and utilization of resources simultaneously with collaboration of KFRI and seven other institutions (1. State Forest Research Institute (SFRI), Arunachal Pradesh; 2. Rain Forest Research Institute (RFRI), Assam; 3. National Institute of Fashion Technology (NIFT) New Delhi; 4. Engineering Resources Group (ERG), Bangalore; 5. National Institute of Design (NID), Ahmedabad; 6. Indian Institute of Technoogy (IIT) Mumbai and 7. Indian Plywood Industries Research and Training Institute (IPIRTI), Bangalore). Five states - Kerala, Assam, Arunachal Pradesh Manipur and Tripura were covered under this project. KFRI along with

Training on bamboodhandicrafts in artisan clusters, 1982

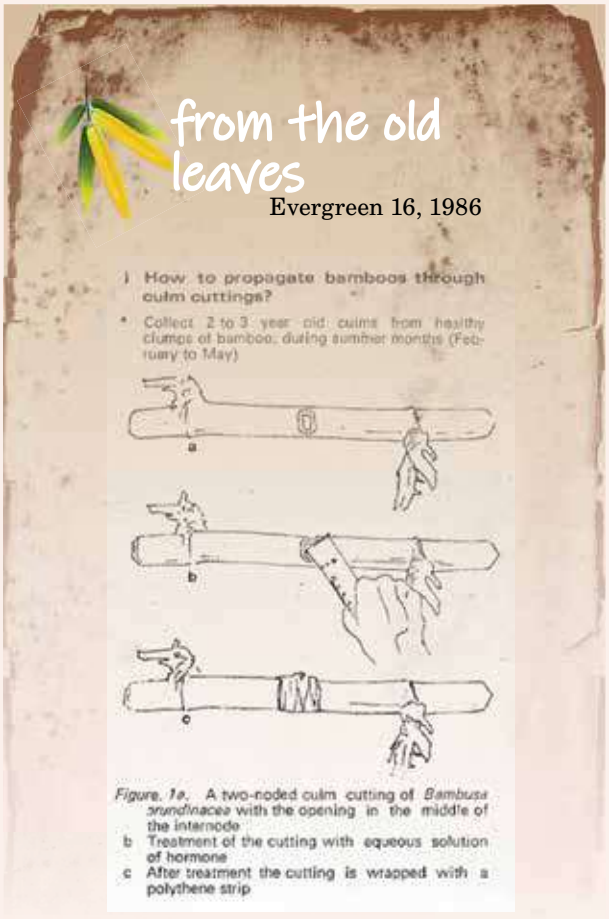
RFRI and SFRI addressed the issues of identification of suitable species for handicrafts and their resource enhancement. Capacity development through training programmes to other two institutions was also KFRIs mandate. This project provided a good opportunity to KFRI to use the acquired knowledge in a larger platform. Also considerable output such as updating of the data base of two bibliographies one each on bamboo and rattan and publication of their hard copies, eight information bulletins and one newsletter in Malayalam was done during this project. Considerable extension work such as capacity building for resource enhancement through training for farmers, identification of farmer friendly non thorny species for domestication, establishment of decentralized nurseries and demonstration plantations with people's participation were also done during this period. A series of agricultural lessons with the support of the All India Radio (AIR) under 'Farm and Home' programme broadcasted helped to create awareness about potential of bamboo and popularize bamboo cultivation in non-forest areas. This project was the first one I had coordinated under the proficient guidance of Dr. JK Sharma, Director, unstinted support of nearly 20 Scientists and the entire staff of KFRI.


Dr. K.K. Seethalakshmi and V.P. Raveendran
Bamboosetum 2011

In the meantime, at national level, for speedy implementation of the integrated bamboo project, National Mission on Bamboo Application (NMBA) was set up in 2002. NMBA was under Technology Information and Broadcasting Council (TIFAC) of Ministry of Science and Technology. NMBA upgraded bamboo as the timber for 21st Century and identified 16 priority species for focused development. Experts from KFRI (Drs. Mukthesh Kumar and Seethalakshmi) were actively involved in NMBA meetings. In the beginning utilization was the main focus for which machinery development and processing technology was of primary concern. Later when an

attempt was made to prepare a package of practice, the dearth of species specific information was evident which lead to an All India Coordinated Project on species trials. Experimental plots were established with 8 species. Twelve institutions from different agro climatic conditions all over India collaborated with this. NMBA brought out several handbooks on production and utilization of bamboo and some of them KFRI got translated to Malayalam.

Kerala State was the pioneering one to establish a State Bamboo Mission (KBM) as early as 2003 with the initiative of Mr. C.P. John, former member of State Planning Board. KBM functioned under Kerala Bureau of Industrial Promotion (K-bip). It facilitated bamboo cultivation in forest as well as non-forest areas. KFRI was given an important responsibility of identification of suitable species for cultivation in Kerala, production and distribution of plating stock to public and technology transfer on cultivation through decentralized training programmes in different Panchayaths. Another important activity initiated by KBM was organization of Bamboo Fest and technical seminars that provided an opportunity to public to get an exposure to bamboo and bamboo products. This is an annual continuous activity, so far organized at Cochin and the latest one (16th) was over recently in December 2019.



When large scale plantation of suitable species was initiated to meet the requirements of upcoming industries, the availability of planting stock of preferred species was a limitation. DBT came with a timely support for scaling up of technology already developed in laboratories for mass multiplication through tissue culture and field trials of tissue cultured planting stock. KFRI in collaboration with Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore and Institute of Wood Science of Technology (IWST), Bangalore carried out these field trials in Southern India along with R&D to standardize protocols for other species suitable of cultivation.

KFRI received another project from CSIR for screening of reed populations in Kerala in relation to lignin content and identify low lignin containing varieties. This was for paper industries and low lignin will help to reduce the cost of bleaching while processing the pulp.

Another important milestone in bamboo sector development in India was formation of National Bamboo Mission (NBM) in 2006. NBM was established under Ministry of Agriculture and Cooperation. The proposal came in the Seventh World Bamboo Congress organized at Delhi in 2004. KFRI made excellent presentations and distributed several of its publications in this meeting. NBM is well structured with a National Steering Committee and State Level Bamboo Missions. Areas of support available, the budget allocation, procedure for application and shares of state and central governments are clearly given it its guidelines. In return to the significant input given by KFRI for preparation of DPR for NBM, the institute was considered to support NBM as one of the Bamboo Technical Support Group which need to cater to the requirements of six southern states

and support National Steering Committee. This is a prestigious project launched in 2007 and continues even now. The advantage of BTSG is that it can directly submit the proposals without routing through State Bamboo Mission to NBM. NBM also provided R&D grants to BTSG to update bibliographic data bases, conduct research on molecular markers for identification of species at juvenile stages and on status handicraft industries of southern India and socio economics of marginalized bamboo artisans.

Prior to formation of NBM an elaborate proposal for recognition of KFRI as 'Centre of Excellence in Bamboo and Rattan Research' was prepared by the team under the leadership of Dr. J. K. Sharma and submitted to the Ministry of Environment and Forests through Chief Minister of Kerala. It was agreed in principle but unfortunately kept aside since two National Missions exclusively for Bamboo development was launched during this period.

Throughout the duration of research and extension work, various departments of Govt. of Kerala and KSCSTE after its formation in 2003 supported KFRI for need based studies such as base line information, demand and supply of raw materials to industries, volume weight relationships, economics of plantations, status of rare and endangered species, their conservation, capacity development for livelihood improvement of marginalized bamboo dependents, cluster development, use of bamboo in construction, organization of seminars and recently on carbon sequestration which generated lot of information for filling gaps. During this period KFRI also drafted a 'Bamboo Policy' for Kerala State with definite Action Plan.

The majority of the work of KFRI along the publications all over the world is available at BIC-India (KFRI Library) in digital form as books, edited books, research reports, scientific papers, popular articles in newsletters, proceedings of seminars, training manuals, handbooks and CDs.

In short, a tour through KFRI starting from FRC-Velupadam will fill one with abundant information and practical experience. The bambusetum provides a visual treat of diversity in size and growth forms, Common Facility Centre is packed with up-to-date machineries for processing and exhibits products that could be developed. Nursery educates one with the techniques for multiplication and if you are lucky you carry home your favorite species for life long association. Beyond bambusetum a place which makes you cool even in hottest summer days is the germplasm collection of the endemic reed bamboo species *Ochlanda travancorica*. With one more day if you go to the main Centre, Peechi update with knowledge from BIC, see the tissue culture laboratories where the difficult to propagate species are dealt with utmost care and the molecular biology labs evolving methods for correct identifications, complete herbaria and cibachrome of most of the species with clear documentation, Samples of rare seeds in seed centre and so on. You will get information about the training programmes if you could interact with staff of extension and training division. Above all the present Director Dr. Syam Viswanath who is an expert in Sandal and Bamboo alike was a partner with KFRI in DBT project on field evaluation of tissue culture plants and NMBA project on multi-location species trials. Sure with his guidance and the support of efficient young team, KFRI will be able to unveil many more intricacies of this simple at the time complicated grass group.

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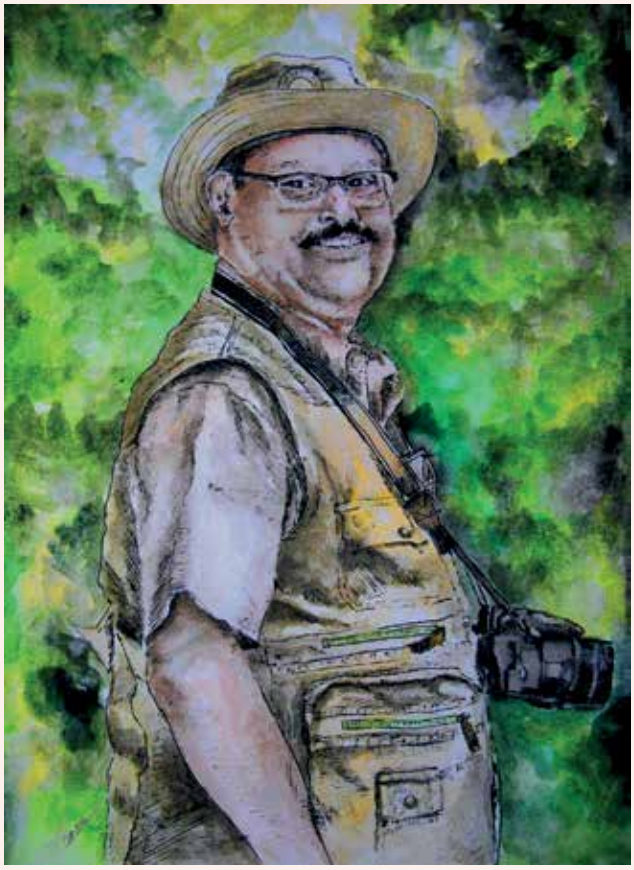
Concept: A.V. Raghu, Drawing: Sudheer P.Y.

The Wildlife and the Wildlife Biology Division of KFRI

Dr. P.S. Easa
Formerly Director and Head, Wild Life Department, KFRI, Peechi

The end of 1970s is remembered for the public movement to save the Silent Valley. The public from different walks of life organised programmes all over the state and the movement grew as a national and even international one. At the same time, Dr. V.S. Vijayan and Dr. M. Balakrishnan, the wildlife biologists of KFRI were in Silent Valley collecting scientific information, which turned out to be the first basic information on the uniqueness and bio-diversity richness of the area. The contents of the Report was widely used by various organisations to highlight importance of the forests in Silent Valley and ultimately helped in getting the area declared as a National Park. That was the first Research Project of the Wildlife Division after its formation. I was fortunate to be with them at the time of report preparation helping them with map preparation and weather data collection from the KSEB office.

That was the time when forest and wildlife management issues were discussed in the Executive Committee of KFRI. Kerala Forest Department came forward with financial and logistic support to initiate an Ecological Study in Periyar Wildlife Sanctuary in 1977. This was probably the first such initiative for generating information on one of the Protected Areas in Kerala. The five year long study brought out very useful information on the status and distribution of animals and the availability of the resources. However, the focus was on selected



mammalian species, especially the larger ones. The Periyar experience was very rewarding especially for the youngsters in the Scientists' Team. The almost frequent visits of Dr. Salim Ali and his associates including Shri J.C. Daniel, Shri S.A. Hussain, Dr. R. Sugathan and Dr. Robert Grub were encouraging and was opportunity for interaction with scientists of wider experience. The work, which was started with Dr. Vijayan, Dr. Balakrishnan (later joined Kerala University) and myself ended up with Shri P. V. Balakrishnan (later shifted to college teaching), Dr. K.K. Ramachandran and Dr. P. Vijayakumaran Nair and Dr. E.A. Jayson.

Almost parallel to the work in Periyar, Dr. Vijayan was also a part of a multidisciplinary team studying the impact of multipurpose reservoirs, the focus being

Idukki Wildlife Sanctuary. By the end of 1981, the youngsters in the wildlife team started thinking of working on selected species. I joined for my Ph D and shifted to Parambikulam Wildlife Sanctuary initiating studies on Ecology and Behaviour of Elephants. Dr. Ramachandran initiated his study on Malabar Giant Squirrel in Parambikulam as a part of his doctoral thesis. Later in the end of 1980s, there had been further studies on movement pattern of elephants, studies on sambar deer. Dr. Jayson specialised in birds with his thesis on Community Ecology of birds in Silent Valley. He also continued his interest in birds with studies on birds of Kole wetlands and also the Mangalavanam Bird Sanctuary.

