Annual Report
2005 - 2006

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION
(An Autonomous Council of Ministry of Environment and Forests, Government of India)
DEHRADUN (UTTARANCHAL)

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FOREWORD

Indian Council of Forestry Research and Education (ICFRE) is striving for the holistic development of forestry research at national level through need based planning and promoting, conducting and coordinating research, education and extension covering all aspects of forestry.

The council deals with solution based forestry research in tune with the emerging issues in the sector, including the global concerns such as climate change, conservation of biological diversity, combating desertification and sustainable management and development of resources. Topical research by the council enhances public confidence in the ability of forest managers and researchers to successfully handle challenges related to natural resource management.

The council gives high priority to collaborative research. Joint research in the field of climate change and mitigation potential methodology for Clean Development Mechanism (CDM) in partnership with US Environmental Protection Agency (USEPA) and European Union, collaboration with Italian Trade Commission and Italian Wood Working Machinery Manufacturers Association in the field of training on wood working, establishment of Forest Genetic Resources and invasive species network in Asia Pacific region are some of the glimpses of council's international collaborative achievements.

At national level, the council has established links with funding agencies like Department of Science and Technology (DST), Council of Scientific and Industrial Research (CSIR), National Bank for Agriculture and Rural Development (NABARD), National Oilseeds and Vegetable Oil Development (NOVOD) Board, National Medicinal Plants Board (NMPB) and many state organizations to conduct mutually beneficial research. A compendium of projects funded with support of National and International donor agencies has been prepared.

Countrywide, forestry education is promoted by providing financial support to various Universities imparting forestry education with a view to strengthening their infrastructure to improve teaching and research capabilities. Much emphasis is given on the quality of forestry education, and subsequent placement of forestry students of Forest Research Institute (FRI) Deemed University. Efforts are being made to establish links with reputed overseas forestry education institutions to project the capabilities of FRI Deemed University, as also to improve upon its own system.

This report provides an insight into research, education and extension activities of the council in the context of forestry research. I feel honoured and privileged in presenting the Annual Report of ICFRE for the year 2005-06. I hope the report would serve as a useful reference for policy makers, planners, development agencies and all those having stake in forestry.

