KFRI EVERGREEN

Half Yearly Newsletter of the Kerala Forest Resarch Institute, Peechi

No.49 September 2002

From the Director's Desk

Conservation and management of tropical forests and economic development

Many of the environmental problems challenging human society are fundamentally ecological in nature. The growing human population and its increasing use and misuse of resources are exerting enormous pressure on the Earth's life support capacity. We have to develop a strrong knowledge base to conserve and manage wisely the Earth's natural resources, especially the tropical forests without disturbing the environment.

Because economic development is needed to satisfy societal needs, many analyses have focused on these paradigms to solve environmental problems. But these economic development paradigms do not fully address the negative impacts on the biosphere. One of the best examples of this today is the tropical regions of the world. Development that has taken place in many tropical regions during the last few decades has caused widespread ecological problems such as loss of soil fertility and genetic impoverishment, to the extent that large swaths of land in the tropics are now lost to unproductive use.

In particular, tropical forests are not managed, but exploited. The fact that the present patterns of economic development are environmentally damaging does not mean that the solution to our environmental problems is to curb economic development. No economic development, or a decrease in economic development could be equally damaging, and in some cases more damaging than economic growth. We need a definition of sustainability that allows compatibility between environmental conservation and the economic development needed to satisfy societal needs.

Forested areas play an important role in the conservation of environmental quality through conservation of soil and water resources and biological diversity. They are the principal source of timber and wood, for which the demand in 1988 amounted to 264 million m^3. About 90 percent of this demand was for fuelwood. But our forests are also the main source of fodder and non-timber forest products. The yield of wood and non-timber forest products help to generate additional employment and income, additional value through processing and trade of forest products, increase contribution to foreign exchange earnings and increase return on investment. Forests are under high pressure to supply forest products to a growing population in a land scarce situation. There is a tremendous urgency to finding ways to manage forests sustainably in the face of current pressures and to augment the raw material production. Despite large-scale wasteland afforestation and farm forestry schemes the production from these areas has not significantly relieved the pressure on forests. Afforestation programmes have suffered from technological weaknesses which have limited the productivity and the impact of these efforts are not visible. Indiscriminate import of timber from several countries without knowing their natural durability clearly shows that our forests are not able to meet the increasing demand of wood. In the present scenario, the most important gaps which need to be addressed are: the quality of planting materials; lack of appropriate models and modalities for regeneration of degraded forests with people's participation; planting practices and a range of appropriate models for commercial and farm forestry production for specific areas; downstream processing of forest products to increase retained value

ISSUE HIGHLIGHTS:

WELCOME:

International Conference:

Quality Timber Products of Teak From Sustainable Forest Management

at Kerala Forest Research Institute, Peechi, India

2 - 5 December 2003

Interaction Workshop on Bamboo Resource Development and Utilization in Kerala

Kerala Forest Research Institute (KFRI) organized an Interaction Workshop on Bamboo Resource Development and Utilization in Kerala sponsored by The Development Commissioner (Handicrafts), Ministry of Textiles, Government of India and United Nations Development Programme (UNDP), New Delhi at Mascot Hotel, Thiruvananthapuram on July 22, 2002. Sixty-seven participants including various stakeholders participated.

Inaugural Session:

The Workshop was inaugurated by Sri. P. K. Kunhalikutty, Hon'ble Minister for Industries. Sri. K. Sudhakaran, Hon'ble Minister for Forests and Sports, presided over the function. Dr. J. K. Sharma, Director, KFRI, welcomed the participants. Sri. A. K. Handoo, Regional Director, Office of the DC (Handicrafts), Chennai provided the objectives of the Workshop. Sri. V. Ramachandran, Vice-Chairman, State Planning Board delivered the Keynote address. Smt. Tinoo Joshi,IAS, DC (Handicrafts) gave a special address highlighting the objectives and achievements of

Dr. J. K. Sharma, Director, KFRI, welcoming the participants

Sri. K. Sudhakaran, Hon'ble Minister for Forests and Sports, delivering the Presidential Address

Sri. P. K. Kunhalikutty, Hon'ble Minister for Industries, inaugurating the workshop

Objectives of the Workshop by Sri. A. K. Handoo, Regional Director, Office of the DC (Handicrafts), Chennai

Sri. V. Ramachandran, Vice Chairman, State Planning Board delivering the Keynote address

Special address by Smt. Tinoo Joshi,IAS, DC (Handicrafts)

Bamboo and Cane project. Dr. K. K. Seetalakshmi, Convener of the Workshop proposed vote of thanks.

Technical session:

Sri. C. P. John, Member, State Planning Board chaired the Technical Session. There were five invited papers.

Sri. Ravi Capoor, IAS, ADC(Handicrafts) provided the details of the various initiatives undertaken by the Office of the DC (Handicrafts) to improve the bamboo based craft.

Sri. Susanth Mittra, Representing an NGO from New Delhi presented a paper on the Opportunities in the bamboo sector.

Dr. Manmohan Yadav in his paper stressed the importance of Forest Certification as a marketing tool to communicate sustainable

and other benefits; increasing the value of forest through non damaging uses such as ecotourism and managed supply of genetic materials, increasing people's perception of the value of forests and all the benefits they provide and a strong extension process. The most important goal is to adopt scientifically sound criteria and guidelines for the management, conservation and sustainable development of all types of forests.

Experience has shown that sustainable development requires a commitment to sound economic policies and management, effective and predictable public administration, the integration of environmental concerns into decision making and progress, which allows for full participation of all concerned. While managing resources sustainably, an environmental policy that focuses mainly on the conservation and protection of resources must take due account of those depending on the resources for their livelihood. A development policy that focuses mainly on increasing production of wood without addressing sustainability of resources on which production is based will sooner or later run into declining productivity, which could also have an adverse impact on poverty. KFRI has an uphill task to address some of these environmental issues from the social angle and sustainable utilization of forest resources, which will require strengthening socio-economic research in the Institute with clearly defined short and long-term objectives.

forest management and the activities undertaken by the Indian Institute of Forest Management, Bhopal.

Sri. B. Chandrachoodan Nair, Chief, Industry and Infrastructure Division, State Planning Board gave an overview of the activities under the Bamboo Development Scheme.

Dr. K. K. Seethalakshmi, KFRI provided the information on Support and Services available for Cultivation and Utilization of Bamboo and activities under the KFRI component of the UNDP Cane and Bamboo project.

Open House Discussion:

Smt. Tinoo Joshi chaired. The Participants expressed their interest in bamboo cultivation and utilization and also highlighted the key issues that restrict both cultivation and growth of bamboo industries in the State.

An Exhibition of Bamboo products:

An exhibition was organized in the foyer. Bamboo products developed by Uravu, an NGO from Wayanad, Kerala and new designs and furniture developed during the UNDP Cane and Bamboo project were displayed. The KFRI displayed the books

A view of the participants during the Open House Discussion

and other important publications on Bamboos.

This was a unique opportunity with Hon'ble Ministers for Industries, Forests and Members of State Planning Board, Officials of Industries and Forest Departments, Office of the DC (Handicrafts) and Export Promotion Council for Handicrafts, Scientists, Artisans, Progressive farmers, NGOs, Representatives of Kerala State Bamboo, Kerala State Industrial Development, Kerala Forest Development, Kerala Artisans Development and Handicrafts Development Corporations, Kerala Kadhi and Village Industries, Western Ghat Development Cell, Co-operative

Pleanary Session

Societies and Charitable Trusts, Industries, Exporters and Media persons for exchange of ideas which led to clear cut recommendations for planning the way ahead.

Plenary Session:

Sri. I. Radhakrishnan,IAS, Secretary, Industries, chaired the plenary session. Dr. J. K. Sharma and Sri.. P. H. Kurien, IAS, Director, Industries Department consolidated the deliberations of the Workshop. The Workshop concluded by drafting the recommendations for the overall development.

Recomendations:

Dr. J.K. Sharma and Sri. P.H. Kurian highlighted the main issues, which came up during the open house discussions. Sri. I. Radhakrishnan emphasised that the Industries Department is prepared to provide all necessary help for promoting the bamboo sector in the State. However, he mentioned that there are a few key issues, which should be tackled on priority basis for making any headway in the right direction.

Some of these are:

1. The Kerala Land Reform Act needs revision to permit bamboo growing in private lands.
2. For better linkage an Inter Department committee involving Agriculture, Forests, Industries and Local Self Government Departments may be constituted with a Technology Mission approach for addressing the requirements for a conducive climate for bamboo sector in the State.
3. Prospective entrepreneurs need to be identified and involved in the manufacture and export of value added handicrafts. An example of a viable entrepreneur is the Coir exporters. In this way, the hurdles for cultivating bamboo can be removed, bamboo can be made farmer friendly and the products can have good marketing.
4. Pilot scale programmes can be initiated for making simple tools, development of marketable designs, product diversification, marketing of bamboo products, viable plantation modes etc.
5. For financing these programmes, loan schemes can be provided with the help of State and National financial organizations such as Kerala State Industrial Development Corporation (KSIDC) and National Bank for Agriculture and Rural Development (NABARD).

The following recommendations were made for which necessary actions are required for developing the bamboo sector in Kerala.

1. Frame long-term policy on overall development of bamboo sector in Kerala.
2. Remove hurdles at policy and legal levels in the cultivation and utilization of bamboo.
3. Enhance bamboo resources in private lands, wastelands and along riverbanks through people's participation and Local Self Governments and disseminate information about cultivation of suitable bamboo species for specific end-uses, management and processing and the potential of bamboo as an industry to various stakeholders.
4. Provide adequate financial support for bamboo farming and utilization, through financial institutions.
5. Develop bamboo-based model enterprises producing high value added products. Industries Department may act as a facilitator.
6. Develop a market strategy at State level for the raw material and finished products. Establish bamboo markets and develop market links including export.
7. Create Common Facility Centres near clusters of artisans for designing, product development, value-addition and utilization.
8. Kerala Forest Research Institute to act as a networking agency and take necessary follow up actions.

Quality Timber Products of Teak From Sustainable Forest Management

Kerala Forest Research Institute, Peechi, India

2 - 5 December 2003

CONFERENCE INFORMATION

India, the hosting country of the Conference, with a total land area of 3.287 million km², is the seventh largest country in the world, situated in South Asia. With diverse climatic condition such as alpine temperate in the north, desert in the west and hot and humid tropical climate in the south. India is a union of 28 States and 7 Union Territories. There are 18 official languages with 1652 dialects with English as a main link language. With an estimated annual growth of about 1.6%, the population was estimated to be more or less 1 billion in the year 2001.

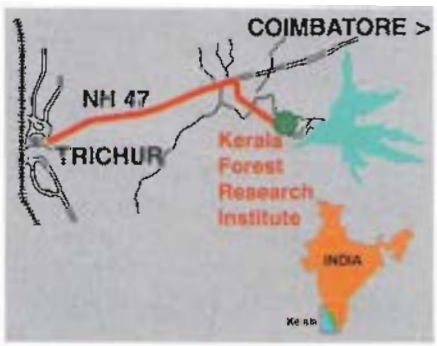
Kerala State, (8° 18'–12° 48' N; 74° 52' 77° 22' E) situated along the south-western coast of Peninsular India, is a region endowed with rich tropical forests and wildlife. The capital of Kerala State is Thiruvananthapuram (Trivandrum). The southern part of the Western Ghats lies along the eastern side of the State. These hill ranges which harbour diverse types of tropical forests are considered as one of the 25 biodiversity hotspots in the World. Besides conservation forestry the State is also accredited of pioneering attempts in plantation forestry. The world's first teak plantation established at Nilambur, Kerala, during 1846 is still maintained in the memory of Mr. H.V. Conolly for his pioneering effort.

Kerala State is also known for spices (cardamom, cloves, black pepper, nutmeg, etc.), coffee, tea, cashew and fisheries, coconut fringed landscapes and scenic backwaters and lagoons. Numerous famous temples, mosques (India's first mosque is situated Kodungaliore, 41 km away from Thrissur) and churches, a variety of traditional art forms like *Kathakali* and *Mohiniyattam* closely interwoven with the social life of people, depict the glorious cultural heritage of the State.

Venue

The conference venue is *Kerala Forest Research Institute, Peechi* - located in central part of Kerala State in the midst of tropical forests with a scenic beauty, which attracts a large number of tourists throughout the year. The nearest city is Trichur (Thrissur) (18 km), the cultural capital of Kerala which is well connected by road and train from Chennai (Madras), Bangalore, Kochi (Cochin) and Coimbatore cities. The new Cochin (Kochi) International Airport at Nedumbassery is only 60 km away while another accessible domestic airport is at Coimbatore, Tamil Nadu (100 km). More information about India and Kerala, can be obtained through the websites :

www.keralatourism.com ;
www.keralagreenery.org ;
www.keralam.com



Climate

The weather in and around Peechi during December is very pleasant with an average temperature of 25° C.

Official Language of the Conference

The Official language of the Conference is English. Only English is used by the speakers in all the sessions and field excursion of the Conference and no translators will be available.

Conference Web Pages

All conference announcements and conference information are available on the following websites:

http://kfri.org/html/k0500frm.htm
http://iufro.boku.ac.at/iufro/intronet/d5/hp50602.htm

If you experience any difficulty in finding the above pages, please go to www.kfri.org and click on the International Teak Conference.

Registration Hours

On Monday, 1 December 2003 the Registration will be open from 14.00 to 20.00 h in respective places of accommodation arranged for the delegates. The Registration desk will also be open from 8.00 h prior to the opening ceremony, on Tuesday 2 December 2003.

Conference Pack

Each registered participant will receive a conference kit containing the name badge, the final conference programme, a list of participants, invitations for social events and information on field excursion and tourist information on Kerala. In addition,

it will contain detailed programme and tickets for Post-conference tours of participant's choice for which advance payment is made.

Your personal badge is your admission ticket to all sessions. Kindly wear your badge at all times.

Financial Support for Participation

Limited funds will be available to support the participation of invited speakers from the developing countries. However, efforts will be made to assist those scientists/ researchers of developing countries who will be in genuine need of support, with partial financial assistance. Participants are encouraged to contact their own government/embassy sources and international develop-ment agencies such as ITTO, Commonwealth Foundation, SPDC (IUFRO), UNESCO, UNDP, etc. Participants who desire to obtain recommendation letters from the Organizers in support of their application may contact the Conference Convener.

Passports/Visas

Overseas' participants may contact the nearest Indian High Commission/Embassy/ Consulate or their travel agent to find out visa requirements for entry into India.

Health Insurance

All participants should meet their own insurance for medical care and hospital treatment. Please check vaccination requirements from your travel agent.

Banks/Currency/ Credit Cards

Foreign currency and travellers cheques can be changed at all commercial banks during banking hours in Thrissur Town. The banks are open Mondays-Fridays (1000-1400 hrs) and Saturday (1000-1200 hrs).

The Indian monetary unit is *Indian Rupee* (INR.). One *Rupee (Re.) = 100 Paise. 1US$ = Rs. 47.00; 1 Euro = Rs. 55.00* (approx.). International Credit Cards are accepted at several banks, hotels and super markets.

No Smoking

Smoking is banned in public places in Kerala. The Conference venue is a smoke-free area. Smoking is not permitted at any of the sessions, forums, poster sessions or conference functions.

Other Facilities

The following services will be available for the participants at the venue during the Conference.