The beginning of 1990s, especially 1992 brought in lots of changes in the activities of Kerala Forest Research Institute, especially the Wildlife Division. There had been changes in the Kerala Forest Department with a new Chief Wildlife Warden (Shri P. K. Surendranathan Asari) and in KFRI with a high ranking Forest Officer (Dr. S. Chand Basha joining as the Director. The Forest Department wanted to generate information on the Protected Areas in Kerala and formulated projects by including in the Annual Plan of Operations submitted to Ministry of Environment and Forests. KFRI was the major beneficiary of the initiative and the entire institution became vibrant with different research projects in almost all the disciplines.

Probably, one of the most important policy decisions by Kerala Forest Department was in the wildlife population estimation ("census"). In 1992, the Department decided to adopt available scientific methods for estimation. and that too by involving trained public. Fortunately the decision had the full backing of the political boss, the Hon. Minister for Forests. Kerala Forest Research Institute was given the task of co-ordinating the population estimation and I was entrusted with the work. Elaborate arrangements were made for training the Trainers, the forest staff, publicising the programme inviting volunteers, training them in different regions, procuring the required equipments and preparing the data format. Analyses of the data were done at KFRI and the Report was finalised after clarifying all the doubts raised by the higher officials in the Department. About 1400 public were trained on the methods and their participation added transparency and credibility to the whole exercise. Moreover, the programme also turned out to be an awareness programme with increased public support for conservation. The population estimation following scientific methods and involving the trained public was the first in the country and was hailed by everyone. The then Secretary in the Ministry of Environment and Forests in Government of India, in one of the review meetings in Delhi congratulated Kerala for the initiative and specifically mentioned the advantage of having a scientific institution backing in the programme. This programme was

followed in subsequent years. The whole programme was a combined effort of the scientists in Wildlife and Statistics Divisions. Dr. Jayaram joined the wildlife team in the whole programme. As an offshoot of the programme, a project on Evaluation of methods for estimating the abundance of herbivores in the Forests of Kerala was initiated.

A Hand Book on field guide to Animal signs was prepared by Jayson and myself and was very useful especially while conducting population estimation based on indirect evidences.

By 1990s, Wildlife Division started projects on Status, Food and Feeding of larger Mammals in Idukki and Chimmony Wildlife Sanctuaries generating base line data on the mammalian fauna of the area and estimating their seasonal abundance and distribution. The habitat utilisation studies in Wayanad wildlife sanctuary looked at the seasonal abundance and distribution of animals in various habitat types. The study in Parambikulam was with stress on Gaur. Observations were made on gaur for population, herd size, structure and composition. Food species were identified and their abundance in different habitat zones estimated. The seasonal abundance and distribution in different habitats in Parambikulam including the plantation were monitored and correlated with various factors.

For the first time, we attempted and succeeded in attaching radio transmitters on two animals for studying the home range. This was also the time when the problem of human wildlife conflict was addressed in Wayanad (by myself and Sankar) and Peppara sanctuaries (by Viajayakumaran Nair). Interestingly, the title of the Wayanad project was human wildlife interaction and not conflict. This term was later after about ten years or so was highlighted and replaced the word conflict in the international forums and of course there was no mention of our initiative and the vociferous researchers in India kept silent when brought to the notice. The abundance and seasonal distribution of mammals in Wayanad were monitored. Crop damages in selected settlements were recorded and monitored for crop species, extent of damage, animals involved, type of damage, etc. The effectiveness of protection methods employed was assessed. The crop damage in terms of economic loss were estimated. Effective methods for protection of crops were suggested. The works in Peppara also brought out information useful for developing mitigation strategies.

The prey-predator studies in Eravikulam National Park was the first of its kind in the state. The predators and the prey species of this unique National Park were identified. An identification technique using the hair from the scats was developed based on the standardization of animal identification based on the hair structure. An important project was on the development of Habitat Suitability Index model for Nilgiri tahr in Eravikulam National Park. The observation of Nilgiri tahr abundance and distribution with the availability of food species and the geographical parameters in Eravikulam were used to develop a habitat suitability index for the critically endangered Western Ghats endemic. The fragmented habitats in Kerala were visited for estimating the population and assessing the threat factors.

In 1999, a project was taken up on the population of elephants in Periyar and adjacent areas. The herd size, structure and composition were recorded. There was also an attempt for documenting the distribution and estimating Tiger population in Periyar Tiger Reserve. Documenting the faunistic diversity of Chinnar wildlife sanctuary was also a mile stone as this was the first authentic documentation in the drier wildlife sanctuary in the state.

One of the least studied animal in the forests of Kerala the sloth bear was studied for estimating its abundance in different habitats. The food species were also identified from the scats by comparing with the reference collection of plant parts prepared.

A very ambitious project on small mammals was taken up in 1993 with Shri Padmanabhan, the scientist in the Division to survey the areas for various species. The forest divisions in Kerala were visited recording the small mammals in the area through various techniques. Selected habitations and villages

were also visited for recording the rare ones. The report lists the species and distribution in Kerala.

While Dr. Ramachandran continued his works on arboreal species like lion-tailed macaque in Silent Valley and adjacent areas, arboreal ones in Nelliyampathy and the Grizzled Giant squirrels in Chinnar, I diversified my interest by initiating studies on fresh water fishes in the river systems in Kerala and the reptiles and amphibians in Nilgiri Biosphere Reserve (funded by MoEF). The studies on the arboreals estimated the population along with distribution details and identified threats suggesting solutions. The studies on fresh water fishes documented the species along with the ecological parameters. The threats to the conservation of the species were identified and actions suggested. The survey in Kerala part of Nilgiri Biosphere Reserve recorded the reptiles and amphibians along with details on abundance and distribution and diversity in different habitats were estimated. The threats also were assessed.

Activities of the Wildlife division were not limited to the field research. There were several other programmes like Biodiversity Documentation for Kerala. The Division took the initiative for compiling a list of the species under different groups reported so far from the state. The Division published on mammals, birds, reptiles, amphibians and invertebrates excluding the insects, lichens, algae, bryophytes and pteridophytes.

I was involved in several workshops on Biodiversity Register preparation organised by Prof. Madhav Gadgil at Centre for Ecological Sciences, IISc, Banagalore and also the Biodiversity Register preparation of Ernakulam district led by Prof. M. K. Prasad. This prompted me to go for Biodiversity Register preparation for Pananchery Panchayath in Thrissur with colleagues from other disciplines. In the programme, plants and animal species in the Panchayath were documented by involving the local residents through a questionnaire survey and direct observation. The people's knowledge on the use of the species were recorded along with the names of the persons. The document has the list of the species, the people's traditional knowledge on the use of various species cultivated in the areas at present and a list of the traditional varieties. Another work was the project Monitoring Biodiversity in the selected landscapes in the Kerala Part of Western Ghats where selected groups of plants and animals were monitored in selected landscapes with the trained college teachers and students. Biodiversity Education was another programme where selected Teachers from Colleges and Schools and Post Graduate Students were given a few days long training on various aspects of biodiversity assessment and monitoring. Selected scientists from different Divisions were involved in the programme. Another programme was Training for the Implementing Officers of Government Department on the programmes under Western Ghats Development of the Planning Department. This was conducted in different locations in the state where Resource Persons were brought in for lectures.

The plantations in Parambikulam and Wayanad were always considered good as wildlife habitat. However, there had been no documentation done. As an attempt, the scientists from different Divisions joined together to prepare Management Strategies for promotion of succession in Plantations of Parambikulam and Wayanad Wildlife Sanctuaries. Abundance of selected groups of plants and animals in the plantations and natural Forests in Parambikulam and Wayanad were estimated and compared between habitats. The measures to improve the plantation areas were suggested.

Later during 2012 – 14, the amphibians of Agasthyamalai landscape in relation to altitudinal and habitat parameters, especially the reed inhabiting ones were studied. The amphibians in the landscape were surveyed and abundance estimated. Unique breeding biology of two species observed for the first time. The habitat requirements of selected species were also worked out. The Division also participated in the studies on impact of fire on grasslands and selected groups of animals in Eravikulam National Park and Parambikulam Tiger Reserve. The impact study on grasshoppers and amphibians need special mention.

Since road kills were identified as a major threat to the animals in some of the forest areas, road kills along the roads in Vazhachal – Malakappara and Udumalpet – Chinnar were recorded and the habitats along observed. The conservation relevance of road kills were discussed.

The Wildlife Division had been active in all the programmes of Kerala Forests and Wildlife Department. We were involved in planning and conducting population estimation of species like Nilgiri tahr, organising bird surveys. The bird survey conducted with active partnership of the NEST (Nature Education Society, Thrissur) in Peechi – Vazhani wildlife sanctuary had participation of bird watchers from all over Kerala. This was followed by surveys in other areas including Kole wetlands and Vembanad lake.

The Wildlife Division had been represented in the policy making bodies of the State and Ministry of Environment, Forests and Climate Change. There had been representation in the National Board for Wildlife, State Board for Wildlife, Tiger Conservation Foundation, Research Advisory Committee, Tiger Conservation Plan Approval Committee, Management Effectiveness Evaluation Committee and many others.

The responsibility given to me as Co-ordinator of the Renovation work of Teak Museum was really challenging. We had to get the museum experts and artists from National Museum of Natural History for designing and other institutions for implementation in addition to scientific input from the concerned scientists.

Any narration of the activities of the Division cannot be complete without remembering the encouragement from the Directors like Dr. P.M. Ganapathy, Dr. S. Kedarnath, Dr. S. Chand Basha and Dr. K.S. S. Nair. There had been constant interaction, support and advice from the Forest Officers from top to bottom. Shri P.K. Surendranathan Asari, Shri Sasidharan Nair, Shri T.M. Manoharan were the leaders among them. A separate article would be required to remember all the Forest Officials starting from the higher to the Field Staff.

I strongly believe that the successful completion

of so many projects were because of the contributions from the Research Fellows, who worked day and night. Dr. C.P. Shaji, Dr. S.M. Vairavel, Dr. A. Veeramani, Shri Sabu Jahas, Shri Saju K. Abraham, Dr. Balasubramaniam, Shri Joseph Thomas, Dr. Sivaperuman, Dr. Gigi K. Joseph, Dr. Jayahari, Dr. Christopher, Dr. Manju C.Nair, Shri Prasanth, Shri Patrick. Shri Sandeep Das, Shri Dhaneesh Bhaskar and Shri Rajkumar. Ms. Valsalakumari K.R., Ms. Sreelatha, Ms. Kavitha, Shri Hari, Ms. Bhagyalakshmi, Ms Ranjana, Ms. Reena P. Chacko., Ms. Sunanda M.K. who assisted in the laboratory works for the successful completion of projects can never be forgotten. Shri Suresh P.S. had been an important part of most of the projects. The field staff including the Tribal Trackers in various places were the saviours and guides in the field. There were also drivers like Shri Madhavan, Shri Girijan, Shri Mohandas, Shri Jayan, Shri Herald Wilson who drove us to remote areas in the state.

The precious collections of fresh water fishes, reptiles and amphibians in the Wildlife Division is the result of the effort of the Fellows like Dr. C.P. Shaji, Shri Saju K. Abraham and Shri Joseph Thomas. There was a time especially in 1990s when the activities of the Division hit the news papers. It could be on new species, new distribution or a general article. The Wildlife Division could be proud for the contributions, which are being continued now by the then Research Fellows and the “retired” scientists.

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Stalking birds and rodents in forest

Dr. E.A. Jayson
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Bird studies in KFRI were started in 1985 when we initiated a multidisciplinary research on the tropical wet evergreen forests of Silent Valley National Park of Palakkad District. From this study we could establish that the present buffer zone of the Silent Valley National Park is equally diverse in bird diversity as that of the core area of the Park. At that point the present buffer zone was not declared as buffer, but has only the status of a reserve forest and later this was declared as Buffer. Sighting of King cobras was nerve shattering experience we had from this study.

After studying the tropical forest birds our focus turned towards the Kole wetlands of Thrissur. This work produced detailed and concrete data on the diversity of migratory bird species in the Kole wetlands and with this baseline data, Vembandu Kole wetlands together were declared as a Ramsar Site (2002). When we were conducting the fieldwork, we could see the professional hunters hunting the ducks and cormorants and sharing the booty with the owners of the paddy fields. Now there is no open hunting of birds in the Kole wetlands and the wetland is protected very well as a Ramsar Site, which is visited by many transcontinental migrant species of birds. Local people looked and treated us with skeptic look initially when we explained our bird studies to them.