(Jagdish Kishwan)
Director General
Indian Council of Forestry Research and Education
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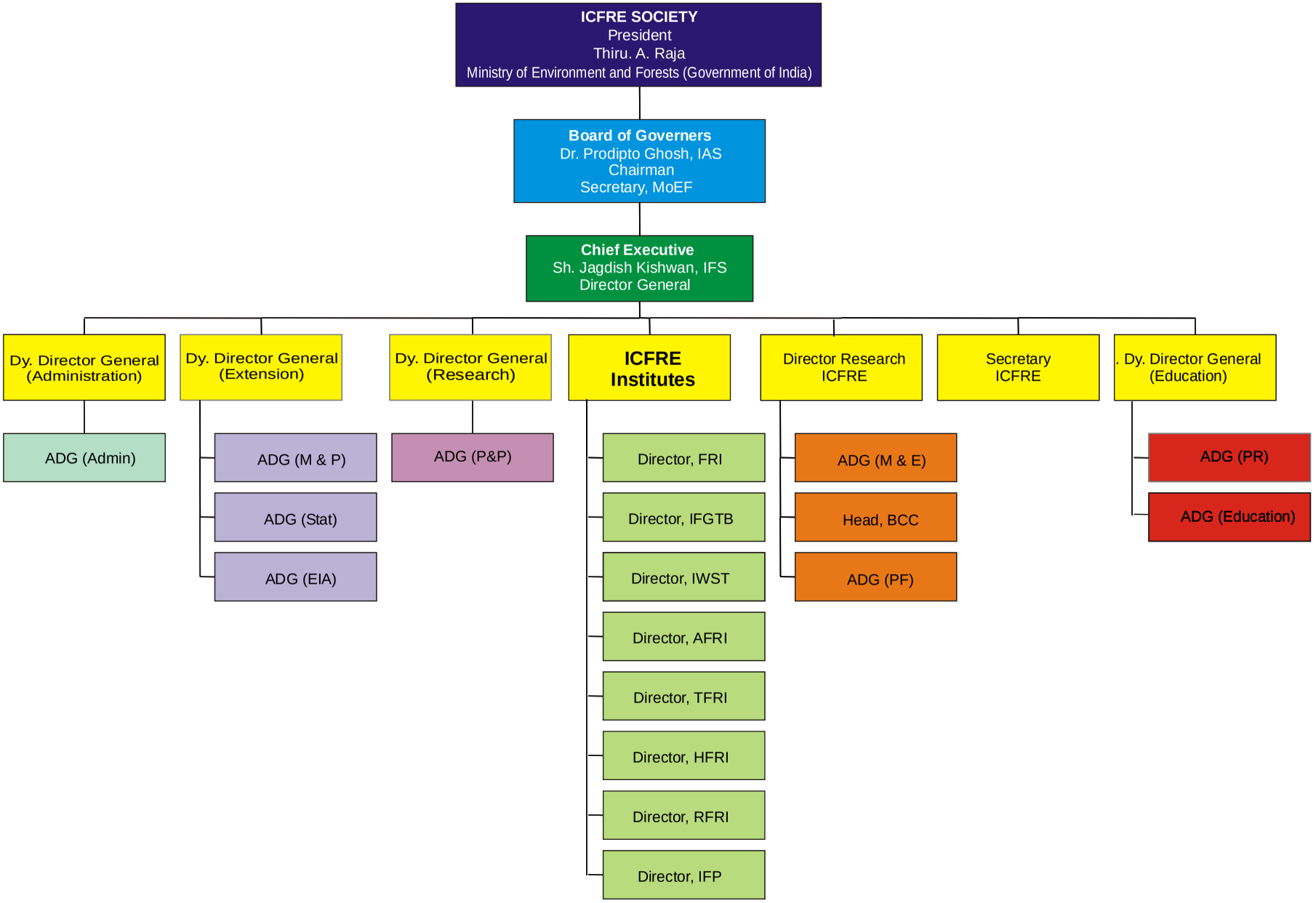
Dated 21st August 2006

ORGANIZATIONAL STRUCTURE OF ICFRE



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CHAPTER 1

Introduction

Indian Council of Forestry Research and Education (ICFRE) is an apex body in national forestry research system with the mandate to develop a holistic approach through need based planning, promoting, conducting and coordinating research, education and extension covering all aspects of forestry for ensuring scientific management of forests, tree improvement, forest productivity through scientific and biotechnological researches, bioremediation of degraded land, efficient utilization of forest produce, value addition of forest products, conservation of biodiversity and climate change, appropriate agroforestry models for various agroecological zones, policy research, environmental impact assessment and integrated pests and disease management.

Objectives of ICFRE

- To undertake, aid, promote and coordinate forestry education, research and their applications.
- To develop and maintain a national library and information centre for forestry and allied sciences.
- To act as a clearing-house for research and general informations related to forests and wildlife.
- To develop forestry extension programmes and propagate the same through mass media, audio-visual aids and extension machinery.
- To provide consultancy services in the field of forestry research, education and allied sciences.
- To undertake other jobs considered necessary to attain these objectives.

ICFRE has eight regional research institutes and three research centres in different bio-geographical regions of the country to cater to the forestry research needs of the nation. The regional research institutes are located at Dehradun, Shimla, Ranchi, Jorhat, Jabalpur, Jodhpur, Bangalore and Coimbatore and the centres are at Allahabad, Chhindwara and Hyderabad.