Information Desk: A meeting point for delegates for personal messages/ correspondence during the Symposium, with facilities like E-mail, Fax, Telephone, computers and Xerox copiers.

Banking: Banking facility will be available for enchasing traveler's cheques, foreign currencies, etc.

Travel: A travel agent will be available at the Symposium venue for travel arrangements, confirmation of flights, etc.

FIELD EXCURSION

In-Conference field excursion is planned for a full day on 4 December 2003 to get acquainted with the prevailing plantation management practices (with home garden teak, teak wood farm, clonal seed orchards, state forest plantations), teak timber depot, industrial processing and trade in Nilambur, including the world's oldest teak plantation raised in 1842. The other major attraction is a visit to teak museum – first of its kind established by KFRI depicting history of teak cultivation, management and utilisation.

POST CONFERENCE TOUR

The Post-conference tours with five options different ecosystems and tourist attractions are planed to be organised if there is sufficient interest with at least 15 participants for each of five optional tours. The tour Cost includes transportation, meals, refreshments and accommodation (if applicable). The major tour attractions are listed below:

TOUR I: One-day (Cost US $ 15/Rs. 750) : Mountainous/high range forests, farms, oil palm plantations, Water falls , Sholayar reserviopr/hydroelectric power project, bamboo/reed breaks, tea estates, tribal colonies.

TOUR II: One-day Tour Cost (US $ 15/Rs. 750): Beach / coastal attractions, backwater/Vembanad lake, boat cruising.

Palaces/ Museums, Cochin city, shopping, etc

TOUR III: Three Days and Two Night halts (US $ 150/Rs. 7500): High Range/cool mountainous forests in Munnar, shola forests and grass lands, tea estates, spice plantations, Ervaikulam National Park, Marayur sandal forests, Indo-Swiss Cattle Farm, Waterfalls, Hydroelectric power projects, Thekkady Wildlife Sanctuary, Boating in Periyar Lake, etc

TOUR IV: Three Days and Two Night halts (US $ 150/Rs. 7500): Sea coast, Hosueboats, boating, mangrove forests, Kovalam beach, heritage monuments, palaces, /temples, Kanyakumari sun-set, etc

TOUR V: Four Days & Three Night halts (US $ 200/Rs. 10000) : High range forests, National parks, Wildlife sanctuaries, heritage monuments, palaces in Mysore City, Ooty sight seeing, etc

ACCOMPANYING PERSON'S PROGRAMME

The registration fee for accompanying person's programme includes conference kit containing Conference programme, information on local sightseeing / shopping, tickets for social events, lunch / tea during the Conference and one day field excursion. Visits to local places of tourist interest will be organised during the Conference days, if there will be sufficient participation with in payment of additional costs.

REGISTRATIOIN INSTRUCTIONS

Please type or print in block letters as you compiete your registration form and mail or fax your form(Available at http://kfri.org/html/k0500frm.htm or http://iufro.boku.ac.at/iufro/iufronet/d5/hp50602.htm), remembering to print your name at the top of each page to avoid confusion if pages are separated.

Please refer to the numbered sections below as you complete the registration pages.

1. Delegate Information

Please use a separate registration form for each delegate. You may enter any number of accompanying persons.

2. Accompanying persons

This section is for accompanying persons who are paying the conference accompanying person's registration fee. Please provide full name.

3. Registration Fees

Please note the early registration fee deadline. Take advantage of the savings by returning your registration before 1 September 2003. For accompanying person's and post-conference tours, full payment and reservations are due by the same date.

4. Social Events Guest Tickets

Please note which events you and any accompanying persons wish to attend, even if the cost is included in the registration fee. This will help us make necessary plans. Individual tickets will be distributed at the conference information desk..

5. Accompanying Person's Programme

Registered accompanying persons receive a name badge and conference kit. Participation in the opening ceremony, in-conference tour, cultural programme and farewell banquet is included in the accompanying persons fee. A hospitality room will be available to those wearing their name badges. Special tour programmes have been scheduled throughout the week with varying cost. Tours will be available on a first-come, first served basis. Tour registrations can be made during the conference only if there is space available.

6. Post-conference Tours

Choose the Post Conference Tour you wish to attend. Full payment and reservations are due no later than 1 September 2003 along with the Registration Fee. Additional post-conference tour registration can be made only if the seats are vacant.

7. Arrival and Departure Times

Please indicate your arrival and departure time to assist with our planning and scheduling so that conveyance will be available for you from the Airport/Railway Station and for return after the Conference.

8. Special Needs

Please indicate any special needs, disabilities, or dietary concerns that you may have.

9. Payment

All payments must be made in US dollars, Euros or Indian Rupees and payable to the Director, Kerala Forest Research Institute. The banking fee, if any, will be the responsibility of the delegate. However, the simplest and least expensive way to cover all expenses is to make payment by Visa, MasterCard, American Express, or Diners Club International. Other credit cards cannot be accepted for your fee and tours.

All payment received, either by cheque or credit card will receive a copy of the receipt.

CONFIRMATION

Written confirmation will be sent indicating payment, tour and excursion details. Please bring the confirmation letter with you to assist us with your registration in Peechi.

CANCELLATION

No refund will be given after 1 November 2003, a 50% refund will be offered between 1 and 31 October, 2003 and a 75% refund is offered before 30 September 2003.

LIABILITY

The fees associated with the conference, tours and excursions do not cover medical care or travel insurance. The Conference Secretariat is not responsible for these or other losses or damage to luggage or personal belonging that delegates and their accompanying persons may incur.

If you have any questions about the Conference, e.g., registration, payments, accommodation, the accompanying person's programme, please contact and complete the Registration form and return to:

The Convener,
International Teak Conference 2003,
Kerala forest research institute, P.O. Peechi
680 653, Thrissur district, Kerala State,
India
Fax: +91-487-2699249
Email: kmbhat@kfri.org
iteak@kfri.org
to reach before 1 September 2003

Crocodiles – their habitat, status, conservation, reproductive behavior and human- crocodile conflict

Crocodilians (crocodiles, alligators, caimans, and gharials) are prominent and widespread occupants of tropical and subtropical aquatic habitats. The Crocodilians are the only living remnants of the ruling reptiles, which evolved in the Mesozoic era. Crocodilians are amongst the most voracious predators on earth, with hunting skills honed through 200 million years of evolution. Among the crocodilians, crocodiles live for long period in the wild and there are records of individuals living for decades. The crocodiles in the world have benefited from protection and strict control measures. As a result, crocodile population has increased and the range has expanded back into historically occupied areas. The crocodiles are exploited for their valuable skin, which supports an international trade worth over US$500 million annually.

Distribution/habitat

In the Indian subcontinent, three species of crocodiles occur, namely Gharial (*Gavialis gangeticus*), which belongs to the family Gavialidae, Saltwater crocodile (*Crocodylus porosus*) and Mugger crocodile (*Crocodylus palustris*) belonging to the family Crocodylidae. The Important features of three species of crocodiles found in India are given in Table 1.

Mugger is distributed in most parts of India except Jammu and Kashmir and some north Indian States. The Mugger is a medium-sized crocodile (maximum length 4–5m), and has the broadest snout of any living member of the genus *Crocodylus*. Muggers are found in a number of freshwater habitat types including rivers, lakes and marshes. They are also adapted well to reservoirs, irrigation canals and man made ponds, and in some areas may even be found in coastal saltwater lagoons. In India, Muggers are reported from over 50 locations and the wild population is tentatively estimated at 3000 to 5000.

Mugger crocodiles are a hole nesting species. As with other hole nesters, egg laying takes place during the annual dry season. Females become sexually mature at a length of approximately 1.8–2 m, and lay 25–50 eggs (Fig. 1).

Food and feeding habits

There is considerable difference in food and feeding habits of 23 species of crocodilians. Young ones often eat aquatic insects, small fish and crustaceans and as they grow larger,

Fig. 1. Crocodile eggs collected from the nest

they eat vertebrates, including fish, turtles, birds and mammals. Crocodiles have varied hunting techniques, ranging from simple, savage rushes to complex entrapment behaviour. They use their powerful tails to knock larger prey into the water where the crocodile has the advantage. One of the most common hunting techniques is surprise. A crocodile waits for its prey to come down the water's edge for a drink, and then it slowly swims to the shore and lies in wait, with just its eyes above the water, a few feet from the animal. Then it suddenly lunges out of the water and latches onto the animal's head with its powerful jaws. If it can get a firm grip with its teeth, the crocodile pulls the animal into deeper water, where it drowns its prey. Crocodiles have no way to anchor their prey once it is dead, so to get a mouthful of meat, they bite the animal and roll over and over on their long axis until they twist off a chunk of meat. Then they bring their heads above water, flip their food into the air and grab it again, each time getting it further and further down the gullet. They usually need to rest for a few minutes before taking another bite. If the skin of the prey animal is too tough for the crocodile to penetrate, it stores the dead animal in an underwater hollow until it rots enough for the crocodile to bite into it.

Behaviour

Crocodiles attempt to maintain their body temperature within narrow limits by basking in the sun when cool and seeking shade when hot. Crocodiles have complex behaviors including social interactions, dominance hierarchies, vocalization, coordinated feeding, and well developed maternal behavior.

Crocodiles breathe by moving their internal organs. Air enters the body through the nostrils, situated at the end of the snout. The air passes through the jaw into the throat where it enters the trachea and passes into the lungs. Air can also enter the throat through the mouth. They also allow the crocodile to breathe when in water and only the tip of the snout is above the surface. The nostrils can be closed when the crocodile is underwater. Crocodiles also appear to breathe by circulating air in the throat and lungs by "panting", while keeping the mouth flaps closed. Another view is that the "panting" is for the olfactory purposes.

Crocodiles have extremely good vision. While submerged, crocodiles can see both under and above the water. They also have a third eyelid (nictitating membrane), which is transparent. This eyelid moves from the front to the back of the eye, and is used under water to protect the eye surface. The eyes can be withdrawn into the head for protection when seizing prey or fighting. Since the nictitating membrane is not very transparent, vision is comparatively good above water. Crocodiles have extremely sensitive hearing. Crocodiles can taste, and can distinguish between different types of food. Despite its appearance, the skin is sensitive to touch. The tail is an extremely sensitive area.

Breeding behavior

During the breeding season, males set up territories and the females approach the males for mating. Adults of several species emit loud vocalizations during the breeding season.

After elaborate courtship, copulation takes place in the water. Mating starts some 40 days before laying, and continues up to the time of laying. Females deposit 10 to 60 hard-shelled eggs into a nest, which is a hole dug into the ground. Most females remain near the nest during incubation and protect it from predators.

Conservation and status

Management of Mugger crocodiles is based principally on the legal protection of wild populations and captive breeding for restocking. In India, a large-scale captive rearing programme was initiated in 1975. Eggs were collected from the wild and captive adult breeding stock of young ones produced. The resulting juveniles were used to restock natural population in 28 National Parks, Wildlife Reserves and Crocodile Sanctuaries throughout the country. A total of 1,193 individuals were released between 1978 and 1992. Currently, there are over 12,000 Muggers in captivity.

In Kerala, Muggers are kept in captivity at Neyyar and Peruvannamuzhi by the Kerala Forest Department apart from the Zoos at Thiruvanathapuram and Thrissur. Natural populations of crocodile are seen at Parambikulam Wildlife Sanctuary, Islands in Waynad Wildlife Sanctuary apart from Neyyar Wildlife Sanctuary.

While illegal skin trade was a major problem in the past (1950s 1960s), the current threats to the Mugger crocodile are principally habitat destruction, drowning in fishnets, egg predation by people, and the use of crocodile parts for medicinal purposes. Adequate survey data exist only for India and Sri Lanka, and indicate that populations, while generally small and isolated, are widespread. Sri Lanka has the largest remaining wild populations (approx. 2,000 individuals), but they are concentrated in only two National Parks, Wilpattu and Yala.

Crocodiles in the Neyyar Wildlife Sanctuary

Crocodiles were released into the Neyyar Wildlife Sanctuary as a part of Crocodile conservation project launched in the State of Kerala with the joint effort of the Government of India, U. N. D. P. and F. A. O. of the United Nations. Two captive-breeding centres were established in Kerala, one at Neyyar and another at Peruvannamuzhi during 1977. A view of the Neyyar Resorvoir during monsoon is given in Figure 2. The way how a crocodile is caught is shown in Figure 3. The purpose of the breeding centres was to breed the species in captivity and to release them into protected areas.

From 1985 onwards, the crocodiles in Neyyar Wildlife Sanctuary have started attacking local inhabitants along the bank of the Reservoir and many people were injured in the process. Further introduction of crocodiles in the Reservoir was stopped after the initial release of 29 crocodiles in 1983. This led to increase in the captive population of crocodiles. Thirty-six Mugger

Fig. 2. Neyyar Reservoir during Monsoon

Table 1. Important features of three species of crocodiles found in India

Important features	Gharial	Mugger	Saltwater crocodile
Popular name	Gharial	Indian Mugger	Estuarine crocodile
Zoological name	*Gavialis gangeticus*	*Crocodylus palustris*	*Crocodylus porosus*
Distribution	India, Nepal, Pakistan	India, Bangladesh, Nepal and Iran	India to South China, Indonesia, Philippines, Papua New Guinea, N. Australia
Habitat	Perennial and deep rivers	River, marsh, swamp, lake, and large pond, any fresh water habitat	Estuarine rivers and creeks where mangroves are present. Seldom in upstream rivers but often in open seas
Nesting season	March/April	Feb./April	May-June
Nest sites	Highly sloppy sand- banks	Sand-banks, mud-banks	Open areas amid mangroves
No. of eggs	10-97	8-45	10-75
Incubation period	75-80	55-75	75-80
Life span	100 years	70 years	100 + years
Breeding life	50 years	50 years	Not known
Temperament	Timid	Aggressive	Aggressive

(*Crocodylus palustris*) crocodiles were introduced into the Reservoir during 1983.

Crocodiles can be easily spotted at Neyyar when they bask on the banks of the Reservoir. Surveying in rowing boats and walking through the banks are the most successful methods. Crocodiles can also be spotted, when they are swimming in the lake. Crocodile nestling in the Neyyar Resevoir is shown in Figure 4. The best months for censessing the crocodiles in Neyyar Reservoir are April and May when the water level is lowest and banks are exposed to the maximum.

Direct sightings

An adult crocodile with 10 young ones were recorded in the month of May 2000. Most of the crocodiles sighted in the Reservoir were adults of more than 3 m in length. Only few instances of sub adult crocodiles were recorded. Eggs of crocodiles were found in the sanctuary during the breeding seasons of 2000 and 2001. Complete census of crocodiles in the Reservoir revealed twelve crocodiles during 2001 in areas of the Reservoir adjoining the human habitations and two animals in the interior areas.

Fig. 3. Crocodile caught from Kottamanpuram

Fig. 4. Crocodile nestling in the Neyyar Reservoir

Indirect evidences

Faecal samples provide indirect evidence of crocodiles in certain areas and help in the estimation of crocodile population in the Reservoir. Continuous monitoring of crocodile population is necessary to manage them to avoid conflicts with humans.

Human-crocodile conflicts

Only the larger and fiercer species are involved in human attacks. The Nile crocodile *Crocodylus niloticus* and the saltwater crocodile *C. porosus* are considered most dangerous, some leading to human deaths, are reported for American alligator, American crocodiles, Morelet's crocodile, Black caiman and Mugger.