The Kole Wetlands is one of largest, highly productive and threatened wetlands in Kerala and it comes in the Central Asian Flyway of migratory birds. The Malayalam word Kole indicates bumper yield, which refers to a particular type of cultivation method adopted in backwaters from December to April. Recently foraging ecology of birds in Kole wetlands was also studied during June 2014 to September 2017. Feeding behaviour of Oriental darter, Little cormorant and Asian Openbill stork were studied. Oriental darter is a diurnal feeder, forages solitary most of the time. They forage mainly in water depth more than 30 cm. They feed varieties of fishes like Silver carplet, Mahe Barb, Swamp Barb, Climbing Perch, Pearl Spot and Striped Snakehead. Little cormorant is also an exclusively piscivorous and diurnal feeder and forages solitary as well as in group. They forage in every water sources like small ditches, pools, canals, open waters and river as well as in various water depth (> 10cm).They feed varieties of fishes like Green Stripe Barb, Silver carplet, Mahe Barb, Swamp Barb and Stinging Catfish. Openbill storks forage in Kole Wetlands in different microhabitats like mudflats, shallow water streams, paddy fields, small ditches, and along the bank of small canals characterized

from the old leaves

Evergreen 21, 1988

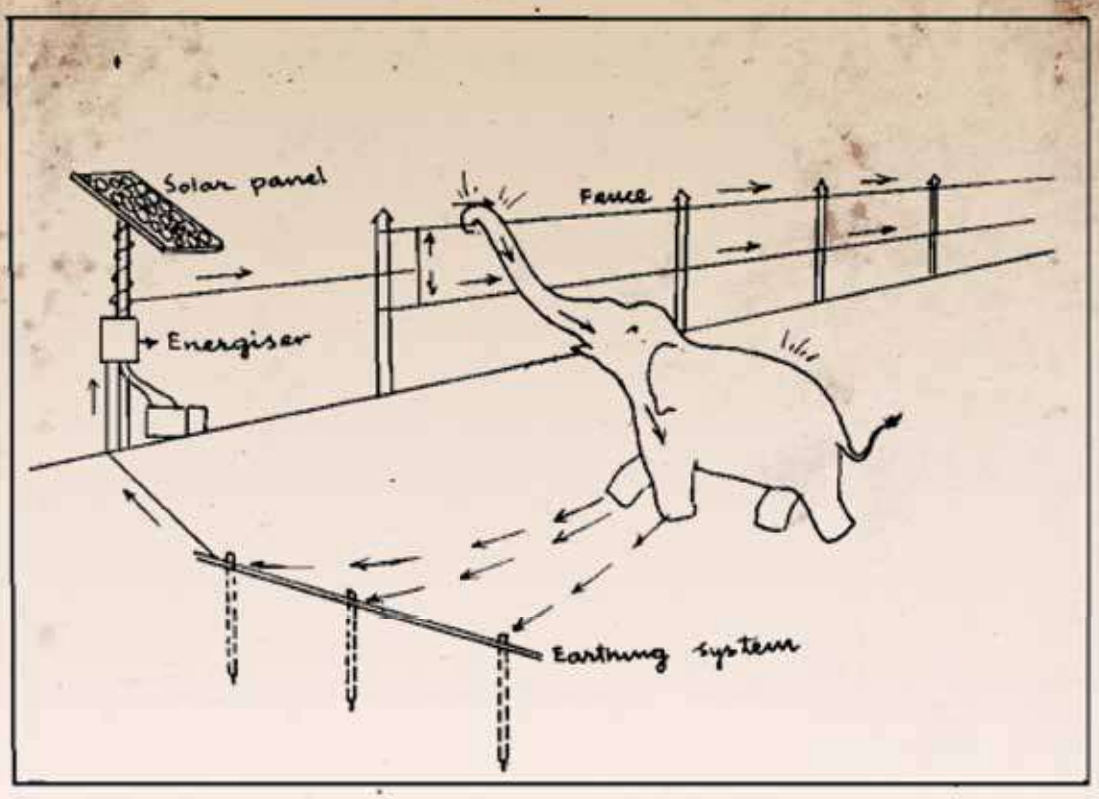

Fig. 1. Mechanism of working of an electric fence

by diurnal feeding. Asian Openbill storks feed on molluscs mainly snail and freshwater mussel.

Studies on the birds of Mangalavanam WLS in the Ernakulam Dist. has became a history now because this is the only one available study detailing the birds in the sanctuary including the breeding and roosting populations recorded in thousands during the year 2000. Now these populations are not present in the sanctuary, because the whole birds evacuated the sanctuary. Hundreds of nestlings falling from the nests during the heavy rain were heart breaking. Later Forest Department started a nursery for the falling chicks and could save some of the fallen chicks picked from the ground. Many hypotheses were put forward for the reason of roosting and breeding birds leaving the sanctuary and debated even now. But we firmly believe that the loss of protection provided by the continuous human presence from the surroundings is the real cause of birds leaving the sanctuary.

A study on the communal roosting behaviour and patterns of roosting in birds to elucidate the factors controlling the communal roosting behaviour was also carried out by us. The study was initiated in the year December 2015 and the field data collection continued up to December 2017. Twelve species of birds were found to roosts communally in Kerala and out of these eight species were wetland birds and four species land birds. The studies showed that the communal

roosts were formed in four types, namely communal roosts of wetland species alone, land bird roost, mixed species roosts and communal roosts of birds of prey. A total of 258 communal roosts were recorded during the study and out of these 44 were communal roosts exclusively with wetland birds, 131 with land birds, 66 with mixed species and 11 with birds of prey species. Protecting the communal roosting sites is crucial for the conservation of wetland birds.

Malabar Spiny Dormouse with radio transmitter

Human – crocodile conflict at Neyyar Wildlife Sanctuary in the Thiruvanathapuram Dist. created much heat locally and people were highly agitated and KFRI was called in to do a detailed analysis. This study provided ample opportunity to interact with the local people. The study established the exact population of the Mugger crocodile in the Reservoir authentically and replaced the misconception of thousands of crocodiles present in the sanctuary. After the study, suggestions offered by us were implemented and human-crocodile conflict ceased. Counting the crocodiles at night in boats with searchlights was sporty and thrilling.

Malabar Spiny dormouse is a small rodent with the size of a rat and face similar to it but its tail resembles the squirrels. It is one of the endemic mammals of the Western Ghats. Tribal's who were assisting us in the trapping studies were also skeptic about our mission. They used to wonder about our research and its motives. We could develop efficient method to trap the Malabar Spiny Dormouse in the study. Tracking the radio collared Spiny Dormouse at the dead of night was nerve splitting. Two groups of tribal assistants used to guard us with crackers in the vicinity to warn the marauding elephant herds coming to the area.

Studies on the conservation of Owls again provided a chance to work in the tropical forests in night with exciting experiences. Both Spiny door mouse and Owls were nocturnal and they were not active at day time. In both the studies field work commenced only after 6 pm, when the subjects became active. The owls were estimated using the method of call play back in which the recorded calls of different species of owls were played from a fixed station in the forest areas. By hearing the calls, some owls approached the playing station looking for the individual making the sound or in other cases they responded from faraway places. Flying squirrels fleshed out of their hides after hearing our played calls, because for them it was their predator's calls. We could formulate a census method also to count the flying squirrels, which are also nocturnal using this method. Distribution, status and habitat use of forest owls in the southern Western Ghats of India was studied from February 2005 to January 2008. The objectives were to make an inventory of forest owls in the study area, to find out the factors that influence the owl distribution and abundance and to characterise the microhabitat use of owls. Intensive surveys were carried out in 276 census points, using dusk watch, initial quiet listening, call playback and spotlighting. One hundred and thirty seven points were surveyed from Kerala and 139 points from Tamil Nadu State. Thirteen species of owls were recorded from the southern Western Ghats of Kerala and Tamil Nadu. Out of the sixteen species

Nest study in Peppara

of owls distributed in Kerala part of the Western Ghats, eleven species are found in the forests and others in the cultivation and in open country. Two species are migratory and 14 species are resident.

Human - wildlife conflict studies initiated by KFRI has given the Institute a head start in this branch of studies now. We were the first in Kerala to initiate detailed analysis on human- wildlife conflict. We covered the whole State first and then detailed studies were also conducted in Marayur, Peppara, Thrissur, Nilambur and Wyanad. Apart from documenting the species of animals causing damage to crops in the initial studies, we could quantify the damage to each crop in specific areas in the latest research. Seven species of wild animals namely Asian elephant (*Elephas maximus*), wild pig (*Sus scrofa*), Indian crested porcupine (*Hystrix indica*), Indian giant squirrel (*Ratufa indica*), Indian peafowl (*Pavo cristatus*), bonnet macaque (*Macaca radiata*) and sambar (*Rusa unicolor*) were damaging the crops in the Thrissur District. Feeding of Indian giant squirrel on coconut was reported for the first time and this behaviour was recorded in the Forest Ranges adjacent to Wildlife Sanctuaries in the Thrissur District. Chilli-rope was found to be an effective short term remedial measure to prevent elephants from entering crop fields in the tropical monsoon condition. Honey bee fences were tested and the efficiency was standardised during the human –wildlife conflict assessment at Nilambur. Many management suggestions were also available from these studies.

A bird strike sometimes called "birdstrike", bird ingestion (for an engine), bird hit, or BASH (for Bird Aircraft Strike Hazard) is a collision between an airborne animal (usually a bird or bat) and a human-made vehicle, especially aircraft. (Recently the term "wildlife strike" has been introduced to denote the collision between animals and aircrafts). A bird or a flock of birds that suddenly arising from a runway or surrounding area may collide with an aircraft and cause the aircraft to crash, possibly resulting in the loss of human life. Damage caused to aircraft usually results from collision of one or more birds with the engines and/or fuselage. Although most bird strikes do not result in crashes, they do involve expensive structural and mechanical damage to aircraft. A study was initiated in January 2016 with the financial support from Indian Navy to find solutions to reduce bird strikes in INS Garuda, Cochin Naval Base. Management suggestions from the study reduced the bird hits and INS Garuda again contacted the Institute for a new contract for a similar study. Now a study on the bird hazard at Trivandrum International Air Port is undergoing.

We could do studies in the forest, wetlands during day time at night and also on various practical problems. Starr tortoise was first reported from Kerala in the Chinnar Wildlife Sanctuary (1992) situated in the Idukki District, The suggestions from the studies solved many environmental issues and produced very valuable basic data also.

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KFRI - Soil Museum

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Soil, the key source of life in this planet is very dynamic and heterogeneous natural resource. The thin layer of soil above bed rock is the centre of many global issues such as food security, water security, climate change adaptations and mitigation, biodiversity protection, environmental and human health etc. The transfer of knowledge to the general public on the significance of soil on sustenance of life in this planet, and the need for sustaining the ecosystem services they render in the changing global climatic scenario has become a major challenge. The idea of communicating and sensitising the general public on soils and their functioning through soil museum had been vested with soil science community during the historical evolutions. The first soil museum in the world was opened in 1902 in Russia by Vasili Vasilyevich Dokuchaev, the father of pedology with the first collection of soils across the globe. Later, the idea of exhibiting the soils in a soil museum has been followed by several countries.

The soil museum in KFRI is very unique in the sense that it showcases the diversity of soils in different types of forest ecosystems, and the reflections of degradation of natural vegetal covers on soil beneath, which is not attempted in any of the soil museums across the globe. The museum was established as part of a research project funded by KFRI plan, and was inaugurated by Dr.Suresh Das, Executive Vice President, Kerala State Council for Science, Technology and Environment on 10 December 2015 at the opening session of a national seminar on "Issues, challenges and strategies in sustaining soil health" hosted by KFRI during 10 - 11 December 2015, as part of celebrating the international year of soil.

No.	Forest ecosystem	Location
1	Teak plantations -1st rotation	Chathumbryi, Nilambur
2	Teak plantations -2nd rotation	Valluvassery, Nilambur
3	Teak plantations -3rd rotation	Valluvassery, Nilambur
4	Natural bamboo	Kottilappara, Nilambur
5	Moist deciduous forest	Peechi, Pattikkad
6	Reed bamboo	Watchmaram, Kollathirumed
7	Shola forest	Mannavan shola, Munnar
8	Grass land	Rajamala, Eravikulam
9	Dry deciduous forest	Jellimala, Chinnar
10	Scrub jungle	Karakkad, Chinnar
11	Degraded forest	Kuthiran, Pattikkad,Thrisssur
12	Semi-evergreen forest	Chimney Dam, Palappilly
13	Teak plantation -2nd rotation-lateritic soil	Machad, Vadakkanchery
14	Agroforestry	Myladumpara, Peechi, Pattikkad
15	Evergreen forest	Sholayar, Vazhachal

The museum welcome visitors with a pictorial exhibit kept outside, showing the built-in similarities of man and soil from a philosophical angle. Inside the museum, the major attraction is a three dimensional model of Kerala, placed in the centre of the room depicting nine different types of soils of Kerala viz ; coastal alluvium, mixed alluvium, acid saline, kari, laterite, red, hill, black cotton and forest soils. Among these, the forest soils support the mountaneous area in the Western Ghat region of Kerala, comprising different types of natural

forests and forest plantations, which make strong imprints on the soil beneath them over a long period of time. Normally, there are lot of restrictions for the general public to enter into the forests, and even if they enter, they are unable to understand what is happening below the forest floor. So , a collection of 15 soil monoliths featuring the soils in different types of forest ecosystems as detailed here under in the Kerala part of Western Ghats are exhibited in the museum. They are kept in glass enclosures with wooden frame, attached to the surrounding wall

A monolith is essentially a profile representing the soil typical of a region, with all the basic characteristics preserved intact. It displays vertical sections of the soil from the surface to the bedrock below displaying the various horizontal layers or genetic horizons. Alongside each monolith, is provided the information on the taxonomy, physical and chemical characteristics of the soil, forest type and the picture of forest type and soil profiles. Any degradation of a forest ecosystem is reflected in the soil profile and the visitors to the museum are exposed to and educated on the degradation of soil due to deforestation and consequent depletion of ecosystem services, which ultimately threatens the existence of life on this planet.

A typical soil monolith comprising of all the major horizons, made artificially with rocks, soils and vegetal cover is also exhibited in the museum for educating the students on soil formation and different factors involved in that process.