Research Institutes under the council are:

- Forest Research Institute (FRI), Dehradun
- Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore
- Institute of Wood Science and Technology (IWST), Bangalore
- Tropical Forest Research Institute (TFRI), Jabalpur
- Rain Forest Research Institute (RFRI), Jorhat
- Arid Forest Research Institute (AFRI), Jodhpur
- Himalayan Forest Research Institute (HFRI), Shimla
- Institute of Forest Productivity (IFP), Ranchi

Advanced research centres under the council are:

- Centre for Social Forestry and Eco-Rehabilitation (CSFER), Allahabad
- Centre for Forestry Research and Human Resource Development (CFRHRD), Chhindwara
- Forest Research Centre (FRC), Hyderabad

Major Achievements/Highlights of Research

- The council has been funded by ITTO for strengthening the capabilities of forestry statistics nationwide
- The council in coordination with IWST and Central Water and Power Research Station, Pune, for the first time in India has prepared Mine Closure Plan for Kudremukh Iron Ore Company Limited (KIOCL) as per the directives of the Hon'ble Supreme Court. The plan has been approved by Indian Bureau of Mines.
- The council completed socioeconomic survey in eight villages for Tapovan Vishnugad Hydro-Power Project (4x130 MW), NTPC at Chamoli District of Uttaranchal.
- The council conducted monitoring and evaluation of National Afforestation Eco-Development Board (NAEB) of MoEF project on coastal shelterbelt plantations in Bhubaneshwar, Orissa and Area Oriented Fuelwood and Fodder Programme in Jhansi, Uttar Pradesh.
- The council has sanctioned 59 projects through the Research Advisory Group (RAG). These projects were approved by VII Research Policy Committee (RPC). A document of completed projects of ICFRE institutes from 1900-2005 has been hosted in ICFRE website.
- The council under the EU-India small project facilitated dissemination of information and policy reforms for A&R CDM sink projects. Conducted International workshop on Climate Change Mitigation in forestry sector using results of projects, regional and national analysis and preparation of project proposal in partnership with Joanneum Research Austria and Freiburg University Germany.
- Under USEPA FORCLIMIT India (Forests and Climate Change Mitigation Networks) Programme, first phase in Udhamsingh Nagar and Nainital (Uttaranchal) for farmforestry and community forestry was completed. Industrial potential approach at Singareni coalfield in Andhra Pradesh is in progress.
- The Director General of the council participated in the meeting of Conference of Parties (COP-11)/ Meeting of Parties (MOP-1) of United Nations Framework Convention on Climate Change (UNFCCC) at Montreal, Canada.
- The council has prepared a compendium of National and International Donor Agencies for funding of forestry and environment projects for ready reference.
- The council has got approved a comprehensive project “Samudai Adharit Samanvit Van Prabandhan Evam

Sanrakshan Yojana of Bihar State" by the Planning Commission of India, with a budget of Rs. 51.09 Crores for Phase-I.