Human fatalities are usually the result of attack by larger crocodiles of 3 m or greater length. However, attacks by smaller individuals are widely reported. Non-fatal interactions can also be serious to local people, particularly predation on pets and livestock.

Crocodile attacks were reported from 1985 onwards from the Neyyar sanctuary. Among these, more than 15 were serious attacks on humans. Ten men and five women were attacked in these incidents. A lady was attacked twice causing severe injury to body and hand. She had lost one of her hands. In another incident, a woman lost her forearm. Similarly, many victims survived crocodile attacks and live with serious deformation to the body parts. All other victims were severely mauled and hospitalised varying from one to six months. Most of the attacks were on legs and the attacks happened when the victims were in knee-deep water for bathing or for washing clothes. Two peaks of attacks were noticed. One peak was in the morning hours and another one in the evening hours. Age of the victims ranged from 8 to 60 years. Many of the victims were alone when the attack happened. Chronology of attacks revealed that highest number of attacks was occurred during the years 1995 to 2000.

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Garcinia indica - a potential species for homesteads of Kerala

The tourists to the sunny beach of Goa remember being served a large glass of refreshing drink after a heavy meal. This is prepared from the fruit of the Kokam (*Garcinia indica*) tree. This drink is of high demand in the market. It is known as *Punampuli* in Malayalam. This has been used by Goans as a cooling ingredient for centuries.

The Kokam tree, belonging to the family *Cluseaceae* is largely grown in the southern districts of Maharashtra. It is a slender evergreen tree with drooping branches. The tree is found in the tropical rain forests of the Western Ghats, from Konkan southwards in Mysore, Coorg and Wayanad. It flowers in November-February and fruits ripen in April-May.

The fruits are round, darkish purple, about an inch and a half in diameter with 7 or 8 seeds. The fruit has an agreeable flavour and a sweetish acid taste. Kokam contains 10% malic acid and a little tartaric/ citric acid. The seeds of the fruits yield edible fat known commercially as Kokam butter. It is extracted by crushing the kernels, boiling the pulp in water and skimming off the fat from the top or by churning the crushed pulp with water. Kokam butter, as sold in market, consists of egg-shaped lumps or cakes of light grey or yellowish colour with a greasy feel and an oily taste. It is used as an edible fat and also as an adulterant of ghee. Kokam butter is suitable for use as confectionary butter. It is also suitable for candle and soap manufacture. The cake left after the extraction of oil is used as manure The habit, trunk features and the fruits are shown in Figures 1-4.

Fig.1. Habit

Fig.2. Trunk Features

Fig.3. Fruiting twig

Fig.4. Fruits

Kokam has numerous medicinal values as well. It is prescribed for heart ailments, dysentery, diabetics and tumors and to fight cholesterol. It is also used for piles. Kokam butter can be used to treat back aches and muscle pulls. It is used to give an acid flavour to curries. Demand for Kokam extracts is rising in India and abroad.

Kokam, thus, is a good tree which can be introduced and successfully cultivated into the homesteads of Kerala.

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Clothes moth – a pest of natural cellulose fibre

Larval cases of clothes moth, *Tineapellionella* Linnaeus

Clothes moth is a household pest because the larvae feed only on materials such as wool, silk, hair, bristles, feathers and fur. The common name 'Clothes moth' is due to the small silken case that the larva spins about its body and carries about wherever it feeds, thrusting its head

and legs out in front. This is shown in figure. Usually it remains unnoticed sticking and crawling on the wall.

A total of 11 species of clothes moths grouped under the genus *Tinea* of the family Tineidae, have been recorded from all over the world. Of these, three species of the genera *Tinea* are found in India viz., *Tinea pellionella* Linnaeus, *Tinea translucens* Meyrick, and *Tinea dubiella* Stainton. Of these, *Tinea pellionella* Linneaus is the common species found in Kerala. The adults of this species have a wingspan of 0.5 cm. The wings are brownish and have 3 dark spots. The males are active fliers compared to females, which are sluggish, and fly only for short distances. The females, which live for about 30 days, lay 100 to 300 eggs.

The larva shows diverse habits. Rarely will the larva spin a web directly on the material on which it is feeding. Usually it attaches its case to a substratum by means of silken threads. The larva can turn within its case and feed on food material from either end of the case without altering the position. The larva cannot live without the case and if removed from the case it dies. The larval stage lasts for 50 or more days, and the pupal stage is passed in the case which forms the cocoon after both ends have been sealed with silk.

The best way to combat clothes moth is to prevent the moth from becoming established in the home and protecting the clothing by fumigation with naphthalene. Regular vacuum cleaning of rugs, carpets, and crevices in floors, vents etc. will considerably help in keeping the pest away.

Several groups of tiny moths that come under the group *Microheterocera* includ-ing the clothes moths are poorly studied. Recently, the Ministry of Environment & Forests, Govt. of India have initiated an All India Co-ordinated Research Project under which investigation on this group of insects is being carried out.

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Kadam (Neolamarckia cadamba) - seedling production and nursery management

Kadam (*Neolamarckia cadamba* (Roxb.) Bosser), belonging to the family Rubiaceae is a fast-growing, large, deciduous tree, occasionally buttressed, reaching up to 37.5 m in height and 2.4 m in girth with a clear bole of 9 m and horizontal branches. Small orange coloured flowers in globose head appear from May to July or December to March on the West Coast and fruits (pseudocarp) ripen and fall during August to October. The pseudocarp is a globose, orange, fleshy mass of closely packed capsules, each containing a number of minute seeds. About 30,000 seeds weigh one gram.

Kadam wood is soft and light in weight. Colour of the wood is white with yellowish tinge to creamy white or yellowish-grey. Sapwood and heartwood are not distinct. Kadam is mainly used for veneers in plywood industry, match splints, turnery, etc. The wood is suitable for making pencils of high and medium qualities.

Kadam is frequently cultivated as ornamental and shade-tree in plantations throughout India. M/s Hindustan Pencils Limited, a sister concern of M/s Apsara Plastics Private Limited, Mumbai has raised Kadam plantations at Kottur and Narassipuram in Coimbatore District, Tamil Nadu for the purpose of pencil manufacture.

As per the request of M/s Apsara Plastics Private Limited, Mumbai, the Kerala Forest Research Institute raised a nursery of Kadam seedlings at Field Research Centre, Velupadam during the month of January 2002. For raising seedlings in the nursery, fruits were collected from Kaithakkolli in Wyanad District and from Nilambur in Malapuram District, Kerala during the month of November 2001. For extracting seeds, the fruits were kept in gunny bags for five days to rot. The seeds were squeezed out from the fruits and separated by froth flotation method and then air-dried. Soil and sand were used as the potting mixture in the ratio 3:1 in polythene bags (10 cm x 20 cm flat size). The potting mixture was drenched with fungicide (Emisan 6-0.0025%) and kept for two days. A small quantity of seeds (25-50 Nos.) were sown in each polythene bag and kept under shade net with regular watering. Germination commenced on the 18th day after sowing. The young seedlings grew slowly for the first eight weeks after germination, but subsequently, growth was rapid. About 35,000 seedlings were raised.

Fig.1. A seedling affected by bacterial infection

Fig. 2. A seedling completely recovered from bacterial infection

When the seedlings were 120-day-old, there was an outbreak of devastating bacterial infection (leaf blight) in the nursery. Nearly all of the seedlings were affected by the infection. The bacteria affected tender leaves and stem. The affected leaves showed large number of tiny brownish spots with purple boundary. In severe cases, the apical bud and tender leaves dried up showing a blighted appearance. The affected stem showed water soaked slimy patches. In such cases, the plants wilt and dry up rapidly. The infection spreads in epidemic portions during continuous rain. Application of Streptocycline (6 g dissolved in 100 litre of water) as foliar spray and drenching the seedlings with the same solution twice a week controlled the infection. The seedlings were protected from rain during streptocycline application. About 60% of the seedlings recovered. Seedling affected by disease and recovered after streptocycline application is shown in Figures 1-2.

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Ecology-economic linkage, market mechanism and biodiversity loss of non-wood forest products

Some people assume that harvest of non-wood forest products (NWFPs) has only less impact on forest than logging. However, this assumption is unfound-ed. Forest ecosystems have such complex interrelationships that har-vests of some non-wood resources can affect plant and wildlife populations as negatively as logging. Further, the type and quantity of species harvested by the collectors to a great extent dependent on market mechanism and there exists a linkage between ecology-economic systems. The understanding of this linkage, among other things, is essential to prevent biodiversity loss and formulate strategies for sustainable management of NWFP resources. An attempt is made here to highlight and test empirically the linkage dynamics and its implication on loss of bio-diversity of NWFPs.

The economically important species are those which have an effective demand and thereby priced high. Contrary to this, ecologically important/sensitive species are those, which are in the threshold of vulnerability/ endanger-ment due to repeated/over extraction. The situation separates out a group of species, which neither belongs to the former nor the latter in the existing/ present/short run situation. This will lead to the existence of a class/group of intermediate or orphan species. This group of species is always overlooked in the decision processes and at policy levels in the short run because of the lesser importance attached to it either economically or ecologically. In reality, these are the economically and ecologically potent species in the long run since through technological explosion, there is a possibility of identifying non-substitutable uses of these species.

In the natural system, extraction of species, except for the subsistence uses, is economically decided upon. When this type of species-specific exploitation continues indiscriminately for a long time, it leads to formation of a class of ecological species, which is threatened. When the ecological species is considered endangered, further exploitation is restricted.

Since the economic importance of the species is decided by the demand, which in turn is a derived demand for many other uses, it necessitates the discovery of potential substitute/alternative in the natural system. This will lead to the formation of another class of economic species, which again leads to ecological species, and the 'ecology - economic species cycle' continues. This is on the assumption that there are substitutes/ alternatives for many of the species exploited. But if there is no substitute/alternative for a class of species, continuous exploitation leads to an irreversible loss of the species affecting the biodiversity. The potential substitute species are none but orphan species. If and only if this ecologic-economic species cycle is thoroughly understood can one make judicious decisions for sustainable use of NWFPs.

The cycle explained above is resultant of the myopic approach adopted by the stakeholders of the resources. The pertinent question arising in this situation is regarding the economic species. Unless an effective demand is there, exploitation is futile; and if the demand exceeds supply the above situation occurs. This can be called a "Decision Paradox" wherein the present economically right decisions taken in the short run are responsible for the future ecologically wrong condition, which results in biodiversity loss.

The market mechanism is a regulatory instrument in the economy. The well-functioning market will manage resources efficiently. Abundant resources will command a lower price and no justification to be conserved and managed carefully. However, resources that are not part of anyone's environ-ment or for whatever reasons remain outside the domain of markets cannot benefit from careful management and conservation that goes with increasing scarcity. Unfortunately, resources without a price lack scarcity and value register and hence these are inevitably overused, wasted and degraded since their zero price communicates a message of abundance or economic insignificance.

Commercialization and harvesting of selected species mainly due to easy marketability and profitability have led to serious erosion of NWFP resources. The prime consideration of the gatherers is to maximize returns in the shortest time possible, regardless of whether sustainable or not. Further, market forces play a prominent role in deciding which of the species are to be harvested. Partly due to poverty and partly due to absence of alternative employment opportunities, the gather-ers are forced to gather more quantity for survival. Empirical evidence shows that regeneration potential of NWFP species declines as harvest intensity

Plant species	Collection/ house hold (hh)/ ha	Maximum quantity extractable Kg/ha	Quantity extracted over/ under extractable quantity kg/ha	Harvest ratio*
Asparagus racemosus	2	1.5	-0.5	1.33
Costus speciosus	0.25	2	1.75	0.13
Curcuma aromatica	1	3	-0.01	1.01
Desmodium velutinum	3	2.5	-0.5	1.2
Dioscorea pentaphylla	3.75	1.05	0.3	0.71
Hemidesmus indicus	3.75	1.9	0.95	0.5
Phyllanthus amarus	3.75	1.67	1.02	0.39
Pseudarthria viscida	5	4	-1	1.25
Sida rhombifolia	8	6	-2	1.33
Solanum indicum	5	3	-2	1.67
Solanum viarum	4.375	3.24	-1.135	1.35

*- Harvest Ratio= Q_e/Q_a where; Q_e =Quantity extracted and Q_a= Quantity available for harvesting. Q_a is that quantity which has attained the growth/maturity and is harvestable.

increases.

In view of the above discussion, an attempt was made to test empirically the ecology-economic linkage by collecting data from a sample (Kattunaicken tribes) from Wayanad Wildlife Sanctuary, Kerala. This exercise used PRA techniques, to work out the total availability of extractable resources (matured plants/parts), their level of extraction by sample households and how the demand-pull decides the sustainable/ unsustainable extraction of NWFP products. The findings are indicative of the anomalies of the market mechanism in the NWFP sector and its influence on resource front. Table 1 presents the details of collection of NWFPs per household, maximum extractable quantity per ha and harvest ratios.

The under/over utilization of the resources implies unsustainable resource use in the area, which is determined by market forces, in the form of demand for the products. Nine of the 11 species studied projected an unsustainable level of harvest. The quantity extracted over/under extractable quantity in the Table shows both positive and negative values. The positive and negative values indicate the percentage extraction of optimum and the same over/beyond the available harvestable level of resource. If the harvest ratio of the given species is more than one, it indicates unsustainable extraction of the NWFP species and *vice versa*. Extraction of more quantity over extractable one points out that the tribes collect immature plants also for getting more income, which results in slow depletion of resources. Thus unless there are enough plants for regeneration or activities like enrichment planting, biodiversity and sustainable growth cannot be maintained.

Invariably, it was found that over harvested products are highly demanded ones characterizing demand pull and consequently, its prices also showed increase over a period of time. For instance, the price of *Curcuma aromatica* increased from Rs. 3.75 in 1982-83 to Rs. 20 in 1999 and that of Pseudarthria *viscida* from Rs. 4 in 1982-83 to Rs 16 in 1999. In the case of *Hemidesmus indicus,* the price showed a fluctuating trend; for instance, its price declined from Rs. 12.50 in 1982-83 to Rs. 6 in 1985-86, then increased to Rs.8 in 1990-91 and Rs.11.40 in 1994-95 and then shot up to Rs. 30 in 1996-97.

This is indicative of the existing influence of demand-pull over sustainable/unsustainable extraction of NWFP species. This satisfies the condition of ecology-economic cycle where the economic species (the species extracted due to demand pull) leads to the formation of a set of ecologically vulnerable species. Thus it becomes imperative that the ecology-economics linkage dynamics are properly under-stood and that market management particularly, an understanding the demand-pull, is very essential for prevention of depletion of NWFP resources.

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Infrastructure Development in KFRI

Kerala Forest Seed Centre (KFSC):
The foundation stone for the building of KFSC was laid by Sri K. Sudhakaran, Hon'ble Minister for Forests, Govt.of Kerala on 6 May 2002. It is a collaborative project with the Kerala Forest Department at a total cost of Rs.55 lakhs provided under Kerala Forestry Project (WB).

Completion of Herbarium Building:
In the existing block of Genetics and Botany Divisions, construction of Herbarium Block was completed. Soon the Herbarium will move to its new spacious place.

Construction of boundary wall:
Construction of boundary wall (2235 m long) is in progress where the new construction works are to be taken up under ACA from the Planning Commission, Govt. of India.

Tarring of the roads in front of the Type I quarters:
The tarring works in front of the Type I quarters completed.