It is planned to expand the museum by displaying 15 more monoliths from different forests types across

Highlights

1. The monolith from shola forest was unique with its dark brown colour even up to 1.5 m depth, indicating an extraordinary higher stock of carbon throughout the profile.
2. But in grasslands, which was geographically adjacent to shola forest, the brown colour due to deposition of organic matter was only up to 55 cm from soil surface.
3. The soil column in the profile of evergreen forest was very shallow with a depth of 56 cm on weathering parent material.
4. The monoliths from natural bamboo and reed bamboo were with abundant fine fibrous roots in the soil.
5. No significant morphological variations were observed between the soil monoliths from teak plantations of 1st, 2nd and 3rd rotations flourished on alluvial soil at Nilambur.
6. But the monolith from teak plantations of 2nd rotation on lateritic soil exhibited signs of laterisation
7. High degree of laterisation and presence of hard laterite were noted in the degraded forest.
8. The soil monoliths from the dry deciduous forests and scrub jungles, located in the rain shadow areas were without any symptoms of leaching of basic ions and red colour due to the dominance of iron.
9. It is very unique to note the extra ordinary higher level of exchangeable Al in the shola forest soils than other soils including degraded lateritic soils.

India and displaying them in the adjoining room along with other exhibits like soil piping model, collections of different stages of laterites, rock types and other information related to soil. These forest ecosystems include sub-alpine and dry alpine forests from Shimla;

littoral giant Andaman tropical forests and volcanic region from Andamans ; mangroves, swamp forests, kole lands and KFRI Peechi campus from Kerala ; Sal forest from Malwa plateaux ; Reed brakes and shifting cultivation from north east India, Laterite top and Deccan plateaux from Maharashtra ; arid xerophytes and north tropical thorn forest from Gujarat.

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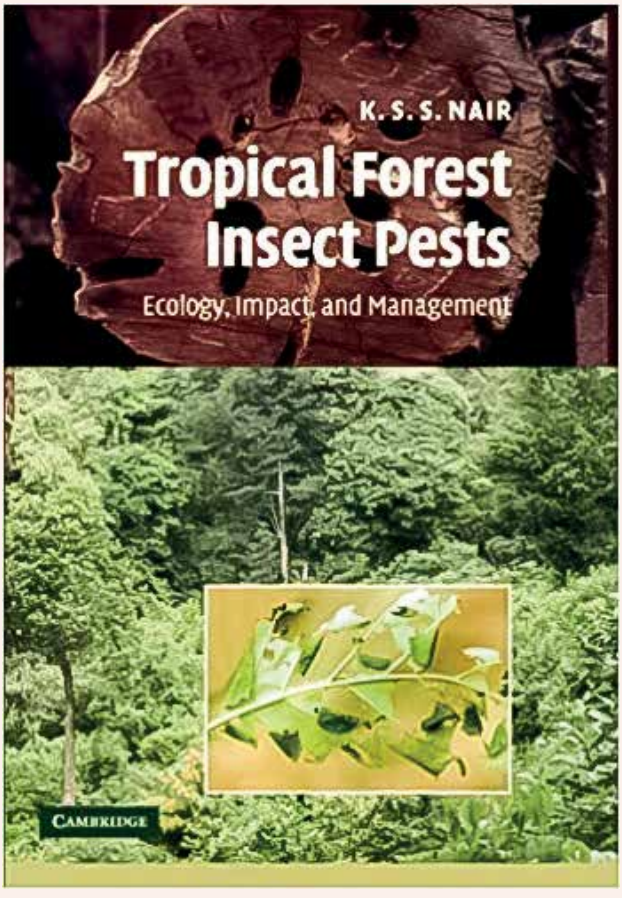
From insects to the health of forests: The tale of the Forest Entomology Department

Dr. T.V. Sajeev
Head, Forest Entomology Department & Research Coordinator, KFRI, Peechi

In 1965, something exceptionally new happened in the forests of India which got repeated in 1978. The first time, it was in Konni teak plantations in Kerala and the second time, it was in Barnawapara plantations in Madhya Pradesh. This was the spraying of chemical pesticides from air- 80 litres of Malathion, 75 litres of Fenitrothion and 260 kg of Carbaryl- over plantations to control a pest of teak called the teak defoliator. It was between these two aerial sprayings that the Kerala Forest Research Institute was born. The Entomology Department which was one among the first departments of KFRI, squarely addressed the issue. "The problem of insect defoliation of teak: to spray or not to spray?" was the title of the paper presented by the Head of the Department- Dr KSS Nair (KSS) at the second Forestry Conference at Dehra Dun in January 1980. He argued that before we undertake further aerial application of pesticides, we should generate baseline data on the economics of loss due to defoliation and the nature and causes of fluctuations in insect populations. This call was heeded to and since then, until now nowhere in India has aerial application of chemical pesticides done, preventing immense environmental hazards



which would have happened. And KFRI took up the challenge of estimating the economic loss and developing alternate strategies to manage insect defoliation in teak- a challenge which decided the research agenda of the Entomology Department for the next two decades.

The saga of teak defoliator research

The teak defoliator is a small moth with arrives in large numbers, lays eggs on the tender foliage of teak and the emerging larvae devours the entire foliage of the tree. In a fortnight, the tree would be left leafless. The research on the teak defoliator- *Hyblaea puera*- went through a series of time bound research projects funded by various State, National and International agencies like the Kerala Forest Department, Department of Biotechnology, Govt. of India and the then ODA. Nilambur, where the first commercial plantation of teak was established was selected as the study zone. The Entomology Department made sure that every new Scientist newly recruited is posted there to continue this research theme. The first to move in was Dr VV Sudheendrakumar (VVS) who implemented a well drawn out experiment plan with the help of KSS and Dr RV Varma (RVV) from the Entomology Department, Dr KC Chacko from the Silviculture Department and Dr K Jayaraman from the Statistics Department. This study for the first time came up with an empirical estimate of loss due to the pest- a potential loss in volume increment of 44%. Converted to monetary terms, this is a loss of Rs. 75,000 per hectare per year. Having estimated this very high loss, efforts were initiated to develop non-chemical control options. In 1986, Professor Alan A Berryman from Washington State University, USA visited the Nilambur teak plantations during an outbreak period of the pest. The discussions that happened gave a strong background for studies on the population dynamics of the pest. Twenty years later, he wrote that his chance stumbling on an aggregation of moths made him understand the sudden appearance of concentrated, single aged populations of larvae that completely defoliate stands of teak trees, and made him and KSS think of this insect more like a locust than a moth. Sampling in the teak plantations of Nilambur, VVS identified five insect parasitoids of the pest and also evaluated their potential to be used as a biocontrol agent. It was found that most of them could not respond numerically to fast buildup of pest outbreaks. Dr K Mohanadas (KM) succeeded VVS at Nilambur and started studies on the population dynamics of the pest by intense sampling of both outbreak and non-outbreak populations of the teak defoliator. He used this data to prepare the life-table of the pest and in association with Dr Zacharias identified the bird predators of the teak defoliator. Dr Mohammed Ali from the Pathology Department had been exploring the pathogens of the pest and identified four species of bacteria, two species of fungi and a baculovirus as causing mortality in pest populations. It was time to evaluate all the natural enemies of the teak defoliator. It was found that the baculovirus was the best option since it is target specific and hence safe to all other organisms and being a virus, can be stored and used when needed. Research shifted to large scale production of the baculovirus, safety testing and formulation. Dr George Mathew (GM) had developed an artificial diet to rear the insects during the defoliation time of teak so the experiments could continue all through the year. Supported by DBT, a pilot scale production plant was established at Nilambur Subcentre of KFRI. It was at this juncture that Dr Hugh F Evans from Forest Research, UK chipped in with his experience in field application of baculovirus. Within a Control Window concept, precise estimations were developed for field application using ground based high volume power sprayers. In March 2006, KFRI obtained the Indian patent for the manufacturing process of this biopesticide. In the next three years, KFRI worked closely with the field staff of the Kerala Forest Department to transfer the techniques of monitoring of pest and application of the biopesticide.

Now when we look back, the research on teak defoliator was a phase in which all the Scientists of the Department worked together with colleagues from

other Departments joining as and when needed to provide significant breakthroughs. And moreover, large scale broadcasting of chemical pesticides from air stopped for ever in the teak plantations of India. Again, a KFRI method for developing a biocontrol agent for forest pest emerged which included living with the pest in the field, closely observing all stages of its growth, preparing life tables to identify the most important mortality agent, close understanding of the population dynamics of the pest and finally zeroing in on the best biocontrol agent and then following it up with application technology and technology transfer.

Forest insect diversity

The thump rule for forest entomologists in the tropics is that if there are ten insects out in the forest, we have named only four of them. It was GM who set out, joined soon by VVS to explore insect diversity in Wayanad, Malayattur, Silent Valley National Park, Periyar Tiger Reserve, Parambikulam Wildlife Sancturay, Shendurney Wildlife Sancturay, Peechi-Vazhani Wildlife Sancturay, Peppara, Wildlife Sancturay, Sholayar forests, Nilgiri Biosphere reserve, Neyyar Wildlife Sanctuary, Nilambur, Nelliyampathi Ponmudi and Thenmala. These explorations paved the base line of insect diversity in the forests of Kerala. All insects collected which number to 40,483 specimens remain preserved in the insect repository at KFRI, Peechi which include 4128 identified species. There still remain 2500 odd insects waiting nomenclature.

Forensic entomology

When forensic science was not as developed as now, Entomologists of KFRI used forensic entomological techniques to identify the time of death of a corpse found days after death beside a railway line at Shornur. Later, the Department also helped to identify a species of wasp which killed a man with multiple stings. It was a case in which the species was identified based only on the stings left on the dead body.

What is there below ground?

Insects below the ground was of practical interest since termites impacted the establishment of exotic species like Eucalyptus. The department came up with recommendations which could make sure that the young saplings were safe when out-planted in the field. These recommendations were later fine tuned when the recommended chemical pesticides were banned and also when root trainers came into the nursery technology. RVV continued his pursuit on below ground insect diversity by shifting from pest control to evaluation of biodiversity across different landuse systems. It was his studies which showed that even when above ground flora has been completely replaced and when the above ground fauna disappears with it, the below ground fauna takes time to be replaced, retaining the memory of the past above ground flora.

Butterfly gardens

Having worked for many years on the taxonomy of Butterflies, GM took a sharp turn into conservation of butterflies by establishing the first ever butterfly garden of Kerala in KFRI. He followed it up with one at Thenmala, then at Nilambur and then, as they say his history. There are more than 75 thriving butterfly gardens in the State established by KFRI including one at Kanakakunnu Palace where regular flower shows happen every year. The garden at KFRI, Peechi has become an open experimental laboratory where in studies are in vogue on thermal ecology of butterflies. With daily observations, population patterns have been deciphered for many butterflies and several new natural enemies including parasitoids and pathogens have been described.

The species that invade

Midway through the history of the department, both the Pathology and Entomology Departments were pooled into the Program Division named Forest Health. This greatly increased the scope and one of the first research areas o be taken up was Invasive alien species (IAS)- those species which have come from other countries and causing economic and/or

ecological problems here. Dr KV Sankaran from Pathology Department had pioneered work on one of the major IAS in Kerala- *Mikania micrantha*. KFRI conducted the first ever survey of IAS plants Kerala, recording 82 of them. Risk assessment was done for all of them and research towards developing management protocols was initiated. The Department took up the massive task of mapping and developing management strategies for the invasive Giant African Snail which has expanded its invasive range in Kerala in recent years. An ecofriendly control method identified by two student twin sisters at Konni was adapted; field tested and put to practice all across Kerala. Awareness raising activities were undertaken in most infested locations and eradication of the snail at the hub in Willington island was directly done with the help of student volunteers.

On an useful insect

The lac insect cannot fly. It feeds of small braches of specific host plants and covers itself with an exudation which helps it to protect itself from predators. This exudate is so unique in that it contains resin, wax and dye which are used in medicines to colouring agents and perfumes. In 1999 VVS and RVV had a chance observation on a living population of the lac insect in an *Amherstia nobilis* tree in Thrissur Zoo premises. They published the observation in the journal Entomon. This publication triggered a call fifteen years later from the Lac Research Institute (now, National Institute of Natural Resins and Gums) at Ranchi inviting KFRI to join in an All-India Coordinated Research Programme on conservation of lac insect genetic resources. KFRI is assigned with surveying Karnataka, Tamil Nadu, Pondicherry, Lakshsdweep and Kerala. A germplasm collection is now set up at KFRI and efforts are being made to integrate lac cultivation into agroforestry of Kerala.

A magnum opus on tropical forest entomology

Any student of forest entomology will notice that the theory of the discipline evolved from immense case studies in the temperate forests. The tropical forests are quite different and so are tropical insects. They have more generation per year than their temperate relatives and the population dynamics would be different. A complete treatise on tropical forest entomology was authored by KSS and published by Cambridge University Press in 2007. Titled Tropical Forest Insect Pests: Ecology, Impact and Mangement, it covers tropical forestry, ecology of insects in the forest environment, insect pests of natural forests and plantations, stored timber and their management. It also includes case studies of pests of Acacias, Bamboos, Casuarinas and 26 other major timber species of the tropics. Treated as the best text book on the topic, the book remains prophetical even after a decade of its publication. For one case, one of the current areas of research in the Entomology Department is to identify and characterize the pheromone of teak trunk borer- a pest which lives in-accessibly within the heartwood of the teak tree and devours the timber to turn it into firewood. Re-reading the book, we find prophetic explanation on the mechanism of evolution of resistance to pheromone mediated pest control methods- a prophesy possible only with deep understanding on the working of nature.

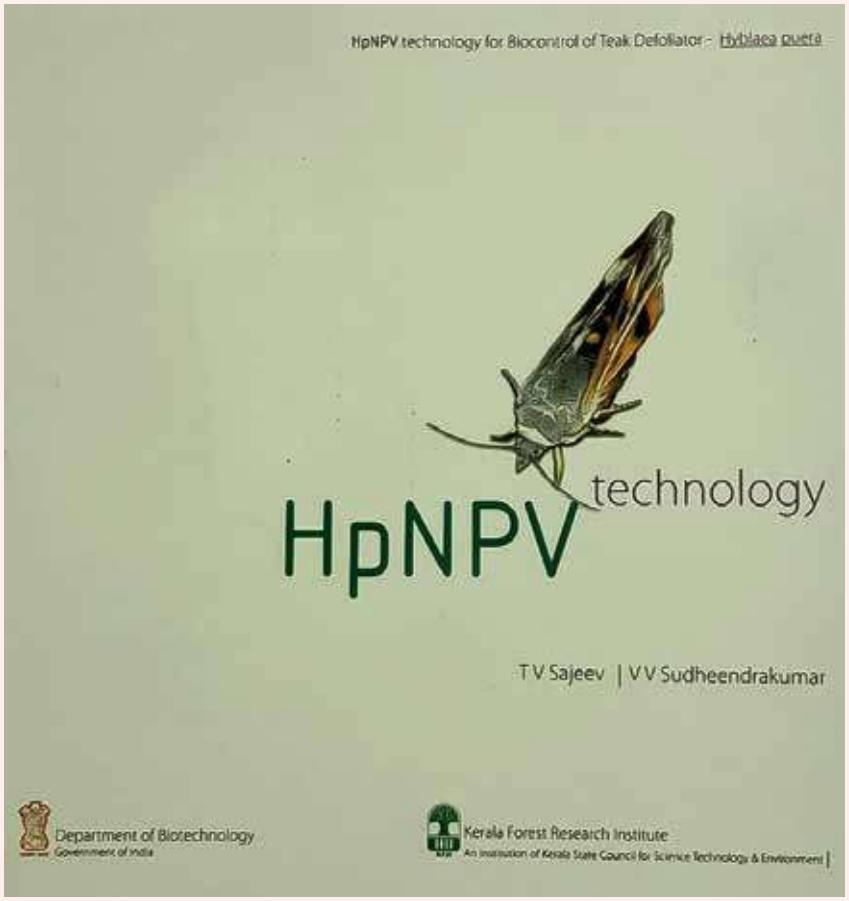
Tree Health Helpline

When most of the research outputs were used by Forest Departments, it was felt that many of the knowledge could also be of use for the common man. A helpline was established with a dedicated telephone number (0487 2690222) which became a single window for all questions related to tree health. It was an instant success and became so popular that it was replicated by many institutions in India and abroad for faster extension of research results. The advantage for the Scientists was that the problems started to come to them from all parts of the State. The facility also made life much easier for the forest staff since they could call us up right from the location and get instant recommendations, replacing the official letter writing process which used to eat up precious time.

Helping neighbouring countries

The expertise in the Department is being availed by Bhutan, Nepal, Maldives and Myanmar where

specific training sessions have been conducted on Entomology and management of Invasive Species. Recently, training have been imparted to forest officials of Nepal and this year extensive surveys are envisaged there looking out for forest insect pests.



What is happening now?

From insects, the Entomology Department has expanded its scope to forest health, encompassing pests, diseases and invasive alien species. Along with a small GIS unit and an insect molecular biology laboratory which caters to several studies, the new addition is the Soundscape laboratory. Using continuous recording of the soundscape for different types of forests, we are linking forest health to the soundscape based on the recent understanding that the soundscape is a better indicator of forest health than many other traditional parameters. Of the four major pests of the teak tree, the teak trunk borer is yet to have a management strategy. In collaboration with Indian Institute of Chemical Technology, Hyderabad, we are getting closer to develop the pheromone trap for the insect. Research on lac insect is moving from surveys to analysis of its natural enemies and population dynamics. The tree health helpline now has an addition named First Questions which is a dedicated helpline for children to ask questions on science and nature and to get them scientifically answered. This year, all locations from where GM and VVS had done insect collections starting from three decades ago are going to be revisited to repeat the collections to compare the insect assemblage, biometry and diversity across time in the context of climate change. Establishment of butterfly gardens in schools and training school teachers for managing them has become a major activity. Invasion ecology research is currently focused on the Munnar landscape which is facing immense stress from climatic variations and tourism pressure.

While writing, there came the mail intimating the publishing our latest paper in Zootaxa announcing a new species discovery- *Formicococcus tectonae*- a mealy bug seen in the burrows of and associated with the teak carpenter worm- *Cossus cadambe*. What would be their association? Would it help us in any way to manage the carpenter worm? Which funding agency can we approach to support this research? Questions never end. Taking forward every thread of research started four and a half decades before and adding new ones is the task here, thanks to the wonderful predecessor scientists who sketched the path with immense vision and creativity.

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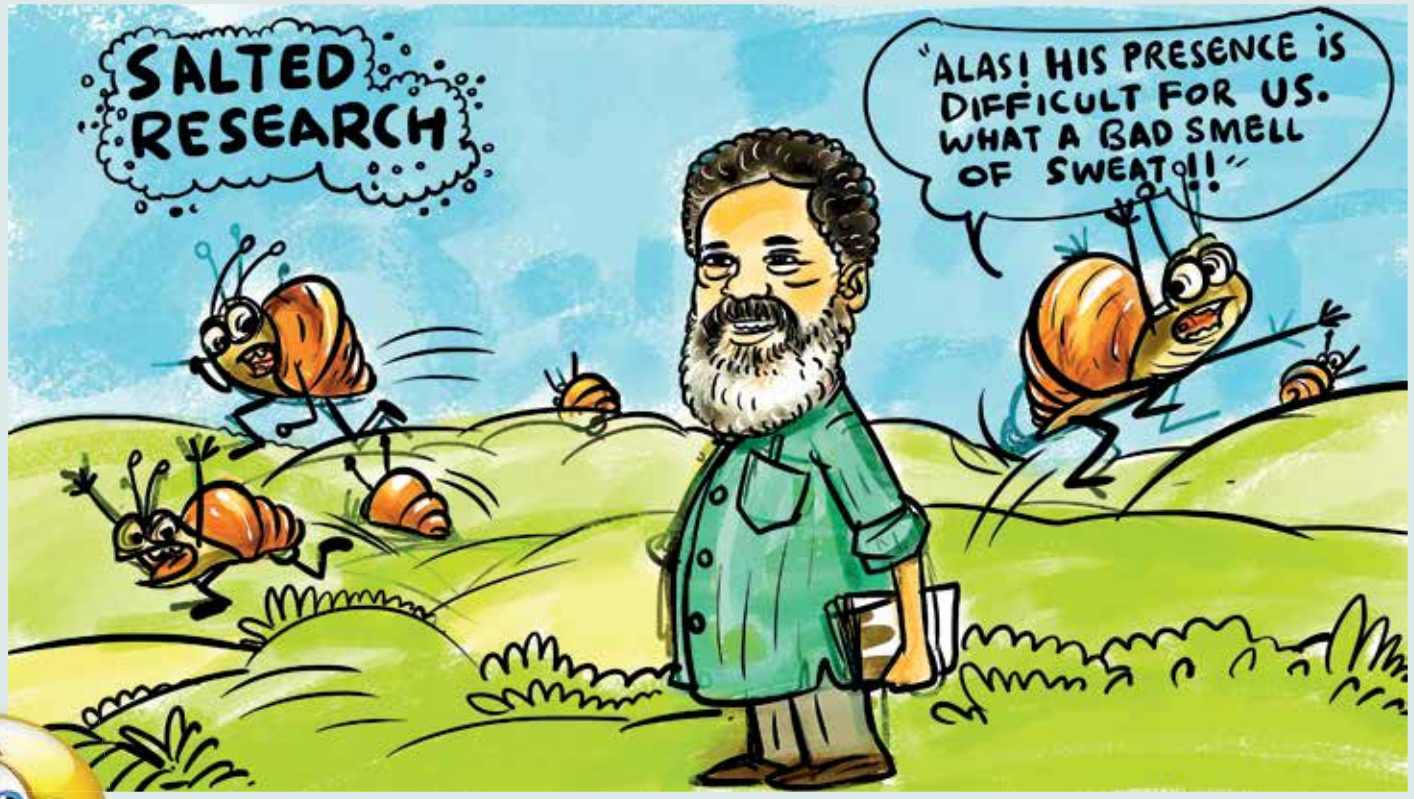

Concept: A.V. Raghu, Drawing: Sudheer P.Y.

KFRI Campus Tour

Forests may be perceived as a wonderful 'organism' at the top most scale of biological organisation of life in the natural world. We all have intently listened to numerous fairy tales about forests and their denizens in our childhood. They featured a kingdom ruled by lions, the elephant's majesty, the fierce power of the tiger, the melodious songs of bird, the deer's innocence etc. While we take an imaginative flight over the forests, we must also realize the roles that forests play in terms of diverse ecological functions on which the very foundation existence of life rests. If you are interested to gather more information on the wonderful forest life, you should definitely visit KFRI. The extension division at KFRI would help you to learn about the scientific importance of forests. This is rough sketch of what a typical guided visit to the KFRI campus would offer.


വനഗവേഷണത്തിലേക്ക് സ്വാഗതം

News feature published in Mathrubhumi Suppliment on 31 January, 2018

KFRI helps you to understand the life in diverse types of forests such as the mangrove forests located at the tidal marshes to shola forests located up to 2800-metre altitude besides the deciduous, evergreen and riparian forests.

The Forest Information Centre, set up close to the extension training division provides a glimpse of the diversity of forests and forest life in Kerala. At the onset of the guided tour, scientists at KFRI would explain the secret life of forests, their importance, trees, water, soil, and the research at KFRI as an introduction to your visit.

Soon after a visit to the Kerala Forest Seed Centre would enable you to learn about the seeds of a number of forest species. Researchers would demonstrate you the diversity of seeds and their unique survival strategies. You would be exposed to diverse and curious techniques followed for inducing seed germination. For instance, termites are allowed to eat the skin of the teak seeds, which helps teak seeds to break their dormancy and sprout; ironically, the termites are deterred from eating away the teak wood because it contains special natural oily chemical compounds. The vicinity of extension division with a modest collection of medicinal plants along a paved trail. The trail would provide you an opportunity to familiarise the medicinal plants such as *Centella, Karuka, Ocimum* and many other herbaceous plants that can be grown in our home. Most of these were abundant in our village trails before they disappeared due to our ignorance and lopsided land management practices.

Soon you would arrive at the Butterfly Garden by taking a walk through the forest trail which also would provide you a glance of bamboo nursery. In the Butterfly Garden, a variety of butterflies and their larval food plants can be familiarised. Larval food plants are the plants on which the mother butterflies lay eggs so that the hatched larva would devour the leaves of this plant to grow up and complete their life cycle by undergoing metamorphosis into an adult butterfly.

Our next destination is Department of Pathology, where one would familiarise world of fungi, from here we proceed to the Entomology Department, which conducts research on arthropods including insects and pests. This would lead you to the wonderful world of the most diverse tiny creatures in the world. There is a collection of insects in the department. This is a repository, which have accumulated samples from beginning of the Institute.

The Economics and Sociology departments provide an opportunity to realise the socio-economic benefits offered by the forests.

Next is our chance to learn about diverse wood resources showcased at the Wood Science department. The scientists in this department will answer to your queries on timber. The xylarium of Wood Science Department will help you to learn about the different types of wood found across the world. The department of wood science would also has much to offer, including available technologies on wood processing for industrial purpose and cost efficient use of wood fuel among others.

Dr. R.C. Pandalai (former Programme Coordinator, Extension Training Division) addressing the visitors

The researchers at the Wildlife Department is engaged in studying the behavioural pattern of wild animals. When we raise our hands in front of the elephant and call their attention, is the elephant actually seeing it? How far is the elephant's sight? How does Hornbill care for its familly? How does the tiger guard its border? All your doubts and more are addressed here. There is modest collection of preserved wildlife specimens from Kerala forests.

How do we scientifically improve the benefit flow from the major timber trees found in our forests? Why is it necessary to study genetics of the trees? The department of forest genetics and tree breeding will answer such questions.

It is only when we talk to researchers in the field of botany that we learn more about plant science and how important it is to know the forest. Plants can be used to recognise forest types. Thorny plants found in dry deciduous forests, the plant commonly called as oil of winter green (an ingredient in most pain balms) found in shola forest etc. are some of the examples.

If you are interested in understanding the influence of forests on the amount of rainfall, ecosystem services offered by forests and impact of global climate change, the researchers in the ecology department would be able to help.

KFRI library has a well-stocked open stalk, reference and digital sections on forestry and various other related research areas. The library also offers literature search service as per your requirements.

You may be aware of the life-sustaining role played by soils. However, you may not have had an opportunity to familiarise with different soils found in the forests of Kerala. The Soil Museum, set up by the Department of Soil Science will help you learn about the different soil types and their features. This is the first of its kind in India.

At the Biotechnology Department, you get an opportunity to know more about the how species differ one another at the DNA level and how this can be used in identification of species. Similarly, you may witness how scientists grow a whole plant from a tiny plant tissue at the culture lab at the department.

It is well known that the chemical compounds found in plants are the basis for its medicinal properties. At the sophisticated laboratory, you will be explained how the chemical profiling of a plant can be done using sophisticated analytical instruments.

At the Silviculture Division, it is possible to learn more about how a plantation of forest or still better a planted forest can be raised from scratch.