Construction of Training & Extension Centre, Research Scholar & Trainees Hostel and Multi storeyed building for additional laboratory space and Conference & Meeting Rooms:
Under ACA from Planning Commission, Govt. of India, initial steps have been taken with regard to the construction of these buildings. A Consulting Archi-tect was selected and building plans were finalised.

Type III Quarters at Nilambur Sub Centre:
Under ACA from the Planning Commission, Govt. of India, two Type III quarters are being constructed at Nilambur to accommodate the Scientist-in-Charge as well as the Teak Museum Curator. The construction work is in progress and it is likely to be completed by March 2003.

Software for field identification of commercial timbers
A software for computer assisted field identification of commercial timbers of India has been developed by the Scientists of Wood Science Division. The software has been written in Visual Basic using Microsoft Access as data base. The software is user-friendly and helps in fast retrieval of data useful for timber identification based on macro-scopic features observed under the hand lens. The package developed for 50 timber species is expandable for unlimited number of species as and when required. Details are available on request. The cost of software is Rs. 750/- or US $ 20.

New facilities
The following facilities have been installed in the Genetics Division

i. Photosynthetic simulation tissue culture racks (2 Nos.)
ii. Solar Photovoltaic pumping system and
iii. Small Hardening Chamber for tissue culture plantlets

TRAINING COURSES

KFRI proposes specialized training courses in tropical forestry to meet the requirements of various stakeholders. It is also proposed to provide tailor-made training depending upon specific needs of the stakeholder.

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Highlights of ongoing projects

Towards biological control of the teak defoliator

The teak defoliator, *Hyblaea puera* Cramer (Lepidoptera) is the most well known insect in Indian forestry, which was recognised as a pest of teak in 1898. Outbreaks of this pest take place every year in extensive areas of teak plantation in Kerala as well as other teak growing areas in the country. It has been reported that 44% of the potential volume increment of trees was lost. The protected trees put-forth a mean annual increment of 6.7 m^3 ha^{-1} compared to 3 m^3 ha^{-1} in unprotected trees.

Natural enemies consisting of parasitoids and predators are known to have a role in reducing the insect populations. Over 15 species of parasitoids 70 species of predators including 6 insects, 16 spiders and 48 birds have been recorded from Kerala. In spite of the presence of these natural enemies, the outbreak of the defoliator regularly occurs in teak plantations affecting volume increment of trees. Considering the importance of managing the pest, attempts have been made by KFRI to manipulate suitable natural enemies as biocontrol agents. However studies indicated that indigenous insect parasitoids have limitations to be effective biocontrol agents particularly because of the characteristic migratory behaviour of the pest. In view of the above attention was focussed on the use of microbial pathogens to control the pest. The search for a suitable microbial pathogen resulted in recording a baculo-virus as a potential biocontrol agent.

The baculovirus –HpNPV, an efficient tool for controlling the teak defoliator

Baculoviridae is the largest and most widely studied family of viruses that infect arthropods including insects which includes two subgroups- Nucleopolyhedrovirus and Granulo-virus. Nucleopolyhedrovirus have received considerable attention as biocontrol agents. Baculoviruses have been isolated from over 700 species of insects. The nucleoppolyhedrosis virus infecting the teak defoliator larvae was first recorded in 1988 from teak plantations in Nilambur. This virus, HpNPV has been studied in detail for its use as a biocontrol agent against the teak defoliator.

Mass production and field application of HpNPV

The first step in using a baculovirus for insect pest management is to make it available in large quantity. As HpNPV is host specific like many other baculoviruses, availability of the teak defoliator larvae in large quantity is a

Fig. 1. A teak defoli-ator larva killed by HpNPV

prerequisite for its mass multiplication. *H. puera* larvae can be mass multiplied either on teak leaf or on synthetic diet. Grown up *H. puera* larvae of fourth /fifth instar are ideal for NPV mass multiplication. The larvae are fed on artificial diet/teak leaf contaminated with HpNPV. Along with the feed, the larvae ingests the virus particles. Infected larvae dies within 3-4 days (Fig.1). These larvae are collected and virus particles are extracted as per the standardised methods

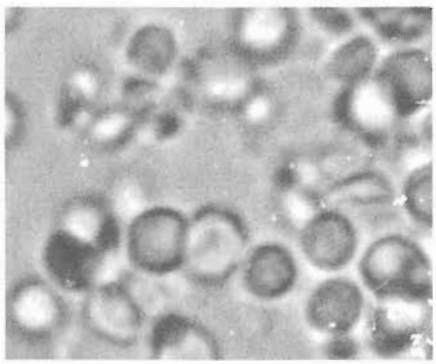

Fig. 2. HpNPV Polyhedral Inclusion Bodies (microscopic)

which includes larval maceration, filtration and centrifugation. The virus particles thus available known as Polyhedral Inclusion Bodies (PIBs) (Fig. 2) are suspended in water. By adjusting the PIBs per unit volume of the solution, the concentration of the virus suspension can be determined. The virus suspension is stored at 20°C in deep freezer to retain the activity for longer period.

The virus suspension containing the required number of PIBs can be used as the spray solution which can be applied on teak trees infested with the teak defoliator. The dosage is to be fixed as per the larval age, age of the trees, area of plantation and the type of sprayer used. As older larvae require more number of PIBs to kill them, the ideal time to spray is when the larvae are in the third instar stage. Third instar larvae can be more easily detected on teak trees than first and second instars. Ultra low volume sprayers are useful for virus application on small to medium sized trees (upto 15 m) High volume motorised sprayers can be used for spraying tall trees upto 30-35 m.

Baculoviruses are liable to be inactivated when exposed to ulta violet rays in sunlight and hence stored in darkness. Because of this reason the virus suspension should contain suitable ultra violet protectants when applied on trees. One practical method to reduce the effect of ultra violet on NPV during spraying is its use in the evening hours. The other environmental factor affecting the viral application in the field is rainfall. To some extend addition of a sticker may be advantageous to prevent the washout in rain.

Use of baculovirus in teak defoliator management is an eco-friendly method. Even though baculoviruses does not ensure rapid kill of the pest larvae as in the case of a chemical pesticide, its use has some long term impact. Larvae dead due to infection fall on ground and the viral particles are released in the soil. Soil is considered to be a good store for the viral particles. The cost of production of the virus is considered to hamper the use of baculovirus as it involves a lot of labour. However such costs will be immaterial when the eco-friendliness of the organism is considered. KFRI has standardised methods for mass production of the virus and its application in plantations.

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Micro nutrients – role in the growth of teak seedlings

Along with macronutrients, micronutrients are also needed for the balanced nutrition and vigorous growth of teak seedlings. Due to the deficiency of micronutrients, plants develop various types of abnormalities such as chlorosis, yellowing, shortened internodes, long abnormal leaves and termination of apical growth (Fig.1).The deficiency of micronutrients leads to 18- 45 per cent reduction in the height of teak seedling during three months after planting and 20-52 per cent reduction six months after planting. Similarly the reduction in healthy leaves due to Cu and Zn deficiency is 38.5 per cent and 23.1 per cent due to Mn and Mo deficiency. At the severe stage of deficiency, the number of healthy leaves is 87.5 per cent less in Fe, Mn, and B deficient plants and 81.5 per cent less in Cu, Zn and Mo deficient plants than control(Figs. 2-6). The growth of root system is considerably affected when all the micronutrients are deficient (Fig.7). But, when each nutrient is considered individually, only the deficiency of Cu results in retardation of root growth.

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Fig.1.Micronutrients deficiency symptoms

Fig.2. Zinc deficiency symptom

Fig.3. Iron deficiency symptom

Fig.4. Molybdenum deficiency symptom

Fig.5. Boron deficiency symptom

Fig.6. Copper deficiency symptom

Fig.7. Growth of root system affected by micronutrient deficiency

Developing know-how for the improvement and sustainable management of teak genetic resources

Teak is a very important quality hardwood species used in plantations in tropical regions of Asia, Africa and Latin America. The unsustainable extraction of timber from tropical forests and the concomitant destruction of biodiversity has become a major cause for concern. Teak is widely planted by smallholders and used in agroforestry systems in Asia. It is estimated that teak plantations account for 5 to 8 per cent of the total forest area planted in the tropics, but account for 90 per cent all of the quality hardwood plantations for timber production. Teak genetic resources have been dramatically altered during the last 50 to 100 years through uncontrolled logging and movement of planting materials.

The area of natural teak forests has drastically reduced over the last 50 years and the remaining forests are still under threat from illegal logging and other forms of forest destruction. The impact of these anthropogenic disturbances on the maintenance of the teak germplasm is unknown.

Knowledge of the existing genetic diversity forms the basis of tree improvement programmes. Methods of tree breeding for higher productivity, quality and resistance to stress rely on the availability of a diverse genetic base. The markers developing in this proposal can further be used to identify accessions in breeding populations and for mapping and disease resistance linkage studies.

Although teak is an important plantation tree species in many tropical countries, genetic studies are limited. This project, sponsored by European Union, involves partners from six countries:

- KFRI, Peechi, Kerala, India
- Centre for Ecology and Hydrology, U.K.
- Bogor Agricultural University, Indonesia
- Kasetsart Univ., Thailand
- Institute for Plant Biotechnology for developing countries, Belgium
- Royal veterinary and Agricultural Univ., Denmark

The project aims to develop specific nuclear and chloroplast DNA marker tools that can be used in tree breeding programmes and in management of genetic resources. The developed markers will be applied to compile information on the geographical distribution of genetic diversity and gene flow at different spatio-temporal scales and in forest stands with different levels of human impact. This information will be integrated to draft guidelines for the efficient use of these resources in breeding and plantation programmes and future conservation and management of teak genetic resources.

Information on genetic diversity at different levels will be collected from a core set of populations and integrated. Specifically the following will be addressed:

1. Ancient migration routes and historical patterns of population differentiation compared to contemporary levels of gene flow
2. Diversity within selected forest stands from across the whole of its natural range; and
3. Levels of diversity and dynamics of gene flow in stands with different levels of human disturbance.

The objectives of the project are:

1. To trace and quantify genetic diversity of teak within its natural range, DNA markers for specific nuclear and chloroplast DNA sequences will be assayed to measure the current distribution of genetic diversity within and between populations, historical migration patterns and mating system.
2. To evaluate the amount of contemporary gene flow through polien and seed dispersal and parentage analysis using hyper variable nuclear DNA and
3. To assess the influence of human disturbance on the genetic diversity.

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Growth enhancement in *Dalbergia latifolia*

Dalbergia latifolia is a naturally slow growing high valued timber species. A study is being under taken at KFRI to enhance its growth through different soil management practices using seedlings, suckers and rooted cuttings. Rooting of shoot cuttings was possible by treating with IBA 5000 ppm. The results of the pot trials indicate that the application of both cow dung and compost in combination with fertilizers leads to 3-4 fold increase in the height of seedlings, suckers and rooted cuttings within six months(Figs.1-2).

Growth of suckers with treatments after 22 months in the field (about 2 m height) is shown in Figure 3.

Fig.1. Growth of seedlings at six month

Fig.2. Growth of suckers at six month

Fig.3. Growth of suckers in the field after 22 months

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Improving productivity of eucalypts through site management practices

The productivity of existing eucalypt plantations in Kerala is low by world standards and has been declining over successive rotations at many sites. A collaborative research programme between KFRI and CSIRO (Australia) supported by Australian Centre for International Agricultural Research, Australia was implemented in Kerala to investigate management options to improve productivity and maintain supply in the longer term.

The major component of the research is a series of experiments at 4 sites (two lowland sites with *Eucalyptus tereticornis* and two highland sites with *E. grandis)* investigating the effects of (i) harvest residue management (retaining or removing slash/ burning the slash), (ii) nutrient additions (application of N and P fertilizers at various levels), (iii) weed control (no weeding, strip weeding or complete weeding), and (iv) legume cover cropping (intercropping with legumes viz., *Stylosanthes hamata*, *Pueraria phaseoloides* and *Mucuna bracteata*). The treatments were applied during the inter-rotation and establishment phases.

Growth of eucalypts determined after four years of applying the various treatments have shown that residue management had no significant effect on tree growth. Addition of nitrogen significantly increased growth of eucalypts at two sites (one each with *E. tereticornis* and *E. grandis*). Significant growth increases were also found with phosphorous addition at one of the *E. tereticornis* sites. A small response to N and P addition recorded during the early

Reports of completed projects

KFRI Research Report No. 227, 65p, 2002. (Menon, A.R.R. and Vijayakumaran Nair, P.).

The forest map of Machad Range in Thrissur Forest Division has been prepared using Remote Sensing data products like Aerial photographs and Satellite imageries in 1:25,000 scale, together with the supplementary maps of drainage, physiography and elevation class. Standard photo interpretation techniques using photo elements and interpretation key were used for visual interpretation of remotely sensed data. Vegetation density slicing was done in three levels using canopy density status viz. high density area, medium density area and low density area. The thematic maps were further divided to in eight grids and grid maps were prepared in 1:25,000 scale for easy reference. To supplement the maps, information related to Reserves and Plantations in the Range is also appended.

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stages of growth (18 months) at the other sites were not significant at 4 years.

Thorough weeding in plots significantly improved growth in the two *E. tereticornis* sites. The magnitude of the response to weed control varied between sites, partly due to species difference in leaf area, and partly because the degree of competition from weedy vegetation varied depending on limitation of site resources. Within *E. grandis* sites, the responses were not significant, although there was a relationship between weed biomass and tree growth especially during the early stages of growth.

Legume intercropping had a small effect in depressing tree growth initially. This is probably due to competition for nutrients between trees and legume understory. However, this effect disappeared after 18 months and there was a consistent trend from then until 4 year measure of improving growth compared to control in one of the *E. tereticornis* sites. If this is a real effect, it is probably associated with nitrogen fixation by legumes, and subsequent enhanced supply of N to trees. In any case, legume intercropping may have positive benefits in the longer term not only due to fixation of atmospheric N but also due to greater input of nutrient rich organic residues to soil.

The study showed that through adoption of more intensive management practices, the eucalypt plantation productivity can be improved. The use of high quality seedlings is another requisite to achieve higher productivity of eucalypts in Kerala.

K.V. Sankaran
Division of Plant Pathology

KFRI Research Report No. 228, 31p, 2002. (Jose Kallarackal and Somen, C. K.)

This document reports the eco physiological aspects of a host-parasite relationship in teak infested with *Dendrophthoe falcata*. Diurnal measurements of water potential revealed that the parasite always maintained lower water potential than its host. Stomatal conductance (g_s) measurements indicated that teak is having stomata on the abaxial side only whereas *Dendrophthoe* possesses stomata on both sides of its leaf. The g_s values during pre-monsoon were almost similar in both host and the parasite with values less than 600 mmol m^{-2} s^{-1}. The low values of g_s indicated that both host and the parasite have good stomatal control during the stress period. Net photosynthesis (P_n) was higher in teak than in *Dendrophthoe*. Teak showed a maximum photosynthetic rate of 13 mmol m^{-2} s^{-1} against 9 mmol m^{-2} s^{-1} in *Dendrophthoe* during pre-monsoon. The post monsoon values of net photosynthesis for teak were much higher than that for *Dendrophthoe,* where P_n decreased to less than 4 mmol m^{-2} s^{-1}. The light availability to the parasite and host showed that the parasite received only 30% of the light as received by the host during post monsoon.

The integrated PAR (photosynthetically active radiation) received by the upper canopy increased up to 7000 mol m^{-2} h^{-1}, while the lower canopy of the mistletoe received a maximum of 2500 mol m^{-2} h^{-1}. Leaf temperature measurements indicated that both host and the parasite maintained 2 to 3°C higher temperature than atmospheric temperature. Sap flow measurements in an infected twig showed that the parasite had lower values of flux during morning and evening, which exceeded that of teak in the noon hours. Leaf number and leaf area developments of selected twigs showed that teak had minimum leaf number and area in January and February. Profuse leaf fall was noticed in teak during this period. In *Dendrophthoe* there was decrease in leaf area and number from November to January. Profuse flowering in teak occurred in July followed by fruit setting that ended in March. Sporadic flowering was also noticed in both cases. Nutrient analysis conducted using mature leaves collected from different plants of both host and the parasite from different locations indicated higher rates of Potassium in *Dendrophthoe* compared to teak. Ecophysiological studies on teak and the parasite *Dendrophthoe* reveal the high ecological and physiological adaptations of the parasite to survive on host tree.

KFRI Research Report No. 229, 2002. (Chacko, K.C., Pandalai, R. C., Balasundaran, M., Mohanan, C., Varma, R.V., Jose Kallarackal, Sujatha, M.P., Induchoodan, N.C. and Kumaraswamy, S.)

This project was aimed at standardizing aerobic composting and root trainer technologies for eight plantation species viz. *Tectona grandis, Eucalyptus tereticornis, E. grandis, E. globulus, E. camaldulensis, Acacia auriculiformis, A.mangium* and *Paraserianthes falcataria*, and comparing the field performance of root trainer plants with conventional planting stocks such as polypotted seedlings and stumps. The different components were aerobic composting of weeds and coir pith, root trainer design, potting media for different species, seed handling and seedling management, shade and irrigation schedule, mycorrhiza application and evaluation of field performance. Studies were not conducted on *E. globulus* as seeds could not be procured in time.

Production of compost from forest weeds and coir pith was investigated in detail. Potting media for *Tectona grandis, Eucalyptus tereticornis, E. grandis, Acacia auriculiformis, A.mangium* and *Paraserianthes falcataria* was standardized

using 64 combinations of weed and coir pith compost, forest soil and sand. Methods for sowing of seeds, pricking out of seedlings, control of pests and diseases and nutrient requirements were worked out in detail for *T. grandis* and in lesser detail for other species. Studies were also carried out on the effect of mycorrhiza on growth of seedlings and the methods of application in the nursery. Shade and irrigation requirements for all the species, were standardized for establishment, growing and hardening phases of seedlings in the nursery. A package of practices for composting and seedling production is provided.

Field evaluation in experimental plantations, showed better growth for root trainer–raised plants of *T. grandis* and *P. falcataria*. The growth of other species was marginally higher for polypotted seedlings. However, this observation was based on data for five months after planting. Data from plantations raised by the Kerala Forest Department did not provide evidence to differentiate the growth performance between root trainer seedlings and conventional planting stock of *T. grandis* and *A. auriculiformis*. Rooting depth of stump-planted *T. grandis* was greater than that of root trainer seedlings. Pest and disease incidences in plantations were also monitored. Sufficient number of plantations of *A. mangium* and *E. tereticornis* were not available to make any objective comparison between planting stocks.

Identification of promising provenances of new fast growing species and development of new eucalypt and acacia clones for establishment of Clonal Multiplication Area (CMA). KFRI Research Report No. 230, 2002. (Balasundaran, M., Sharma, J. K. and Maria Florence, E. J.)

Twenty one new candidate plus trees (CPTs) of *Eucalyptus tereticornis* (11), *E. camaldulenis* (2) and *E. urophylla* (8) were identified from the provenance trial plots and their half sib progenies maintained in the KFRI experimental plots at Kottappara in Kodanad range. Of these, 10 superior clones were identified and planted for field screening for productivity and resistance against Cylindrocladium leaf blight (CLB) and pink disease in clonal testing area (CTA). Forty five CPTs of *E. grandis* were identified, from which 25 clones were planted in clonal multiplication area (CMA) established at Devikolam, for multiplication and field screening for fast growth and disease resistance. A clonal propagation facility was established at Devikolam for vegetative multiplication of *E. grandis* and *E. globulus*, grown only at high elevations.

Initial attempts to multiply vegetatively 4-year-old CPTs identified in *Acacia auriculiformis, A. crassicarpa, A. peregrina* and *A. mangium* provenance trial plots at Kodanad were not a success probably due to increased age of trees and absence of irrigation facilities; the stumps failed to produce coppice shoots. However, *A. mangium* was successfully cloned through coppice shoots produced on pruned branches of older trees and 6- to18-month-old plants of *A. mangium* and mangium hybrid clones. Development of hedge garden by pruning acacia plants initially at 90 cm height at 6-18 month growth was the most efficient method of obtaining assured supply of juvenile coppice shoots for vegetative multiplication. Red soil and washed coir pith and their mixtures were the best rooting media for acacia cuttings.

About 74,000 ramets of 20 KFRI clones of *E. tereticornis* (9 clones), *E. camaladulensis* (8 clones) and *E. urophylla* (3 clones) and three Bhadra-chalam clones, and 5000 ramets of 10 mangium hybrid clones were supplied to the Kerala Forest Department for raising plantations. In addition, 50 ramets each of three new *E. urophylla* clones, two *E. tereticornis* clones, and one *Acacia mangium* clone, and 1000 ramets of 10 mangium hybrid clones of West Coast Paper Mills, Dandeli were also supplied to the central nurseries of the Forest Department for expanding CMA and testing the clones. Field performance of 3-year-old clones of *E. tereticornis*, and *E. camaldulensis* showed that MAI of more than 20 m^3 ha^{-1} yr^{-1} has already been achieved for a few clones. No pink disease infection was observed in any of the field-planted clones except a few plants of Bhadrachalam clones, BCM 7, BCM 83 and KFRI 7. CLB of low to medium intensity was observed on several clones such as KFRI 10, KFRI 14, KFRI 49, BCM 10, BCM 130, BCM 83, BCM 7 and BCM 119 during squally weather. However, infected plants recovered after cessation of heavy rainfall.

Growth of *Paulownia fortunei* and *P. coreana* was not encouraging when the growth was recorded up to 6 months. Clones of *Populus deltoides* attained a height of about 25 cm within 40 days at Kodanad and Devikulam.

Plantation technology for nine selected indigenous tree species of Kerala. KFRI Research Report No. 231, 2002. (Nair, K.K.N., Mohanan, C. and George Mathew).

To standardize the plantation technology of nine selected indigenous tree species of Kerala, namely *Calophyllum polyanthum* Wall. *ex* Choisy (*C. elatum* Bedd.), *Dysoxylum malabaricum* Bedd. *ex* Hiern, *Garcinia gummi-gutta* (L.) Robson (*G. cambogia* (Garten.) Descr.), *Gmelina arborea* Roxb., *Grewia tiliaefolia* Vahl, *Haldina cordifolia* (Roxb.) Ridsd., *Lagerstroemia microcarpa* Wt., *Melia dubia* Cav. and *Vateria indica* L., data were generated on the seed, nursery and plantation aspects of each of the species.

The plantation trial had shown that, in the case of *C. polyanthum*, seedlings can be raised from seeds without any pre-treatment or by vegetative propagation. *Dysoxylum malabaricum*, seeds available from natural stands are much affected by the *Daccus* pest and therefore pest free seeds are to be collected. Even though germination percentage is low, seeds without any pre-treatment is the best source to raise seedlings as the vegetative propagation method tried was not promising in propagule production. *Garcinia gummi-gutta* can also be regenerated artificially from the seed source, which gives 82.5 per cent germination, when sown after removal of the seed coat. In the case of *Gmelina arborea*, rooted cuttings is a potential source of propagules for planting, even though seeds collected from the droppings of deer gave 94 per cent germination. The species comes up well in moist deciduous forest areas. The moist deciduous species *Grewia tiliaefolia* can also be raised on a large scale from seeds, even though germination of seeds is maximum during the 10th month of sowing. An attempt to root juvenile stem cuttings of the species has also proved successful. *Haldina cordifolia* produces ample seeds which can be sown in polyurethane foams and later on pricked into polypots or root-trainers filled with vermiculite or compost (mixed weed or coir pith). Damping-off disease in very young seedlings is a major problem in the large-scale production of seedlings of the species, which can be controlled by the application of fungicides. In the case of *Lagerstroemia microcarpa*, the minute seeds can be sown in trays rather than in nursery beds with fungicidal pre-

treatment to check damping-off disease. From seed source, only 17 per cent seedling production was recorded, whereas vegetative propagation using juvenile stem cuttings gave 60 per cent; root-trainer method was also successful (32%). Seed germination in the case of *Melia dubia* is very poor and therefore, rooted cuttings can be a better alternative to raise plantations of the species.

There is no potential disease or pest problem in the seed, nursery and plantation phases of the species *Calophyllum polyanthum, Dysoxylum malabaricum, Gmelina arborea, Grewia tiliaefolia* and *Melia dubia*. Among the nine species tried, *Vateria indica* is the most potential species as far as plantation growth and seed germination is concerned. When the nine species were graded for their plantation potential, *G. arborea* comes first followed by *C. polyanthum, G. gummi-gutta, G. tiliaefolia* and *L. microcarpa*. The other four species namely *D. malabaricum, H. cordifolia, M. dubia* and *V. indica* showed certain drawbacks which need more attention from silvicultural point of view. As part of this study, separate 'Package of practices' on the plantation technology of the nine species have been prepared.

KFRI Research Report No. 232, 2002. (Chandrashekara, U. M. and Jayaraman, K).

Sixty permanent plots, each of 100 m x 50 m in size (0.5 ha in area), were established to represent major forest types viz. shola forest, evergreen forest, semi-evergreen forest, moist deciduous forest and dry deciduous forest in Kerala. Each 0.5 ha plot was in turn subdivided into 50 quadrats of 10 m x 10 m size, with quadrats permanently marked. Totally 21,239 trees (gbh > 10.1 cm) representing more than 327 species were tagged and identified. Tree seedlings (girth < 10.0 cm) were enumerated in 12 sub quadrats each of 5 m x 5 m in size in each plot.

In the shola forest plot, the estimated ratio between density of un-established seedlings and established seedlings was about 1.2:1.0 and the tree girth class distribution showed a negative expo-nential pattern. These observations indicated that the forest plot is relatively undisturbed and the tree regeneration is satisfactory.

Permanent plots established in evergreen forests are generally different from each other in terms of floristic richness and floristic composition. Same observation was made in the plots established in semi-evergreen forests and moist deciduous forests. While the forests disturbed by selective logging in the past are comparable with the relatively undisturbed plots for floristic richness, density and basal area, forests disturbed by under cropping cardamom are not. In majority of the evergreen forests, a negative exponential curve of girth class distribution was noticed.

In the semi-evergreen forest plots, about 50 to 72 percent of the tree species encountered are those seen in evergreen forests while the remaining are deciduous in nature. In some of the plots, evergreen species form the dominant population and their regeneration is also fairly high. Such plots seem to be floristically more stable due to less anthropogenic pressure at present. They have the potential to become climax evergreen forests.

In the moist deciduous forest plots, which showed signs of severe and continuous disturbance, seedling density is much lower than the tree density. In general, either occasional or continuous human-induced disturbances hinder the recruitment of stems from lower girth classes to higher girth classes and thus the girth class distribution curves in moist deciduous forests are not L-shaped.

In the dry deciduous forests, the density of seedling is less than that of trees. However, tree regeneration by root suckers and multiple shoot production could be the reason for higher values for tree density and basal area.

Since basic data were collected and all trees were marked, long term monitoring of these permanent plots can be undertaken to understand species-wise regeneration pattern and forest recovery processes, besides inventory of flora and fauna and evaluating their diversity.

KFRI Research Report No. 233, 2002. (Jayaraman, K.)

A total of 91 permanent sample plots were established in plantations of the following species *viz., Tectona grandis* (50), *Eucalyptus tereticornis* (15), *Acacia auriculiformis* (15), *Ailanthus triphysa* (3), *Gmelina arborea* (3), *Albizia falcataria* (3) and *Acacia mearnsii* (2). The basic purpose of the work was to study the stand dynamics based on remeasured data over a number of years so that useful information on growth and mortality of trees under varying site and stand conditions is obtained. The sample plots network was also to form a base for growth related ecological studies in the future. This report refers to only the initial phase of a long-term programme of establishment and monitoring a set of sample plots in forest plantations in Kerala.

Representative regions within each Territorial Circle in Kerala were selected and sample plots mostly of size 40 m x 40 m were laid out in these regions, in plantations belonging to different age groups. The locations of the plots were identified in terms of latitude, longitude, altitude and the site map, and their identity with respect to the Forest Division and Range was established.

Basic measurements on trees in the sample plots were made and the site features were recorded for each plot. The measurements on trees included girth at breast height, total height and crown diameter. Summary information on various stand attributes was generated and was documented in this report for future reference, in a systematic manner. These plots are to be remeasured periodically to generate information on growth rate. Certain guidelines for maintenance, future measurement and data analysis are also provided.

KFRI Research Report No. 234, 2002. (Sankar, S. and Chandrasekhara, U.M.)

Survey of home gardens was conducted in seven agro-climatic zones of the State. Home gardens were classified into small, medium and large according to size of the land holding. General features of the home garden, horizontal and vertical community structure, indices of diversity, contribution of home gardens to income of family were determined. In four agro-climatic zones intervention to enhance the productivity was attempted by introduction of annual crops, multipurpose tree species, medicinal plants, fruit crops and plantation/cash crops

after holding elaborate discussions with farmers and stakeholders.

In general, home gardens in all zones had high diversity with a greater index of diversity in large home garden. Large and medium home gardens contributed more to the family income than small home gardens. There was a tendency to practice monoculture in medium and large home gardens. Analysis of the vertical strata of home gardens provided information on space available for introducing multi-purpose tree species in home gardens. The same was more available in medium and small home gardens as the latter were already over saturated in the horizontal and vertical strata.

With in the existing framework of homesteads, with variations in the species choice and incorporation of multipurpose tree species, five homestead models are proposed. The models are coconut based, arecanut based, coffee based, mixed and tree based.

Government policies, markets, market signals and information play a major role in strengthening the home garden resource base. It is high time to promote introduction of Multi-Purpose Tree (MPT) species in home gardens, which requires creation of institution and mechanisms, supply of good quality planting materials, develop a package of practices for tree growing and management in home gardens, ensure realistic value assessment of wood and other products, provide value addition and market facilities. The Kerala Forest Department has been identified as the agency to promote cultivation of trees outside forests especially home gardens.

Ecosystem dynamics in relation to fire in different forest types. KFRI Research Report No. 235, 2002. (Balagopalan, M., Menon, A. R. R., Surendran, T., Mohanan, C. and Rugmini, P.).

The study in the Chinnar Wildlife Sanctuary and at Panthanthodu in the Anakkatty range of Mannarghat Forest Division in 2001, after the occurrence of an intense fire in 1985 at Chinnar Wildlife Sanctuary and in 1989 at Panthanthodu showed that there was marked difference in soil properties between Chinnar and Panthanthodu. With respect to recovery processes, the two ecosystems followed different trends. At Chinnar, soil fertility was the discriminating factor between burnt and unburnt plots. At Panthanthodu, soil texture, alkalinity and fertility were the three discriminating factors between completely burnt, partially burnt and unburnt plots. The ecosystem after the incidence of fire, even when protected fully, could not recoup to its parent stage.