We are sure that your campus visit to KFRI will help you to perceive forest and nature in more details. We would like to see you here…

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പീച്ചിയിൽ KFRI യുടെ ഒരു ക്യാമ്പസ് ഉണ്ട്. തൃശ്ശൂർ വരെ പോയപ്പോൾ പീച്ചി ഡാം കണ്ടതിനു ശേഷം അവിടെ പോയി. ആദ്യം സെക്യൂരിറ്റി പ്രവേശനം നിഷേധിച്ചു. പിന്നെ വ്യക്തമായ ആവശ്യം പറഞ്ഞപ്പോൾ ഡോ. കെ. മോഹൻദാസിനെ കാണാൻ ആവശ്യപ്പെട്ടു. ജീവിതത്തിലെ മറക്കാനാവാത്ത ഒരു കണ്ടുമുട്ടലായി അതു പരിണമിച്ചു. രണ്ടു മണിക്കൂറിലധികം സമയം–അതിൽ ഒരു മണിക്കൂർ ഉച്ചക്കത്തെ ഒഴിവു സമയം ആയിരുന്നു–ഓഫീസിലിരുന്ന് സംസാരിച്ചു. റിമോട്ട് സെൻസിങ്ങിലെ വിദഗ്ധരെക്കുറിച്ചും സാദ്ധ്യതകളെക്കുറിച്ചുമാണ് ഞങ്ങൾക്ക് അറിയേണ്ടിയിരുന്നത്.

പേരുകളും ഫോൺ നമ്പരുകളും വിശദാംശങ്ങളും എല്ലാം തന്നു. പിന്നെ എങ്ങനെയാണ് ഈ ശാസ്ത്രജ്ഞരുടെ സേവനങ്ങൾ പ്രയോജനപ്പെടുത്തേണ്ടത് എന്ന്....തുടർന്ന് KFRI കാമ്പസിനെക്കുറിച്ചും പ്രവർത്തനങ്ങളെക്കുറിച്ചും പറഞ്ഞു. ഞങ്ങളുടെ സ്ഥാപനത്തിന് എന്തൊക്കെ സേവനങ്ങൾ അവിടെ നിന്ന് ലഭ്യമാകും എന്ന്....

തുടർന്ന് മണ്ണിനെക്കുറിച്ച് ...മഴയെക്കുറിച്ച് ...വനത്തെക്കുറിച്ച് ... മരത്തെക്കുറിച്ച്... പൂവിനെക്കുറിച്ച്... പൂമ്പാറ്റയെക്കുറിച്ച് വെള്ളത്തെക്കുറിച്ച്.... ആ ശാസ്ത്രജ്ഞൻ സംസാരിച്ചു. ഇതൊക്കെ എത്ര വേദികളിൽ കേട്ടു....

പക്ഷേ, ഈ മനുഷ്യൻ, ഈ ശാസ്ത്രജ്ഞൻ, പറയുന്ന ഓരോ വാക്കിലും അയാളുടെ ഹൃദയം നനവോടെ കുടിയിരിക്കുന്നുണ്ട്. ആ വാക്കുകൾക്ക് ലാളിത്യവും സ്നേഹവും ചേർന്ന് ഒത്തിരി സൗന്ദര്യം ചാർത്തിയിരിക്കുന്നു. സകല പ്രകൃതിയോടും ജനിക്കാനിരിക്കുന്ന തലമുറകളോടും ഉള്ള നനുത്ത സ്നേഹം ചാർത്തിയ സൗന്ദര്യം!

ഉച്ചയൂണിനു ശേഷം അദ്ദേഹം ബട്ടർഫ്ലൈ ഗാർഡൻ കാട്ടിത്തരാൻ കൂടെ വന്നു.നടവഴിയിൽ ഇളകിക്കിടക്കുന്ന ഒരു പേവിങ് ടൈൽ അദ്ദേഹം മെല്ലെ ഉയർത്തി നോക്കി. ടൈലിനെ തള്ളിയുയർത്തിയ മുളം വേരുകൾ കണ്ടപ്പോൾ ആ മുഖത്ത് വാത്സല്യമൂറുന്ന ഒരു പുഞ്ചിരി... വേരുകളെ ഒന്നു തലോടി... യാത്ര തുടർന്നു. പൂമ്പാറ്റപ്പൂങ്കാവനത്തിലെ ഓരോ ചിത്രശലഭത്തെയും പരിചയപ്പെടുത്തിയത് കുടുംബാംഗങ്ങളെയെന്ന പോലെ... അവയുടെ ജീവിത ചക്രവും ശാസ്ത്രവും വിശദീകരിച്ചത് കൊച്ചുമക്കളുടെ കൃതിയെക്കുറിച്ചു പറയുന്ന വാത്സല്യനിധിയെപ്പോലെ.... മീനുകൾക്ക് അന്നം നല്കുക. ചെടികൾക്ക് താങ്ങാനാവുന്നതിൽ അധികമുള്ള പുഴുക്കളെ നീക്കി.... പണിക്കാരോട് പുഞ്ചിരിയും സ്നേഹാന്വേഷണങ്ങളും കൈമാറി....ഇടയ്ക്ക് ചില സസ്യങ്ങളുടെ ഔഷധ ഗുണത്തെക്കുറിച്ചു പറഞ്ഞു. വിജ്ഞാനം വിഷയസീമകളിൽ ഒതുങ്ങാതെ പരന്നൊഴുകുന്നു; ഒത്തിരി ആഴത്തിൽ, ഓളവും നുരകളുമില്ലാതെ ശാന്തമായി...

അവസാനം സാന്ദർഭികമായി മാത്രം പറഞ്ഞു: ഈ മനുഷ്യൻ വിരമിക്കുകയാണ്, വെറും ഒന്നര മാസം കഴിഞ്ഞാൽ....വിജ്ഞാന ശാഖയോടുള്ള തീവ്രപ്രണയം, വാക്കിൽ നെഞ്ചിന്റെ നേരുനിറച്ചു ചേർത്ത അറിവുകൾ...അറിവ് തിരിച്ചറിവായും ബോധ്യമായും വളർന്നാൽ മാത്രം സാദ്ധ്യമാകുന്ന ആഴമാർന്ന ശാന്തത ...

എത്ര വാക്കുകളിൽ ഞാൻ വിവരിക്കും, ഡോ മോഹൻദാസ് എന്ന പീച്ചി KFRI എക്സ്റ്റൻഷനാഫീസറായ ശാസ്ത്രജ്ഞനെ?

മനസ്സിൽ ഒന്നു കുറിച്ചിട്ടു: "KFRI ഏറെ നല്ലത്. പക്ഷേ ഡോ. മോഹൻദാസ് എന്ന പാഠപുസ്തകം ഇവിടെ തുറക്കാതാകുന്നതിനു മുമ്പ് ഇനിയും ഇവിടെ വരണം–കഴിയുന്നത്ര സുമനസ്സുകളായ കുഞ്ഞുങ്ങളെയും കൂട്ടി..."

ഗൗരവമുള്ള അറിവ് അർപ്പണബോധത്തോടെ വിനീതമായ മനസ്സിൽ കുടിയിരിക്കുന്നത് ഇന്ന് അത്ര സാധാരണമല്ലല്ലോ ....

ബിനോ പി ജോസ്

അസി. പ്രൊഫ. സെന്റ് ഡൊമിനിക് കോളെജ്, കാഞ്ഞിരപ്പള്ളി.

ജൂൺ 20, 2016

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Letter from a visitor

Centre for Analytical Instrumentation – Kerala (CAI-K)

Hon. Chief Minister of Kerala, Sri. Pinarayi Vijayan inaugurating CAI-K on 8th November, 2018

Analytical techniques play an indispensable part of chemical and biological research in recent times. The major hurdles faced by students and academician's are availability of sophisticated instruments as well as its proper usage and data deciphering. CAI-K provides sophisticated analytical testing and research-based analysis to support Academic Research, Industrial Research, Quality assurance and Quality Improvement of process. The lab offers comprehensive analyses of soil, water, plant extracts and other natural products. The CAI-K facility is also designed to cater to the development of human resource requirements on analytical instrumentation through workshops, training programmes and short-term certificate courses. The basic objective is to satisfy the needs of science and research departments of universities, academic institutions and industries by providing high quality training in sophisticated analytical instrumentation facilities.

Considering it's importance and contributions, the facility included as a part of "impactful projects" of Hon'ble Chief Minister of Kerala.

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KFRI Arboretum

The KFRI Arboretum is a living laboratory, including trees, lianas which acts as *an outreach, teaching, and research facility dedicated to preserving the beauty and ecological functions of our biodiversity hotspot.* Located on the main campus, it was developed during 2003-2008 in an area of about 5 hectares. The present holding of the Arboretum is 3200 accessions belonging to 178 species under 50 families and 128 genera, with more than 50 taxa endemic to southern Peninsular India. AThe Arboretum promises to be a rewarding experience to visiting students especially biology students. One of the interesting features of KFRI arboretum is the collection of *Myristica swamps*, the evergreen, water-tolerant trees considered as the most primitive of the flowering plants or "*living fossils*" on earth.

***Myristica* swamps in KFRI** Arboretum

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KFRI Palmetum

Palms are woody monocotyledons coming under the family Arecaceae (Palmae). They form a vital component of the forest ecosystem. With their graceful architecture, palms often dominate the landscape of tropical habitats, providing many of the essentials for human life. Palms have been managed by the local inhabitants for food, fodder, handicrafts, thatch and construction material. Because of their aesthetic value, palms are cultivated for both indoor and outdoor decoration. There are about 2600 species of palms under 200 genera in the world. In India 105 species under 22 genera occur in the three major geographical regions viz., Peninsular India, North eastern India and Andaman and Nicobar Islands. Although conservation and sustainable utilization of this resource assumes great importance, conservation attempts have not received significant worldwide attention. Palmetum is a live collection of indigenous and exotic palms, which serves as a facility for educating the public about the need for conservation of palms. KFRI

Palmetum was established in Peechi Campus in 2000 which contains 145 species of palms under 52 genera. Of these, 80 are indigenous palms and 65 are exotic species with 8 species are Critically Endangered, 9 Endangered, 8 Vulnerable and 23 Near Threatened categories as per IUCN standards. The exotic species include those which are commonly found in Indian parks, gardens and along avenues.

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KFRI herbarium

The Kerala Forest Research Institute (KFRI) herbarium was established in 1982 and is recognized by the International Association of Plant Taxonomists (IAPT), and is known by the acronym KFRI by Index Herbariorum (Taxon 37: 503. 1988). Presently, the herbarium holds over 15,000 specimens representing more than 2300 species from 203 families. It holds a wide collection of medicinal plants from South India and a Pan Indian collection of rattans, palms and bamboos including those from the Andaman and Nicobar Islands. To facilitate access to the KFRI herbarium collection, a database has been prepared that includes information presented on the herbarium specimen label, such as species name, author citation, subspecies if any, family, collection number, location, date of collection, habitat and name of collector. Herbarium specimens were digitized using Canon PowerShot G9 camera fixed on an imaging station and high-resolution images (12.1 megapixels) thus obtained were stored in TIF format. Images have been edited and a standard scale is provided. A website was developed (www.kfriherbarium.in) using standard open-source softwares such as Apache, a web server MySQL, a database system, and PHP, a scripting language. The website provides search interface with provision to search for different parameters of herbarium. Plant taxonomic data are stored in the database that allows rapid indexed search. High-quality digital images are stored as separate files for greater efficiency in magnifying and are displayed using advanced graphics.

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Wildlife Museum

Dr.B. Sandhya IPS, visiting wild life museum

The Wildlife Museum in the Department of Wildlife Biology of KFRI is formally established in 2013. The specimens kept in the Wildlife Museum was never collected intentionally for display in the museum. Starting from 1978, when the scientists started their field work in different forest areas of the State, they collected the dead specimens intended for scientific studies and kept as a wet collection. At present, the Wildlife Museum holds more than 800 specimens collected from various forest areas and reservoirs in the State of Kerala which is a valuable source of study material to the researchers. This include about 120 species of fish, 35 amphibians, 87 reptiles including 50 snakes, 16 species of mammals and several stuffed specimens, collections of wildlife footprints and several invertebrates. The Wildlife Museum is one of the popular destination in KFRI with over 3000 visitors annually, including trainees from the forest department and students from various universities and colleges across India.

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KFRI Library

KFRI Library functions as a full-fledged resource centre on tropical forestry and as a special repository of literature on teak, bamboo and rattan. It also functions as the national level Bamboo Information Centre.

KFRI library with a core collection of 17,500 books and 10,000 back volumes of journals on forestry and allied subjects caters to the information requirements of scientists and research scholars of the Institute and others who are interested. The library collections include many of the valuable reference books, doctoral theses, publications of national and international bodies like Forest Research Institute (FRI), APAFRI, IRGWP, IUCN and IUFRO and databases in CDs and DVDs. Digital collections of the library include 550 research reports, 2000 scientific papers and other documents published by KFRI scientists, which is possible to access through the Intranet library portal developed for the purpose. Digital resources of the library include KFRI Information Bulletins, Ph D theses, Annual Reports and all the published issues of the Evergreen - KFRI Newsletter. Collections of Ebooks, Eprints, Indian Forest Records and Bulletins and

the collections of bamboo, teak and cane literature. Online access to many of the national and international core journals in forestry and allied subjects is available in KFRI library. Also has the access to CABI Abstract database, Ebsco Environmental database, Scopus, IndianJournals.com and J Store.

Anyone can refer KFRI library on all working days without membership.