In general, population of seedling in burnt areas was less compared to unburnt areas at Chinnar. The regeneration potential of trees, shrubs and herbaceous species was also relatively more in unburnt areas. At Panthanthodu, in general, the seedlings of different height classes were observed more in unburnt areas compared to burnt areas, especially the larger seedlings, having height more than 100 cm.

Studies carried out to assess the physiological stress to species due to fire revealed that except in few species, there were no apparent differences in physiological processes. Quantitative assessment on microbial population in soils revealed comparatively very high population of soil fungi, bacteria, actinomycetes and vesicular arbuscular mycorrhizal fungi in burnt soils than unburnt soils in both the forest ecosystems. Soil fungal species and genera occurred more in burnt soils than unburnt soils in both the forest ecosystems.

At Chinnar, the canopy closure was 15.65 per cent less in burnt plots when compared to unburnt plots. At Panthanthodu, the canopy closure was 71.76 per cent less in burnt plots and 34.89 per cent less in the partially burnt plots when compared to unburnt plots.

Based on the annual flow of goods and services per hectare, the loss due to fire is approximately computed for both Chinnar and Panthanthodu. At Chinnar, the loss ranged from Rs. 507/- to Rs. 1914/- per ha per annum in the burnt areas while at Panthanthodu, the values ranged from Rs. 15,276/- to 2,31,754/- in the burnt and Rs. 7427 to 1,12,680/- per ha per annum in the partially burnt areas.

The overall results suggested that the effect of fire on vegetation, soil and soil microorganisms still persists and the ecosystem has not recovered fully even after 15-17 years of occurrence of fire. There was also considerable loss due to fire.

KFRI Research Report No.236, 2002. (Sasidharan, N.).

Situated on the lap of Anamalai hills, in the revenue district of Palakkad, the Parambikulam Wildlife Sanctuary occupies an area of 274 km^2. The sanctuary abodes all the major vegetation types of the Western Ghats. Teak is the major plantation species covering about 87 km^2. During the study, specimens with 2165 field numbers were collected from the diverse habitats of the sanctuary representing 1434 species belonging to 755 genera under 142 families, including two gymnosperms. Among the angiosperms, dicotyledons dominate with 1119 species under 587 genera and 120 families while monocotyledons with 313 species under 166 genera and 20 families. Fabaceae, represented by 116 species under 52 genera, is the largest family followed by Poaceae with 86 species under 58 genera. Thirty-four families and 62 genera are represented by a single species in each.
The sanctuary is situated in the Anamalai-High Range centre of endemism. Three hundred and sixty species recorded from the sanctuary are endemic to Peninsular India of which 28 are exclusive to the Anamalai-High Range centre. One genus (*Haplothismia* Airy Shaw) and four species are so far known only from the sanctuary. Out of the 359 tree species, 25 per cent are endemic species. Among the 57 endemic genera of Peninsular India, 13 were recorded from the sanctuary.

The sanctuary abodes 109 species belonging to various threatened categories of which 10 are considered as *'possibly extinct'*. *Haplothismia exannulata* Airy Shaw and *Syzygium palghatense* Gamble were collected for the first time after their type collections. Endangered species like *Atuna travancorica* (Bedd.) Kosterm., *Piper barberi* Gamble, *Pothos crassipedunculatus* Sivad. *et al.*, *Morinda reticulata* Gamble, *Smithia venkobarowii* Gamble, considered restricted to southern Kerala, have now been recorded from the sanctuary.

Two new species *viz. Medinilla anamalaiana* Sasidh. & Sujanapal and *Pteroceras monsooniae* Sasidh. & Sujanapal could be described from the sanctuary. Species such as *Argyreia osyrensis* (Roth) Choisy, *Chlorophytum malabaricum* Baker, *Cocculus hirsutus* (L.) Diels, *Dalechampia*

scandens L. var. *velutina* (Wight) Muell.-Arg., *Heliotropium bracteatum* R. Br., *Heterophragma roxburghii* DC., *Meyenia hawtayneana* (Wall.) Nees, *Monothecium aristatum* (Wall. ex Nees) T. Anders. and *Triumfetta rotundifolia* Lam. are additions to the flora of Kerala. Though the sanctuary occupies only about 6 per cent of the total area of Palakkad district, the number of flowering plants collected during the study is more than the number of flowering plants recorded in the flora of Palakkad district.

KFRI Research Report No. 237, 2002. (Jayson, E. A. and Padmanabhan, P.)

Crocodiles ranging from 10 to 16 were estimated to be present in the Neyyar Reservoir. Availability of mammals was estimated using direct and indirect methods. Food in the form of fishes is sufficient whereas food in the form of large mammals is inadequate.

Human-crocodile conflicts were studied by interviewing the victims, visiting the sites of attack and also by structured questionnaire survey. Twenty-nine crocodile attacks on humans had occurred before the study was initiated and six attacks happened during the period of study. Two people died during the period of study due to the crocodile attacks. In addition to humans, incidents of attacks on livestock were also recorded.

Dependence of the local people on the reservoir was studied through sample survey. Local people utilise the reservoir for collecting drinking water, bathing, washing clothes, washing cattle, fishing and retting of coconut leaves. Apart from these, three ferry services are operated by Panchayath to cross the reservoir and for reaching the private holdings. Forty-one percent of them depend on the reservoir for drinking water. A majority of the local people depend on the reservoir for their daily needs.

Questionnaire survey conducted among the local population on the banks of the reservoir showed that, among the 150 families contacted, only 35 (23%) were willing to shift from the area to avoid crocodile attacks. Removing the crocodiles from the reservoir was considered as the appropriate solution by majority of them (61%). Eleven per cent of the families wanted all the crocodiles to be killed and removed. Nobody supported the idea of conserving the crocodiles in the Neyyar Reservoir in the present circumstances.

Four other reservoirs in the State were evaluated for relocating the crocodiles from the Neyyar Reservoir. None of the reservoirs was found suitable for the purpose. Infrastructure facilities are lacking in the captive breeding centre at Neyyar. A new pen may be constructed at Neyyar for keeping the problem-crocodiles caught from the Reservoir. A brochure on human-crocodile conflicts in Neyyar was prepared for distribution.

It is recommended to catch all the crocodiles above the size of 3 m from the reservoir to solve the human-crocodile conflict. Proper training on chemical immobilization of crocodiles may be given to the veterinary staff for efficient handling of large crocodiles without causing physical injury. Yearly census of crocodiles during the month of May is suggested to monitor the crocodile population in the reservoir, which will assist in the proper management of crocodiles in future. Public awareness programme may be initiated to educate the people on the precautionary measures.

KFRI Research Report No. 238, 2002. (Mohammed Kunhi, K.V. and Sankar, S.).

Pilgrims from Kerala and Tamil Nadu visit Agasthyamalai annually between January and April and worship Agasthyamuni, the doyen of Ayurveda. This pilgrimage involving thousands of pilgrims has been regulated from 1999 by the Kerala Forest Department. Being a hotspot of biodiversity, there is a growing concern over the degradation of the region and pilgrimage was attributed as one of the major reasons. During the year 2001, 3237 pilgrims visited Agasthyar peak from January to March.

The forest vegetation belongs predominantly to evergreen, semi-evergreen and moist deciduous types. There is a negative impact on regeneration due to visitation by trekkers all along the route. The increasing trends in number of pilgrims over the years raises anxiety, and calls for developing strategies to curtail detrimental factors.

It has been recommended to regulate the pilgrimage taking into account the sensitivity and supportive capacity of the site. Closure periods (rest years) have to be declared for the nature to recuperate. Institutions at the eco-development committee level have to be created so that they manage the pilgrimage and receive economic benefits. Awareness among pilgrims and other stakeholders concerned on Agasthyamalai has to be created and strict guidelines for the conduct of eco-friendly pilgrimage has to be provided.

KFRI Research Report No. 239, 2002. (Mammen Chundamannil).

Developing a visitor management strategy for three protected areas in Kerala, Eravikulam National Park, Parambikulam Wildlife Sanctuary and Neyyar Wildlife Sanctuary is the mandate of this report. Visitor management in protected areas is a new priority in both management and research in Kerala. The objective of the study is to develop an appropriate strategy for visitor management that will optimize visitor satisfaction and conservation priorities. The long term strategy developed aims at upgrading systems of management to raise the protected areas to the status of world-class sites for conservation, research, limited ecotourism and nature education.

Improving basic visitor amenities such as providing drinking water and clean toilets in all parks and making parks visitor friendly, especially women friendly, is a must. Documentation of visitor profile and activities and improving the capacity to monitor changes are essential. Human resource development in this area is a prerequisite. Pre-project environmental impact assessment of all proposed activities in protected areas to avoid disturbance to wildlife habitats, biodiversity conservation and other park values is recommended. Enhanced information availability and transparency in all aspects of park management are suggested. A database of park quality assessments is to be maintained by the Kerala Forest Research Institute. Participatory methods of monitoring and review by creating a new institution, 'Friends of the Park' is proposed. Involving local communities in providing visitor services and park planning has been suggested. Eco-development committees can serve to improve human resource

development within the local community to make them partners in resource conservation and visitor management. Visitor management strategies both short term and long term for the three protected areas are presented.

KFRI Research Report No. 240, 2002. (Anitha, V.)

Resource constraints and poor socioeconomic conditions coupled with easy accessibility to the WLSs explain the anthropogenic dependence/pressure on the study areas. Human consumptive use of resources and human land use practices are incompatible with conserving biological diversity. The existing harvesting systems do not have adequate technological and management backup. Causative factors of human-related constraints in conservation are, tenure issues, lack of community awareness, population pressures versus dwindling resources, unclear institutional arrangements, policy and legal framework, forestland allocation, political interference and market forces. The existence of enclave settlements, which tend to expand at the cost of the sanctuary is a potential threat in the long run. There is a lack of tenurial security among the tribals. Reasonable level of conservation awareness was assessed among the local communities (75%) based on the environmental quality attributes.

The study recommended that catchment area of Peechi reservoir is being subjected to unsustainable land use practices by means of clay mining and cultivation and associated use of pesticides. This may result in irreversible damage to the ecosystem and must be checked. The practice of leaving cattle for grazing in the WLSs for months together should be prohibited. The tenurial complexities in the sanctuaries need to be addressed in order to resolve the land-based conflicts. Firm control needs to be imposed in order to check further expansion of human enclaves within Peechi-Vazhani WLS. Sustainable management of NTFPs in the study areas can be achieved through a combined attempt of strengthening appropriate institutions with adequate management backup, participatory management involving the actual foragers, judicious use of products, adoption of scientific methods of extraction and value addition and practices of *in situ* and *ex situ* conservation. Landscape livelihood approach has to be adopted as a management strategy where along with the PA objectives, sustainable livelihood issues are also addressed in a participatory mode of management.

KFRI Research Report No. 241, 2002. (Ramachandran, K. K. and Kumaraswamy, S.).

A study in Eravikulam National Park and Wayanad and Aralam Wildlife Sanctuaries to know the adequacies of salts in soil, forage samples, water quality and suggest management strategies showed that water is available throughout the year and there is no visible water scarcity in Eravikulam National Park and Aralam Wildlife Sanctuary. On the other hand, water scarcity is observed in the months between January and April especially in Tholpetty, Kurichiat and Sulthan Bathery ranges of Wayanad Wildlife Sanctuary. Creation of artificial waterholes to meet the water requirement of the animals is suggested. The quality of water in the three protected areas falls within the permissible limits of drinking water and safe for animal use; pH was near neutral in all the water samples analyzed. Water of Wayanad Wildlife Sanctuary recorded higher levels of hardness but it is within the permissible limits. There was no anthropogenic pollution of water bodies in the three protected areas except alleged pesticide residues reaching the water stream in Aralam Wildlife Sanctuary. Letting in of the effluent of coffee processing unit was noticed in the Nadudana thodu of Tholpetty range in Wayanad Wildlife Sanctuary.

In Wayanad Wildlife Sanctuary, large number of natural salt licks were seen in Muthanga and Tholpetty ranges, which contain high amounts of sodium, calcium and magnesium. These salt licks were monitored during the different seasons of the year and interestingly some of the salt licks were sloughed in and not used by animals. There were no visible salt licks in Aralam Wildlife Sanctuary and Eravikulam National Park. Moreover, there was no sign of animals eating the soil especially near the water source. It appears that natural salt licks are not common in these two protected areas. However, surface soil samples collected from the protected areas were analyzed for the mineral element concentration. The amount of sodium, calcium and magnesium was lower in the surface soil samples as compared to the salt content recorded in the natural salt licks. No relationship could be established on elemental composition of forage samples and natural salt licks. Forage appears to accumulate lesser amount of elements in comparison to that of soil. The study suggested that in the Eravikulam National Park, water is abundant and construction of check dams or artificial water bodies is not required. Artificial salt licks should not be provided till detailed studies on their impact on wildlife health and behaviour are conducted.

In the Wayanad Wildlife Sanctuary, construction of artificial water holes is needed in Tholpetty, Kurichiat and Bathery Ranges where there is shortage of water during January to April. There is need for maintenance and desilting of existing water holes/check dams at least every three years.Check dams should be constructed only at first/second order streams and should not block the free flow of water.

KFRI Research Report No. 244, 2002. (Jayson, E. A.)

A total of 182 species of birds, belonging to 16 Orders and 47 Families were recorded in the Kole wetlands of Thrissur, Kerala,. Among these, 24 species were new additions to the area. Of the 182 species, 44 were migratory species, and 34 waders. Passeriformes were the maximum represented species followed by Charadriiformes, Ciconiiformes and Falconiformes. There were 45 species of insectivores followed by 41 omnivores and 43 aquatic feeders. Little Egret (*Egretta garzetta)*, Cattle Egret (*Bubulcus ibis)*, Little Cormorant (*Phalacrocorax niger)*, Pond Heron (*Ardeola grayii)*, Median Egret (*Egretta intermedia)* and Whiskered Tern (*Chlidonias hybrida)* were the most abundant species in the Kole wetlands. Species richness (x = 120) and total number of birds (x= 5436) increased during the migratory period and decreased during the South-West monsoon.

Total number of birds varied from 35 to 8033 individuals in a month. Highest number of birds was observed during November and

lowest in July whereas highest density was found in December (25,000 birds/ha). Little Egret was the dominant species and among the ducks, Garganey showed the highest density. Highest number of species was recorded in December and lowest in June. Species diversity index (H') ranged from 0.83 to 1.69 in the four study sites. High diversity indices of birds showed the conservation value of the wetlands. Among the four intensive study sites, highest number of birds was recorded from Kanjany. Total number of birds, monthly density and species richness declined during South-West monsoon season and increased during the migratory period (September to March). As varied microhabitats were available, both diving species and those species which rely on shallow waters, were sighted.

Whiskered Tern (*Chlidonias hybrida),* Wood Sandpiper (*Tringa glareola),* Little Ringed Plover (*Charadrius dubius),* and Redwattled Lapwing (*Vanellus indicus)* were the common waders. Critically endangered waders, namely Curlew (*Numenius arquata),* Green Shank (*Tringa nebularia)* and Curlew Sandpiper (*Calidris testacea),* were also recorded. Species richness of waders varied from 7 to 23 and total number of birds varied from 2481 to 13948. Highest number of waders was recorded during November and December.

Population fluctuations of seven migratory species are presented. Damage to paddy cultivation by birds and important conservation problems recorded from the area are also elucidated. Measures needed to contain the problems are discussed. The proposal to declare this wetlands as one of the Ramsar sites, if materialised, will save the migratory birds from indiscriminate poaching and the habitat also will be protected. The wetlands come under the Central Asian-Indian flyway of continental migrants and their conservation is important for the migratory birds.

KFRI Research Report No. 245,18p, 2002. (Pandalai, R. C.)

A field experiment on the feasibility of introducing different rattan species as an under crop in rubber plantations was carried out at Athirappally Estate (10^0 17' North latitude and 76^0 27 East latitude) Kalady plantation of Vazhachal Division belonging to the Plantation corporation of Kerala Limited. The initial establishment rate of rattan seedlings in rubber plantation was promising with *Calamus hookerianus* Becc. and *Calamus thwaitasii* Becc. and Hook.f showing above 90 per cent survival towards the end of 24 months. Seedlings of these species also attained maximum height during this period. However, lack of protection, especially from grazing animals, brought down the survival percentage of the seedlings. Of the different species tried, *Calamus hookerianus* and *C. thwaitesii* were the promising ones that could recoup even after physical injury from grazing. Production of the climbing organ in rattan – flagellum, started from the third year of under plannting. Management of this thorny whip like organ that can interfere with tapping activity in rubber plantation is a very important silvicutural aspect that has to be studied in detail before attempting larger scale under planting of rattan in rubber plantations.

New Research Projects

KFRI 380/02: Assessing vulnerability and climate change impacts on the vegetation structure and composition in wet evergreen and Shola forests of Kerala part of the Western Ghats (U. M. Chandrashekara-Winrock International India) (Rs. 2.50 lakhs).

KFRI 383/02: Establishment of a Forest Seed Centre (FSC). (K. C. Chacko - Kerala Forestry Project - World Bank) (Rs. 55 lakhs)

Consultancy projects

KFRI Cons.01/02-03: Wood Quality Evaluation of Bhadrachalam Clones of Eucalypts- Bhadrachalam Paper Mills

KFRI Cons. 97/2002: Training workshop on statistical applications in forestry research- Ministry of Environment & Forests, Govt. of India.

KFRI Cons. 98/2002: Production and supply of Kadam seedlings - Apsara Plastics Pvt. Ltd., Mumbai

KFRI Cons.100/2002: Preparation land cover map of Senthurney Wildlife Sanctuary - Kerala Forest Department.

KFRI Cons.101/2002: Transpiration and soil moisture measurement using SFM and TDR- CWRDM, Calicut.

KFRI Cons.102/2002: Wildlife Population Estimation, 2002 – Kerala Forest Department.

Extension Projects

KFRI Ext.01/02: Timber identification and testing - Dr. K.M. Bhat

KFRI Ext.02/02: Production and supply of seedlings of various forestry species - K.C. Chacko

KFRI Ext.03/02 : Statistical consult-ancy and sale of statistical software developed at KFRI - K Jayaraman

KFRI Ext.04/02 : Extension work for the Kerala Forest Department - R. Gnanaharan

KFRI Ext.05/02 : Supply of seeds and clonal planting stock - M. Balasundaran

KFRI Ext.06/02 : Workshop on Specialized PA Management - P.S. Easa

KFRI Ext.07/02 : Workshop on Wildlife Management in Plantations - P.S. Easa

KFRI Ext.08/02 : Supply of seedlings- R.C. Pandalai, T.Surendran and C. Renuka

KFRI Ext.09/02 : Regional Workshop on Community Conserved Biodiverse Areas with special reference to Sacred Goves in Kerala - U.M. Chandrashekara

KFRI Ext.10/02 : Establishment of green belt around Laloor, Trichur – K.C. Chacko, R.C. Pandalai and P.K.C. Pillai

KFRI Ext.11/02 : GIS Consultancy, preparation of maps, image processing and sale of software tools - P. Vijayakumaran Nair

KFRI Ext.12/02 : Technical Seminar on Bamboo Development -M.S. Muktesh Kumar

KFRI Ext.15/02 : Soil analyses and recommendation of nutrient management - M. Balagopalan

KFRI Ext.16/02 : Training programme for Foresters and Forest Guards-P.S. Easa

Extension works

The Soil Science Division carried out analyses of soil and plant samples of teak, eucalypt *(Eucalyptus tereticornis, E. camaldulensis and E. grandis)* and acacia *(Acacia auriculiformis* and *A. mangium)* as per the request of Kerala Forest Department and Kerala Forest Development Corporation for recommendation of fertilizers and recommendations were given. The Division also analysed compost samples from Central nurseries of Kerala Forest

Department as well as from private organizations for physical properties and nutrient status.

The Physiology Division supplied bamboo seeds and rooted cuttings of Plus trees of teak to Kerala and Karnataka Forest Departments.

The Statistics Division carried out an estimation of growing stock of *Eucalyptus tereticornis* in 1998 Perumkunnu plantation, Wadakkan-cherry Range.

Wood Science Division was engaged in services like timber identification, determination of density, moisture content, chemical preservatives for Kerala Forest Department, Sales Tax Office, Neyveli Lignite Corporation and private parties.

Preparation of a development plan for the upper Moozhiyar micro-watershed area in Goodrical Range in the Ranni Forest Division - Dr. M. Balagopalan (Soil Science Division).

Assessment of the impact of fire in Vadasserikkara, Ranni and Goodrical Ranges in the Ranni Forest Division as per the request of Addl. Director General of Police and Commandant General, Fire Force, Govt. of Kerala - Drs. M. Balagopalan (Soil Science Division), K. Swaroopanandan (Ecology Division) and Mammen Chundammannil (Economics Division).

Quality evaluation of converted timber stored in Chottanikkara Temple and assessment of the sandal wood from illicit felling of trees in the Kerala Agricultural University Campus - Dr. K. M. Bhat (Wood Science Division).

Preparation of a brief write-up on Adverse effect of deforestation for transmission to STEC and

Evaluation of the weeding operations being undertaken in the Ranni, Konni and Punalur Forest Divisions under Kerala Forestry Project – Sri. K. C. Chacko and Dr. U. N. Nandakumar (Silviculture Division).

Assessment of the impact of various forest management operations in the natural forests and plantations under Kerala Forestry Projects on biodiversity in Forest areas of High Range Circle and HNL Captive plantation at Kulamavu - Sri. K. C. Chacko and Drs. U. N. Nandakumar (Silviculture Division), N. Sasidharan (NWFP Division) and A. R. R. Menon (Ecology Division).

Examination of material objects involved in various forest offences - Dr. P.S. Easa (Wildlife Division).

Technical assistance on field and laboratory measurements to the B.Sc. and M.Sc. students of College of Agriculture and College of Forestry, Vellanikara - Drs. Jose Kallarackal and C.K. Somen (Physiology Division).

Assistance to the Advocate Commission for evaluating extractable timber quantity from Karuna Plantation, Munnar as per the request from High Court of Kerala - Drs. A. R. R. Menon (Ecology Division) and C. Mohanan (Pathology Division).

Assessment of status of encroachment in Kuttampuzha Forest Range using GPS - Drs. A. R. R. Menon (Ecology Division) and P.Vijayakumaran Nair (FIS Unit).

Enquiry regarding undervaluation of trees for Transformers and Electricals Kerala Limited (TELK), Angamaly - Drs. U. N. Nandakumar (Silviculture Division), C. N. Krishnan Kutty (Statistics Division) and K. V. Bhat (Wood Science Division).

Technical expertise pertaining to animal poaching and monkey menace problem referred to by the Divisional Forest Officer, Kozhikode - Dr. K. K. Ramachandran (Wildlife Division).

De-centralised plan preparation – 10 Five Year Plan - Panancherry Panchayath - Dr. S. Sankar (Agroforestry Division) and Sri. Mohammed Kunhi (Extension Division).

Technical expertise for correction of the scientific names of plants in the Working Plan of Ranni Forest Division - Dr. N. Sasidharan (NWFP Division).

Technical advice on planting stock production to the Staff of the Kerala Forest Department - Dr. K. K. Seethalakshmi and Shri. V. P. Raveendran (Physiology Division).

Control measures on managing the borer problem in mango orchard in Kolkata - Dr. R. V. Varma (Entomology Division).

The Entomology Division investigated the termite problem in eucalypts plantation raised by KFDC, Trichur during September 2002 and suggested advice on control measures.

The Pathology Division attended to the following problems in the nursery and plantations in different Forest Ranges and KFDC.

Species	***Problem attended***	***Forest Range***
Acacia mangium	Wilting	Palappilly
Acacia mangium	Die back and wilt	Palode
Albizia falcataria	Web blight	Palappilly
Tectona grandis	Bacterial wilt in nursery	Konni
Tectona grandis	Bacterial wilt in nursery	Pathanapuram
Tectona grandis	Bacterial wilt in nursery	Olavakkode
Eucalyptus sp.	Cylindrocladium leaf blight	KFDC Central Nursery (Arippa)

Campus News

Teak Museum Curator: Mrs. Sani Lukose, who was working in Natural History Museum, New Delhi joined as Teak Museum Curator, Nilambur Sub Centre in August 2002.

Dr. K. M. Bhat (Wood Science Division) attended the ITTO Workshop on Further processing of tropical timbers in Asia Pacific Region at Gyeongju, Korea during 9-12 July, 2002 and presented a country report for India "Utilization of tropical timbers of fast growing plantations in India" by Bhat, K.M. and Chadha, A.R.

Drs. T. K. Dhamodaran (Wood Science Division), Mohammed Kunhi (Extension Division), M. S. Muktesh Kumar and C. Renuka (Botany Division), R.C. Pandalai (Silviculture Division) and S. Sankar (Agroforestry Division), Sri. K. Sanakara Pillai (Library) Drs. K. K. Seethalakshmi and C. K. Somen and Sri.V. P. Raveendran (Physiology Division) attended the interaction workshop on Bamboo resource development and utilization in Kerala 22 July 2002, Thiruvanantha-puram, Kerala.

Dr. P. S. Easa (Wildlife Division) participated as an expert in the

Brainstorming session on Integrating biodiversity concerns in environmental impact assessment discussion meeting organized by NEERI, Nagpur on 12 July 2002 and

Kudumbasree training programme on 30th April, 2002 at Pananchery Panchayath Office

Dr. E. A. Jayson (Wildlife Division) attended Capacity building training workshop on sea turtle conservation and management at Central Marine Fisheries Research Institute, Cochin from 19-21 June, 2002.

Sri. P. Padmanabhan (Wildlife Biology Division) participated in the Workshop on Chiroptera Conservation International for South Asia (CCISA) at Madurai Kamaraj University on 25 – 29, June 2002.

Indira, E. P. and Mohanadas, K. 2002. Intrinsic and extrinsic factors affecting pollination and fruit productivity in Teak (*Tectona grandis* L.f.). *Ind. J. Genetics & Plant Breeding*. 62 (3): 208- 214.

Sudheendrakumar, V. V. 2002 Bioecology of *Sympiesis hyblaeae* (Hymenoptera: Eulophidae) a parasitoids of the teak defoliator, *Hyblaea puera* Cramer. *J. Biol.Control* 16: 97-101.

Mohanan, C., Chacko, K. C., Seethalakshmi, K. K., Sankar, S., Renuka, C., Muraleedharan, E. M. and Sharma, J. K. 2002. Proceedings of the National Workshop on Policies and Legal Issues in Cultivation and Utilization of Bamboo, Rattan and Forest Trees in Private and Community Lands. Kerala Forest Research Institute, Peechi. 221 p.

Seethalakshmi, K. K., Sankar, S. and Sharma, J. K. 2002. Proceedings of the Interaction Workshop on Bamboo Resource Development and Utilization in Kerala. 28p.

Chandrasekhara, U.M., Abdul Salam, K.A. and Sankar, S. 2002. Issues impeding growing and use of trees and other forest species in Kerala: A stake holder analysis. In: Mohanan, C., Chacko, K. C., Seethalakshmi, K. K., Sankar, S., Renuka, C., Muraleedharan, E. M. and Sharma, J. K. (Eds.) Proceedings of the National Workshop on Policies and Legal Issues in Cultivation and Utilization of Bamboo, Rattan and Forest Trees in Private and Community Lands. Kerala Forest Research Institute, Peechi. p.171-179.

Muraleedharan P. K., Seethalakshmi, K.K., Raveendran V.P. and Sreelakshmi, K. 2002. Some policy changes for promoting rattan industry in Kerala. In: Mohanan, C., Chacko, K. C., Seethalakshmi, K. K., Sankar, S., Renuka, C., Muraleedharan, E. M. and Sharma, J. K. (Eds.) Proceedings of the National Workshop on Policies and Legal Issues in Cultivation and Utilization of Bamboo, Rattan and Forest Trees in Private and Community Lands. Kerala Forest Research Institute, Peechi. p.85-89.

Seethalakshmi, K. K. 2002. Cultivation and utilization of bamboos. In: Seethalakshmi, K. K., Sankar, S. and Sharma, J. K. (Eds.) Proceedings of the Interaction Workshop on Bamboo Resource Development and Utilization in Kerala. 28p.

1. Commercial Rattans of Kerala - C. Renuka and K. M. Bhat
2. Oil Curing Technology for value-added Ratan (Cane) Products -T. K. Dhamodaran and K.M. Bhat
3. Commercial Bamboos of Kerala – M.S. Muktesh Kumar
4. Nursery and Silvicultural Techniques for Rattans -C. Renuka, R.C. Pandalai and C. Mohanan
5. Preservative Treatment of Bamboo and Bamboo Products - R. Gnanaharan and C. Mohanan
6. Protection of rattan against fungal stains -C. Mohanan
7. Micropropagation of bamboo and cane - E. M. Muralidharan

Regional workshop sponsored by Winrock International India, New Delhi on Community Conserved Biodiverse Areas with special reference to Sacred Groves in Kerala during 27-28 July, 2002 at the KFRI Subcentre, Nilambur – Dr. U. M. Chandrasekhara (Sub Centre, Nilambur).

Training programme for Forest Officials on Wildlife population Estimation Techniques as a part of the Wildlife Population Estimation at various parts of Kerala from 17 to 19 and 22 and 24 April, 2002 - Dr. P.S. Easa (Wildlife Division).

State Steering Committee Meeting of NBSAP held at the office of the Science, Technology and Environment Committee, Thiruvananthapuram on 25 June, 2002 - Dr. P. S. Easa (Wildlife Division)

Workshop on National Biodiversity Strategy and Action Plan at Kerala Forest Research Institute, Peechi during 8-9 July, 2002 - Dr. P. S. Easa (Wildlife Division).

Workshop on Specialized Protected Area Management for Forest Officials at Kerala Forest Research Institute, Peechi during 29-31 July, 2002 - Dr. P.S. Easa (Wildlife Division).

Training programme for College teachers on Biodiversity Monitoring Programme at Vazhachal during 5-7 September, 2002 - Dr. P. S. Easa (Wildlife Division).

Training programme for Foresters and Forest Guards from Munnar Wildlife Division on Strengthening Sustainabi-lity of PA system at Kerala Forest Research Institute, Peechi during 18-20 September, 2002 - Dr. P. S. Easa (Wildlife Division).