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Xylarium

Xylarium is a collection of well-curated authenticated wood specimens which is mainly intended to display collection of wood specimens for scientific research, teaching, environmental education and other programmes. KFRI xylarium was established in 1979, and has a collection of 587 specimens (133 samples representing 68 genera and 114 species from India and the rest from 10 foreign countries. The xylarium database has detailed, species name, original wood specimen number, date of collection, collectors(s) name, herbarium number of the voucher specimen, country, altitude, latitude, longitude, habit, habitat, note on collection or accession etc., For each wood specimen, there is a corresponding voucher herbarium specimens deposited at KFRI herbarium with accession number. The dimension of xylarium sample is 10 x 6 x 1 cm for small specimens and 16 x 10 x 2 cm for large specimens. The KFRI xylarium is represented samples from other countries like Australia, Bangladesh, Brazil, Canada,

China, Germany, Japan, Netherlands, Philippines and UK is also indexed in Royal Botanic Garden, Kew in its Index Xylariorum (KFRIw)

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Central Nursery - KFRI

The Central Nursery is located in the main campus, Peechi. The nursery has a collection of quality planting materials of around 150 species, especially of native trees having high demand under timber yielding, fruit bearing, medicinal and endemic categories. The nursery guarantees the timely availability of planting material to the farmers, general public and various government departments. In addition to the above aspects, the nursery is engaged in handling a number of rare and threatened plant species from Western Ghats associated with many research programmes conducted by the Institute. Establishing the nursery techniques of different forest tree species in association with KFRI Seed Centre is the other major task of the Central nursery. The data generated in the nursery is used in the ongoing research programmes and is useful for all future research as well.

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Kerala Forest Seed Centre (KFSC)

Kerala Forest Seed Centre (KFSC), established in 2003 is a collaborative venture of Kerala Forest Research Institute (KFRI) and Kerala Forest Department (KFD). It is located in the KFRI main campus at Peechi. The main objectives of the KFSC are to collect, process, store, certify and supply seeds of various forestry species to the stakeholders as per ISTA standards. Apart from this, KFSC conducts research programmes on seed handling techniques and storage technology, impart technical support on improvements/ amelioration measures for existing seed stands, etc. Since its inception, KFSC has provided about 300 tonnes certified seeds of forestry species. Moreover, seed handling information of the major species were provided to the stakeholders within and outside the State. Apart from the general facilities on seed testing and processing, KFSC has other facilities such as cold rooms with various storage temperature, especially for the recalcitrant seeds.

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Seed grading at seed centre

Insect Repository

KFRI has a well maintained Insect Collection Museum under the Entomology department with 40,483 insect specimens collected during the past three decades. The main objectives are to prepare a data base of identified insects in the collection for easy information retrieval, to prepare an inventory of species in the collection and curation of the insect collection. Major groups represented are Lepidoptera, Coleoptera, Hymenoptera, Diptera, Odonata, Orthoptera and Hemiptera.

We also receive identification requests from students and researchers from various colleges and institutions that are being addressed. To prevent damage of specimens regular fumigation of the collection is being done. Among the specimens, Order Lepidoptera has the largest representation followed by Coleoptera and Hymenoptera. A total of 4585 insect species are unidentified. The longest insect, Stick insect belonging to the Order Phasmatodea, largest butterfly in Asia, Southern birdwing (Papilionidae), and largest moth,Atlas moth (Saturniidae) etc are maintained in the museum.

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A retrospective of the Bioresources Nature Park

The Western Ghats region of India is one of the hotspots of biodiversity in the world with rich plant and animal diversity, and some species are endemic to the region. Conservation of such vast biological resources for the future, while continuing to utilize them to meet the present needs, is really a challenging task. In this context, apart from reduction of habitat loss and in-situ conservation of flora and fauna, *ex-situ* conservation of unique plant and animal wealth of the region as well as education and awareness on biodiversity conservation, management and sustainable utilization are significant. With this background, during the year 2004, with the initial financial support from Department of Biotechnology, Government of India, the Kerala

Forest Research Institute began to establish a Bioresources Nature Park (hereafter, BNP), adjacent to the adjacent to the world famous Teak Museum located at its Sub Centre at Nilambur (76^0 15' 28" E longitude and 11^0 18' 14" N latitude). The specific objectives of the proposed Bioresources Nature Park were to serve as a place for assembling a live collection of different taxonomic group of plants and as a platform for promoting nature education.

For the Establishment of BNP, around 10 ha area in the Campus was selected. Weeds, flowered and dead bamboos, fallen tree debris etc., spread all over the chosen area have been removed and undertaken the establishment works.

It was decided to develop initially following theme areas in the BNP for assembling the plants and thus construction works have been initiated.

1	Orchid House
2	Fern House
3	Xerophytes and succulents House
4	Hydrophytes Garden
5	Butterfly Garden
6	Medicinal Plant Garden
7	Palm Garden

The plant specimens were either collected from natural forests/ponds or procured from collections of other research institutes or bought from commercial nurseries. They have been categorized and presented in already mentioned theme areas, such as, Orchid House, Fern House, Xerophytes and Succulents House, Medicinal Plants Garden, Palms and Rattan Garden and Hydrophytes Garden, and two new theme areas, such as, Taxonomic Garden and Butterfly Garden.

Orchid House

Orchids are the floral aristocrats of the flowering plant world. They form the largest group among plant families and represent highly evolved plants with most complicated flower structure. The Orchid

House with more than 70 species, representing both epiphytic and ground orchids, is a floral paradise in the Bioresources Nature Park.

Daily, the visitors here have an opportunity to see a variety of orchids in different stages of bloom and growth. One can also get familiarized with less common and endemic orchids like *Aerides crispa*, *Bulbophyllum rosemarianum*; medicinal orchids like *Flickingeria nodosa, Nervilia aragoana, Spathoglottis plicata*; commercially important orchid like *Vanilla planifolia* and the prettiest orchid in South India - *Rhynchostylis retusa*

Aside from its flora collection, the Orchid House mesmerizes the visitors with its crystalline water cascade and mystic misty atmosphere and with a floral diagram, drawn using live plants which adds to the information content and beauty of the Orchid House.

Fern House

Ferns are the flower-less, seedless, spore-producing vascular plants with feather-like fronds. They are the first true land plants- the dinosaurs of the plant world. Their ancestors are the source of fossil fuels such as coal and oil that we burn today. The Fern House in the Bioresources Nature Park contains about 75 species of plants which grow in terrestrial (eg. *Selaginella*, *Adiantum*), aquatic (eg: *Azolla*, *Salvinia*) or xerophytic (eg: *Actinopteris*) habitats. In this Fern House, one can also see endemic ferns like *Bolbitis semicordata, Helminthostachys zeylanica*; rare and endangered ferns like *Angiopteris evecta*, *Equisetum ramosissimum*; and species with ornamental values such as *Huperzia phlegmaria, Microsorum punctatum* and *Davallia fejeensis*. The ferns are displayed along paths inside the plus-shaped house, which is provided with shade, sprinkler and mist facilities for their luxuriant growth.

Xerophytes and Succulents Garden

Xerophytes are plants that are adapted to live in dry or desert condition. They achieve this by reducing transpiration and increasing water storage, modifying plant parts into structures like thorns, and growing normally during early hours and cooler seasons. Xerophytes can be of different types, namely, drought escaping, drought enduring or drought resistant plants. Succulents (eg: Opuntia, Aloe,) are plants that have highly developed and specialized ways of storing water. This water stored in leaf, stem or root produces a wide array of swollen appearance to plant parts, and is consumed during period of extreme drought. Non-succulents (eg: Casuarina, Nerium), however, are drought resistant plants which do not have any water storage tissue, but are able to withstand critical dry conditions.

This Xerophytes and Succulents Garden in the Bioresources Nature Park is designed to exhibits live plants adapted dry and drought conditions. The Garden has an outdoor landscape rocky mound and a green house to display medicinal (eg. *Aloe vera*, *Cissus quadrangularis, Sarcostemma acidum*, *Asperagus racemosus*), ornamental *(eg. Echinocactus grusonii, Echeveria glauca, Agave angustifolia, Pandanus sanderi, Opuntia decumbens*), bio-fence (eg. *Agave americana, Bryophyllum pinnatum, Opuntia dillenii*) and bio-fuel (eg. *Jatropha curcas*) species.

Medicinal Plant Garden

The Medicinal Plant Garden is an assemblage of around 500 species of plants, many of which are mainstay drug-producing, whose products such as alkaloids, glycosides and steroids are used in clinical practice around the world. The Garden functions as an educational display and source of information to the visitors on conservation, management and sustainable utilization of medicinal plants. The pathways which crisscross this formal style garden provide easy access for visitors to examine the labeled plants including some rare species like *Acorus calamus, Baliospermum montanum, Coscinium fenestratum, Cymbopogon flexuosus, Embelia ribes, Gloriosa superba, Nilgirianthus ciliatus, Rauvolfia serpentina, Terminalia arjuna, Terminalia bellirica, Terminalia chebula, Trichopus zeylanicus* and *Zingiber zerumbet*. In addition, this Garden, with several medicinal plants which have aesthetic value, forms a model for developing urban green spaces using

medicinal plants.

Nakshatra and Rashi Garden

In Indian culture, every Nakshatra (Star) and Rashi (Zodiac sign) has a symbolic tree or plant that defines its connection with the eternal nature. These plants also have myriad medicinal, aesthetic, cultural, social and economic values. It was a tradition in our country that when a baby is born, parents plant a seedling of the tree of the child's Nakshatra/ Rashi. The tree will be nurtured with a belief that the better the growth of the tree the more health and happiness to the child.

In the Nakshatra and Rashi Garden of this Bioresources Nature Park, plants associated with 27 Nakshatras and 12 Rashis are planted and in front of each plant, a board depicting the details including medicinal use/s of the plant is displayed. The intension of this Garden is to popularize the concept of Nakshatra and Rashi Garden to promote cultivation, management and utilisation of medicinal plants.

Palms and Rattan Garden

Palms are the 'prince among plants' and stand next to grasses in the socio-economy of the human race apart from their significant contribution to beautify the landscapes as horticultural ornamentals. The Palm Garden in the Bioresources Nature Park contains rare and endangered species like *Arenga wightii* and *Pinanga dicksonii* along with many other palms of great economic significance, such as, *Areca catechu*, *Phoenix sylvestris* and *Borassus flabellifer*. Besides, over 40 ornamental palm species popularly known as Royal palm, Queen palm, Majesty palm, Table palm, Shampine palm, etc. growing in the garden also attract the visitors Rattans, a group of climbing and spiny palms are represented in the garden with rare and endemic species like *Calamus vattayila* and *Calamus nagbettai*.

Hydrophyte Garden

Hydrophytes literally mean water-plants. The Hydrophyte Garden in this Bioresources Nature Park is an assemblage of more than 50 species which represent different forms such as floating hydrophytes (eg: *Azolla pinnata*, *Salvinia molesta*), submerged and rooted hydrophytes (eg: *Hydrilla verticillata*, *Ottelia alismoides*), floating leaved, anchored or rooted hydrophytes (eg: *Nymphaea omarana*, *Trapa natans*) and emergent rooted hydrophytes (eg: *Bacopa monnieri*, *Monochoria vaginalis*). The garden is developed not only for educational purposes, but also for the enjoyment to the visitors by having scores of magnificent water-lilies and lotus in various stages of bud and bloom. Among the featured plants are the sacred lotus *(Nelumbo nucifera)*, immortalized in literature, religion and history for its purity of bloom. The visitors can stroll down a winding walk to see interesting water plants.

Taxonomic garden

Taxonomy is the science of naming, describing and classifying organisms on the basis of shared characteristics. The term is derived from the Greek *taxis* ("arrangement") and *nomos* ("law"). Organisms are grouped together into taxa (singular: taxon) and these groups are given a taxonomic rank; groups of a given rank can be aggregated to form a super-group of higher rank, thus creating a taxonomic hierarchy. The knowledge on taxonomy is important to appreciate the rich biological diversity present in our region and to take collective decision to conserve, manage and sustainably use the bio-resources. Recognizing the importance of taxonomy in fields like biological diversity, medicine, horticulture, agriculture and plantation, this Taxonomic Garden of flowering plants is established to introduce basics of taxonomy to the visitors. In this Garden, over 1,000 flowering plants belonging to about 120 families are planted. Plants belonging to different families are arranged in separate blocks. In front of each family block, a board providing information on family characters, floral formula, total number of species of the family seen in Kerala, endemic, rare, endangered and threatened species in the family is installed.

The visitors can stroll down a winding walk to view interesting plants in each flowering plant family. .

Butterfly Garden

Butterflies are scaly winged insects (Lepidoptera) with fascinating life-cycles. The transformation from egg to caterpillar to pupa is one of the wonders of nature. This Garden is designed to attract butterflies and enthuse them to live here. This is achieved by planting larval and adult host plants and a subtle modification of the habitat. The juvenile or caterpillar stage of butterflies feed on foliage of specific plants. The adult (butterfly) feeds on nectar or sap of over-ripe fruits and sappy exudations from plants. Some adults even feed on the fluid content of excreta of animals and birds. Nectar plants such as *Ixora coccinea*, *Lantana camara*, *Clerodendrum paniculatum* and *Zinnia elegans*; larval host plants such as *Murraya koenigii*, *Mussaenda frondosa*, *Aristolochia indica* and *Wattakaka volubilis*; and butterfly roosting plants such as *Crotalaria retusa* and *Heliotropium keralense* are introduced in this garden. The common butterflies present here are Common Mime, Common Rose, Crimson Rose, Lime butterfly, Blue Mormon, Southern Bird-wing, Glassy Tiger Blue, Blue Tiger, Dark Blue Tiger, Emigrants and Grass Yellow. In this Garden, visitors can look out for not just the adult butterflies, but also for the diverse forms of eggs, caterpillars and pupae of a variety of butterfly species.