Orientation programme organized by Malayattoor Forest Division for Newly recruited Forest Guards at Chalakkudy on 22 September, 2002 - Dr. P. S. Easa (Wildlife Division).

Training Workshop on Statistical Applications in Forestry Research at Kerala Forest Research Institute, Peechi during 6 –10 May,

2002 with the collaboration of Ministry of Environment and Forests, New Delhi - Dr. K. Jayaraman (Statistics Division).

Workshop at the Neyyar Wildlife Sanctuary on 10 April 2002 in connection with preparing a Visitor Management Strategy for Neyyar - Drs Mammen Chundamannil (Economics Division) and K. K. Ramachandran (Wildlife Division).

Seminar on Bamboo Development organised by Dept. of Industries, Govt. of Kerala, Kerala, Bureau of Industrial Promotion, Kerala State Bamboo Corpo-ration, UN-APCTT and Dept. of Science & Tecnology, Govt.of India on 15 May, 2002 – Dr. M. S. Mukthesh Kumar (Botany Division).

Short training course for M.Sc. Students in Plant Biotechnology (Plant Tissue Culture, Attachment Scheme) during 25 April 4 May 2002 - Dr. E. M. Muralidharan (Genetics Division).

Training in Bamboo and Rattan Tissue culture to Staff from SFRI, Itanagar as part of the UNDP-Min. of Textiles, Govt. of India project during 26 -31 August, 2002 - Dr. E. M. Muralidharan (Genetics Division).

Training programme on How to establish a forest nursery for a Kudumbashree unit from Pavaratti Panchayath.- Dr. S. Sankar (Agroforestry Division).

Interaction workshop on Bamboo Resource Development and Utilization in Kerala sponsored by Development Commissioner (Handicrafts), Ministry of Textiles, Government of India, New Delhi and United Nations Development Programme, New Delhi at Thiruvananthapuram on 22 July 2002 - Dr. K. K. Seethalakshmi (Plant Physiology Division).

Training received

International

The 2002 TCDC China international training course in Bamboo Technology at Hangzhou, Nanjing, Shenzhou, Dequin and other places in Zhejiang and Jiangsu Provinces from 9th May to 26th July 2002 - Dr. E. M. Muralidharan (Genetics Division)

National

Course on DNA Recombinat Technology conducted by Central Facility for Biotechnology Research, Madurai during 6-18 June 2002 - Dr. V. V. Sudheendrakumar (Entomolgy Division).

Guest lectures

Bamboo utilization with special emphasis on preservative treatment during 3-05-02, 25-06-2002, 26-06-02, 31-07-02, 1-08-02, 13-08-02, 31-10-02 in KFRI and for outside agencies (NGOs) and

Technology transfer on wood utilization at Wood CFC, Cherppu, Thrissur on 23 July, 2002 - Dr. T. K. Dhamodaran (Wood Science Division).

Biodiversity Conservation challenges in the National Seminar on Current Environmental Problems and Management organized by Christ College, Irinjalakkuda on 1 August, 2002 and

Biodiversity measuring and monitoring in the Refresher Course in Zoology organized by Mangalore University on 26 September 2002 - Dr. P.S. Easa (Wildlife Division).

Methods of genetic improvement of pulpwood species: Provenance trial and selection of plus trees of eucalypts and acacia on 14th March 2002 in connection with the workshop/training on Identification of provenances of new fast growing species and development of clones of eucalypts and acacia given to Forest Officials at KFRI, Peechi during 14th to 16th March 2002 - Dr. E. P. Indira (Genetics Division).

Identification of indirect evidence of mammals for the benefit of Forest staff from Idukki Wildlife Division at Kerala Forest Research Institute on 20 Sept. 2002 - Dr. E. A. Jayson (Wildlife Division).

Forest mapping and inventory at Olavakkode on 26 March, 2002 - Dr. A. R. R. Menon (Ecology Division).

Bamboo Utilization in China during a training programme for Women's Self Help Groups on August 1st 2002 at KFRI, Peechi - Dr. E. M. Muralidharan (Genetics Division).

Environmental significance of forests and its conservation to the participants of Legal Literacy Camp, organised on World Environment Day (5th June, 2002) at Collectorate Conference Hall, Palakkad by District Legal Services Authority (DELSA) and Peoples Council for Social justice,

Forest Degradation for the Ranger trainees from SFS College, Coimbatore on 21 September 2002 and

General forestry -current practices, participatory forest management including JFM and VSS and role of computer aided modern management to newly recruited of Forest Guards of Kerala Forest Department as part of their induction training at Vazhachal - Dr. U. N. Nandakumar (Silviculture Division).

Silviculture of forest tree species during the orientation programme for Forest guards of Central Circle held at Central Nursery at Chettikulam on 20 September, 2002 - Dr. R. C. Pandalai (Silviculture Division).

Plant Wealth of Kerala on 14 May 2002 - Dr. N. Sasidharan (NWFP Division).

Propagation of tree species to the newly recruited Forest Guards at Chettikulam Central Nursery.

Vegetative propagation and demonstration on mist propagation system to M.Sc. and B.Sc. students of S. N. College, Nattika and Vimala College, Thrissur and

Vegetative propagation of tree species to a group of farmers and agriculturists from South Kerala Agricultural Society during their visit to KFRI - Dr. T. Surendran (Physiology Division).

KFRI CD1: KFRI Research Reports 1-200

This CD contains full text of 200 research reports published during 1979 - 2000. It is very user friendly and has been provided with author and subject Indexes and other search facility to facilitate easy retrieval of information. The CD will be very useful to know the contributions of KFRI to tropical forestry by way of research. The CD will be a very good source of information to forest officials, scientists, students and teachers, planners, etc.

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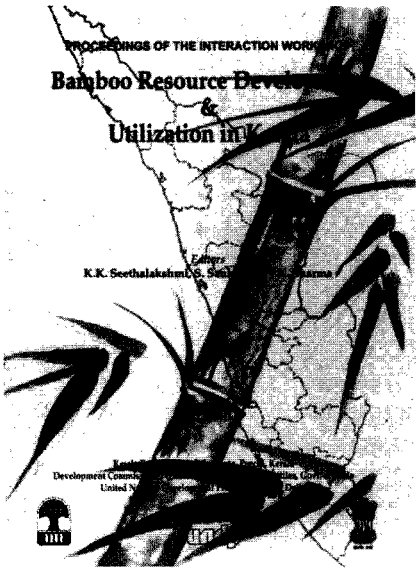

Bamboo Resource Development & Utilization in Kerala: Proceedings of the Interaction Workshop

K.K. Seethalakshmi; S. Sankar; J.K. Sharma

Papers presented in the Interaction Workshop on topics like opportunities available in bamboo sector in India, initiatives taken to improve bamboo handicrafts by the Office of the Development Commissioner (Handicrafts), bamboo development scheme of Kerala, standard setting process like certification of raw material and support and services available for bamboo cultivation and industries have been put together in this proceedings.

Softbound; 18 x 24 cm; 28 pages; published in 2002; Rs.25/US $10 (ISBN 81-85041-37-7)

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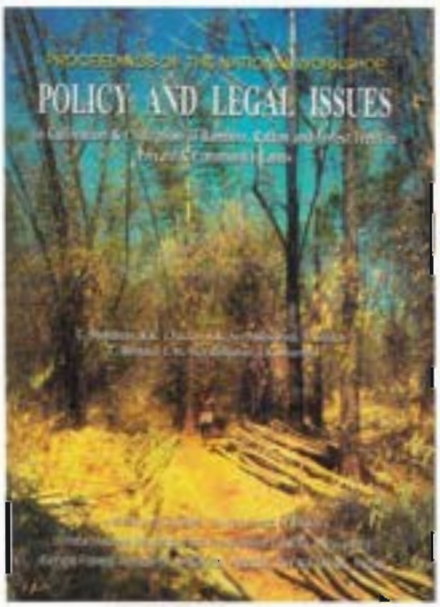

C. Mohanan; K.C. Chacko; K.K. Seethalakshmi; S. Sankar; C. Renuka; E.M. Muralidharan; J.K. Sharma

Information regarding Acts and rules pertaining to cultivation, harvesting, transporting, etc. of various tree species in private and community lands of different states is brought together in this proceedings. In various articles the constrains met by farmers and traders are indicated. Recommendations include amendments of existing rules and regulations to favour the farmers and traders in growing trees and their marketing.

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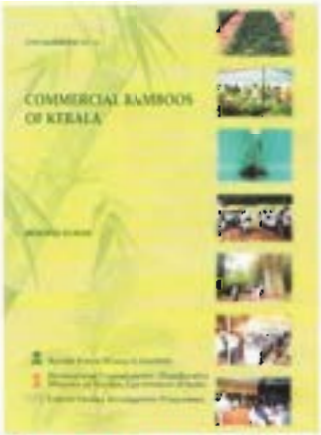

Commercial Bamboos of Kerala

Muktesh Kumar

Nine species out of 22 native bamboos of Kerala are found widely used in the traditional and handicraft industry in Kerala. All the available information on each species of bamboo used for handicrafts in Kerala with regard to their properties and uses, accompanied by brief morphological description for easy identification are provided. This publication will be of help to all those who are concerned with bamboo and bamboo products.

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Releasing Shortly

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N. Sarojam

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Forthcoming Events

1. 26 May-6 June 2003. 3rd Session of the United Nations Forum on Forests. Geneva, Switzerland. Mia Soderlund, UNFF Secretariat; Tel 1-212-963 3262; Fax 1-212-963 4260; unff@un.org;www.un.org/esa/sustdev/forests.htm
2. 6-9 June 2003. China Furniture & Woodwork 2003. Dalian, China. Dalian Northern International Exhibition Centre Co, Ltd; Tel 86-411-230 6845; Fax 86-411-230 9769; bfzl@runsky.com
3. 15-18 June 2003. 2nd International Precision Forestry Symposium. Seattle,USA. Forestce, University of Washington, Box 352111, Seattle WA 98195-2111, USA; Fax 1-206-685 6705; ForestCE@u.Washington.edu; www.cfr.Washington.edu/Outreach/PreFor/index.html
4. 16-18 July2003. China Wood Export & Import Confrence 2003. Shanghai, PR China. Jane Guo; Tel 86-10-8235 7166; Fax 86-10-8235 8779; exporter@chinawood.org; www.chinawood.org/english/chukou/3.asp
5. 13-15 August 2003. 6th Brazilian Symposium on Forest Trasportation. Belo Horizonte, Brazil. Prof Carlos Cardoso Machado; sif@mail.ufv.br
6. 7-10 September 2003. Council on Forest Engineering 26th Annual Meeting; Forest Operations Among Competing Forest Uses. Bar Harbor, Main, USA. Council on Forest Engineering. 620 SW 4th Street, Corvallis, OR 97333, USA; Tel 1-541-754 7558; Fax 1-541-754 7559; office@cofe.org; www.forest-resources.umaiane.edu/nercofe/cofe2003.htm
7. 8-12 September 2003. Applications of Statistics, Information Systems and Computers in Natural Resourses Monitoring and Management. Taipei, Taiwan Province of China. Biing T.Guan, Department of Forestry, National Taiwan University, Taipei, Taiwan Province of China 10617: Fax 886-2-2363 9247; btguan@ccms.ntu.edu.tw;http://ccms.ntu.edu.twu/-btguan
8. 8-17 September 2003. V World Parks Congress. Durban, South Africa. Peter Shadie, Executive Officer, 2003 World Parks Congress, IUCN Programme on Protected Areas, Rue Mauverney 28, 1196 Gland, Switzerland; Tel 41-22-999 0159; Fax 41-22-999 0025; pds@iucn.org;http://wcpa.iucn.org/wpc/wpc.html
9. 9-12 September 2003. Woodmac Asia/FurniTek Asia. Singapore. Singapore Exhibition Services Pte Ltd; Tel 65-6738 6776; Fax 65-6732 6776; events@sesmontnet.com
10. 21-28 September 2003. XII World Forestry Congress. Quebec City, Canada. XII World Forestry Congress. PO Box 7275, Charlesbourg, Quebec GIG SES, Canada; www.wfc2003.org
11. 29 September-4 October 2003. VII Congerso Latinoamericano de Estudiantes de Cs. Forestales. Pucon, Chile. Fco. Salazar No 01145 Casilla 54-D, Temuco, Chile; Tel 56-45-325641; Fax 56-45-341467; Vanefor2002@yahoo.es
12. 2-4 October 2003. World Congress on Export Potential of Medicinal Plants and Primary Health Care for Tribal Development. Delhi, India. Secretary General, World Congress on Export Potential of Medicinal Plants and primary Health Care for Tribal Development, 'Vasundhara Bhavan', E-4 Patel Nagar, Raisen Rd, Bhopal 462021, India; Tel 91-755-754941; sugundh-09@satyam.net.in www.thegreenearth.org
13. 3-6 October 2003. 3rd International Wildland Fire Conference & Exhibition. Sydeney, Australia,Sponsored by ITTO. 3rd International Wildland Fire Conference and Exhibition Managers. GPO Box 128, Sydeney NSW 2001,
14. Australia, Tel 61-2-9248 0800; Fax 61-2-9248 0894; wildlando3@tourhosts.com.au; www.wildlandfireo3.com
15. 19-31 October 2003. 6th Conference of the Parties to the Convention to Combat Desertification. Bonn, Germany. CCD Secretariat; Tel 49-228-815 2800; Fax 49-228-815 2898/99; secretariat@unccd.int; www.unccd.int
16. 3-8 November 2003. 35th Session of the International Tropical Timber Council. Yokohama, Japan. Collins Ahadome; Tel 81-45-223 1110; Fax 81-45-223 1111; itto@itto.or.jp; www.itto.or.jp
17. 12-15 December 2003. Woodworking Korea. Seoul, Republic of Korea. Reed Exhibitions (Germany) GmbH; Tel 49-211-556281; Fax 49-211-556231; REC. Germany@reedexpo.co.uk; www.reedexpo.com
18. 12-14 April 2004. Management of Tropical Dry Forest Woodlands and Savannas: Assessement, Silviculture, Scernarios. Brasilia, Brazil. IUFRO 4.00.00. Professor Dr Jose Imana Encinas, University of Brasilia, DF, Brazil; Tel 55-61-2736026; Fax 55-61-3470631; iufro@unb.br
19. 15-20 August 2004. Forest Diversity and Resistance to Native and Exotic Pest Insects. IUFRO 7.03.07. Hammer Springs, New Zealand. Andrew Liebhold, Northeastern Reaserch Station, USDA Forest Service, 180 Canfield St, Morgantown, WV 26505, USA; Fax 1-304-2851505; aliebhold@fs.fed.us;http://iufro.boku.ac.at/iufro/
20. 15-21 August 2004. XII International Congress of Entomology. Brisbane, Australia. Ashley Gordon, Congress Director; Ashley@ccm.com.au; www.ccm.com.au/icoe/index.html
21. 8-13 August 2005. Forests in the Balance: Linking Tradition And Technology. XXII IUFRO World Congress. Brisbane, Australia. Dr. Russell Haines, Queensland Forestry Research Institute, PO Box 631, Indooroopilly 4068, Australia; Tel 61-7-3896 9714; Fax 61-7-3896 9628; hainesr@qfri1.se2.dpi.qld.gov.au;http://iufro.boku.ac.at