By having a rich plant diversity assembled in above mentioned theme area, this Bioresources Nature Park is now developed as an ex-situ plant conservation area and an important nature education and ecotourism hub in Kerala. The increasing trend of annual visitors is also indicating that the visitors have acknowledged the educational and recreational value of the Bioresources Nature Park. For intensifying the educational role of Bioresources Nature Park, the Kerala Forest Research Institute is aiming to organize more educational programmes from the perspective of biodiversity conservation, ecology, economic botany, horticulture, ethno-medicine and ethno-botany and other allied subjects.

Visiting time: 10.00 am to 5.00 pm (Monday- Holiday)

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Teak Museum

Teak, scientifically called *Tectona grandis* L.f. (Family: Lamiaceae) is considered as a grand jewel in the diadem of tree species that occur naturally in the tropical forests of the world. Teak also became an important plantation species and many of the milestone developments in the history of teak plantations took place in Kerala, India. Nilambur, located in Malappuram District of Kerala State is the place where India's first Teak plantation was raised during the 1840s, paving the way to ensure the steady supply of teak timber in the face of dwindling resources in the natural forests. Recognising the historical importance of Nilambur leading to a momentous shift from a purely extraction and regulatory function of forestry to a phase of resource development, Kerala Forest Department (KFD) and Kerala Forest Research Institute (KFRI) have decided to establish a thematic Museum, devoted entirely to the unique species – Teak, which produces the world's most ideal timber that can be put to almost any conceivable use from handicrafts to building ships. The Teak Museum located within campus of Kerala Forest Research Institute Sub Centre at Nilambur was opened to the public on 21st May 1995. The Museum is ideally located in Nilambur where the plantation activities on this species were initiated about 160 years ago. Also, the Museum is situated very close to the oldest existing teak stands – the famous 'Conolly's Plot'. The Museum is the first of its kind in the world and aims at disseminating information on various aspects of teak, including history, cultivation, management, utilization, socio-economics, etc.

In the Museum, through exhibits and associated texts, information is provided on historic, aesthetic, scientific and cultural values of the species. Exhibits of historic and artistic values are displayed on the ground floor, while the first floor is mostly devoted for exhibits and information of scientific nature.

The extensive root system of a 55- year- old teak exhibited in the portico is symbolic sign welcoming the visitors to witness the past, the present and the future at the museum. In the ground floor of the

double-storied museum, a translite of `Kannimara teak', the oldest naturally growing teak tree located at the Parambikulam wildlife sanctuary and the life-size replica of the trunk of the largest known teak tree growing in Malayattoor forest division are exhibited. A translite of a giant tree present in the oldest teak plantation in the Conolly's Plot at Nilambur helps visitors to visualise the teak plantation activities initiated 160 years ago. The foliage, flowers, fruits and bark of tree are depicted in one bay. Juxtaposed is a large stump of 480-year-old teak tree brought from Nagarampara Forest Range in Kottayam Forest Division.

The first floor of the Museum is devoted to display of scientific information and related exhibits on various aspects of teak. It starts with detailed information on flower, seed and natural regeneration. The characteristics of plus trees (morphologically superior tree as compared to nearby trees) are also described. Seed grading and pre-sowing treatment for better germination of the seed are also depicted. Two methods adopted for vegetative propagation in teak viz., tissue culture and clonal propagation are presented with the help of translites. The adjoining bay shows stages in the complete rotation cycle of teak from seed to a mature tree. Also present are a collection of over 300 butterflies, moths and insects found in teak plantations. Series of paintings on tree felling operations, collection of photographs depicting the phenological events of teak at different seasons, exhibits on traditional harvesting tools, wood samples of different ages from different parts of the world are also special attractions in the museum.

Portraits of great men behind the successful establishment of teak plantations as well as those who have sown the seeds of plantation forestry in India like H. V. Conolly, Chathu Menon and T.F. Bourdillion, take the visitors to a magnificent era 150 years back. The museum also has a world class library on teak and a mini auditorium for audio visual presentations. A Teak Information System (Touch Screen facility) in the Museum also helps the visitors to get information on various aspects of teak tree such as its habit and distribution, history, morphology, cultivation, harvesting, timber, utilization etc.

Dr. Sani Lukose addressing the Teak Study Trainin Programme

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മെട്രോ മനോരമ

2018 ഫെബ്രുവരി 20 ചൊവ്വ 1193 കുംഭം 08

മുള വൈവിധ്യങ്ങളുടെ ശേഖരവുമായി വേലൂപ്പാടം
പാലപ്പിള്ളിയിലെ വനം ഗവേഷണ കേന്ദ്രത്തിന്റെ പ്രാദേശിക കേന്ദ്രവും മാതൃകാത്തോട്ടവും

പാലപ്പിള്ളിയുടെ 'മുള' അഴക്

സുജിൻ മാത്യു തോമസ്

മുളകൊണ്ടുള്ള കരകൗശല ഉൽപന്നങ്ങൾ തയാറാക്കുന്നവർ

• തദ്ദേശീയ വനവാസികളുടെ സംരക്ഷിത മേഖല

• മുള സംരക്ഷണ ശാസ്ത്രീയം.

• ഈറയുടെ ജനിതകശേഖരം.

• പ്രകൃതി സംരക്ഷണത്തിൽ പങ്കാളിയാവാം

മുള പ്രാദേശിക കേന്ദ്രം

News feature published in Malayala Manorama Daily on FRC Palappally

Field Research Centre, Palappilly

Field Research Centre of the KFRI located at Palappilly, about 20 kilometres from the district headquarters at Thrissur, offers basic field experimental facilities needed for research programmes at the Institute. Apart from this, the Centre functions as a resource centre for bamboo with a bamboosettum with a collection of over 70 species of bamboos from across India and south Asia. A bamboo processing centres equipped with machineries for bamboo working has been helping willing members of the local communities in their skill upgradations in bamboo working. The FRC also has an arboretum of endemic plants of the Western Ghats and a collection of reed bamboos. The bamboo nursery along with the forest nursery at the Centre caters the needs of the small and medium farmers who takes up farm forestry and bamboo planting.

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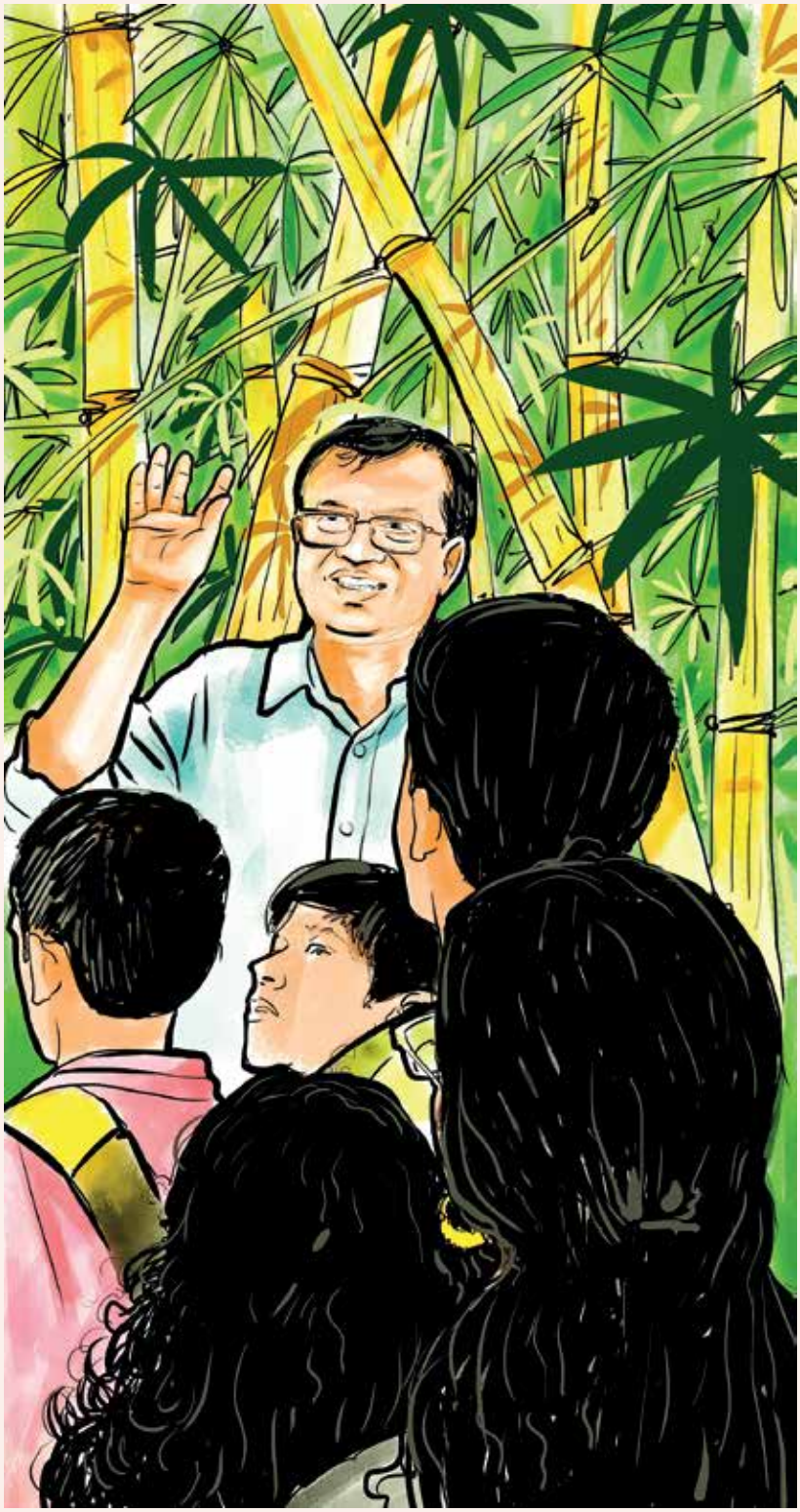

Dr. Syam Viswanath, Director, KFRI, addressing the visitors at FRC on Bamboo Day (*Illustration*)

Field Station, Devikulam

The field station at the Devikulam is located in the high ranges of Idukki district and offers a subtropical bio-climate. There is modest facilities for carrying out field-based experiments, which are to be conducted in the subtropical weather situations. Earlier, the field station has facilitated large-scale production of eucalyptus clones for the Kerala Forest Department. With the modest camping facilities available here, the field station is hub of a number of field-oriented studies for the researchers of the KFRI programmes.

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Field Station, Kottappara

The Field Station at the Kottappara is about 25 ha. and located in the Kodanad Forest Range of Malayattur Forest Division. It has facilities to establish nurseries of forest trees for raising large-scale experimental plantations. Large number of seedlings of the cultivars of eucayptus, albizia, acacia were raised here in the past. Currently, the field station has plantations of clonal propagated eucalyptus species and plus trees of teak selected from forests of Kerala. Besides, the Station facilitates the field experimental components of many ongoing research programmes of KFRI.

Scientist-in-charge, Field Station, Kottappara, Ernakulam, *drhrideek@gmail.com,*

Tree Health Helpline

Established in 2009, the Tree health helpline is the single window of KFRI for all issues regarding trees. The services offered include site selection, soil testing, fertilizer recommendations, pest, disease and weed management, multi-species planting matrices, landscape afforestation, preparation of health cards for avenue trees, tree/wood sample identification, preservative treatments for wood and economic evaluation. Site visits and recommendations are free within Kerala.

First Question

On the occasion of the National Science Day 2019, KFRI has launched First Question- a dedicated Helpline for answering questions children ask about nature. First Question was launched by Dr. Haridasan, former Director FRLHT. Dr. Syam Viswanath, Director, KFRI presided over the function.

The Helpline is in response to the fact that children ask a large number of unique questions which are rarely answered to their satisfaction. Till date, we have received over a thousand calls from 14 different states of India. The questions raised by the callers covered basic sciences, astronomy, philosophy and theology. Various age groups of different backgrounds have been utilizing this platform to get answers to their previously unanswered queries.

Telephone: **0487 2690 222;** *Email:* **helpline.kfri@gmail.com**

KFRI QUICK GLANCE AT THE ACHIEVEMNTS IN 2018 – 2019

PROJECTS

International	- 2	(171.06 lakhs)
National	- 31	(793.37 lakhs)
State Funded	- 16	(457.61 lakhs)

PUBLICATIONS

Research Papers	- 38
Books	- 10
Journals	- 01

SEMINARS ORGANIZED - 10

EXTENSION & TRAINING PROGRAMME ORGANIZED - 30 (205.48 lakhs)

VISITORS/CONSULTANCY/SALES - 190493 (197.75 lakhs)

Ph. D STUDENTS - 35

Hon'ble Chief Minister of Kerala, **Shri. Pinarayi Vijayan** is delivering the inaugural address during the inauguration of Centre for Analytical Instrumentation-Kerala (CAI-K), at KFRI on 08 November 2018 in presence of Shri. CN Jayadevan, MP, Thrissur, Adv. K Rajan, MLA, Ollur, Shri. MC Dathan, Scientific Advisor to CM, Dr. S Pradeep Kumar, Member Secretary, KSCSTE, Dr. Syam Viswanath, Director, KFRI and other elected members and officials.

Hon'ble Minister for Forests, Animal Hus., Dairy Dev. and Zoos, **Shri. Adv. K. Raju** inaugurating the Hostel Complex for Women Researchers, at KFRI on 02 March 2019 in presence of Shri. CN Jayadevan, MP, Thrissur, Adv. K Rajan, MLA, Ollur, Dr. Syam Viswanath, Director, KFRI and other elected members and officials.

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