- Two new species of the genus Angulitermes (*A. bhagsunagensis* sp. now) from Himachal Pradesh and Mecrotermes (*M. vikaspurensis* sp. now) from Uttaranchal have been identified. They are being described for the first time and are new addition to the termite fauna of India (FRI, Dehradun).
- *Phloeobius crassicollis* (Coleoptera : Anthribidae) species damaging green culm of *Bambusa bambos* has been identified (FRI, Dehradun).
- Biologically compatible and economically viable agroforestry models were developed for cultivation of medicinal plants under shade, especially under Eucalyptus, Poplar, Prunus and Mango (FRI, Dehradun).
- Number of shades and good colour fastener properties were identified from *Eucalyptus* hybrid leaves and bark, *Populus deltoides* (bark), *Lantana camara* (leaves) and *Pinus roxburghii* needles (FRI, Dehradun).
- Clonal propagation technology has been developed for superior teak trees (IFGTB, Coimbatore).
- *In-vitro* shoot proliferation methods were developed for large scale multiplication of mature clumps of *Bambusa nutans* and *Dendrocalamus giganteus* (IFGTB, Coimbatore).
- Provenance of high oil content for Jatropha were identified from the clonal germplasm bank (IWST, Bangalore).
- Seed production area of *Pinus kesiya* has been established in the State of Manipur and Meghalaya (RFRI, Jorhat).
- Cost effective afforestation package was developed to reclaim degraded sites (CSFER, Allahabad).
- Molecular profiling of 48 germplasm accessions of *Tectona grandis* and *T. hamiltoniana* by ISSR and AFLP molecular markers was carried out (TFRI, Jabalpur).
- Twenty four teak clones of M.P. origin were identified as highly resistant against teak defoliator (*Hyblaea puera)* and skeletonizer (*Eutectona machaeralis*) (TFRI, Jabalpur).
- Oils and anti-nutritional constituent phytate were isolated and estimated in different provenances of *Jatropha curcas*. Toxic fraction of Jatropha oil were separated and assessed for antifungal and antibacterial activities (TFRI, Jabalpur).
- Agri-lac culture model was developed for the benefit of tribals of M.P. (TFRI, Jabalpur).
- Causes of mortality of *Prosopis cineraria* trees were identified and remedial measures suggested for protecting the infested trees (AFRI, Jodhpur).
- Effect of VAM and biofertilizers were studied for improving productivity of *P. cineraria* (AFRI, Jodhpur).
- Urban aesthetic forestry model was developed for arid region of Rajasthan (AFRI, Jodhpur).

- Technologies for afforestation of salt affected areas in arid region of Rajasthan were developed (AFRI, Jodhpur).
- A herbal garden with economically important medicinal plants has been established (CFRHRD, Chhindwara).
- Nursery techniques for propagation of *Buchnania lanzan* was developed (CFRHRD, Chhindwara).

CHAPTER 2

Indian Council of Forestry Research and Education

The activities of forestry research, education and extension at ICFRE headquarters are as under :

FORESTRY RESEARCH

The Project Formulation Division acts as a nodal agency between the ICFRE Institutes and potential donor agencies, for the formulation of research projects of ICFRE Institutes/Centres in the identified thrust areas and their submission to various National and International donor agencies as per their funding requirements. It also coordinates the release of funds to ICFRE Institutes from the donor agencies and evaluates the Project proposals with regard to their suitability in the identified thrust areas.

Thirty International Projects and 9 International Concept Notes are in the pipeline for funding with Donor Agencies, such as Japan International Co-operation Agency (JICA) Japan, Department for International Development UK (DFID), European Union (EU), Food and Agriculture Organization (FAO) of the United Nations, Asian Development Bank (ADB), etc. In Addition to the above, 18 International Projects are already under implementation.

Two hundred four National Projects and 13 Concept Notes are in the pipeline for funding with 40 National Donor Agencies such as Department of Biotechnology (DBT), Department of Science and Technology (DST), Ministry of Environment and Forests (MoEF), National Medicinal Plant Board (NMPB), National Bank for Agricultural and Rural Development (NABARD), Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR), National Oil Seed and Vegetative Oils Development Board (NOVOD), Govind Ballabh Pant Institute of Himalayan Environment and Development (GBPIHED), Ministry of Textile (MoT), Sir Ratan Tata Trust (SRTT) etc. In addition, 144 National Projects are already under implementation. A large number of Research Projects received from ICFRE Institutes, MoEF and other agencies have been evaluated with regard to their suitability in the identified thrust areas. This Division coordinated with the Planning Commission for the preparation of State Development Reports (SDR) of Tripura, Lakshadweep and Andaman & Nicobar Islands. SDR of Andaman & Nicobar Islands has been finalized.

Comprehensive Bihar Project titled “Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojana of Bihar State” was prepared for funding by Planning Commission, Government of India. The Project has been approved with the revised budget of Rs. 51.09 Crores for Phase: I. The proposed budget for Phase: II is Rs. 252. 33 Crores.

A Compendium of National and International Donor Agencies for funding of Research Projects was prepared. Author's Workshop on “History of Forests of India After 1947” was organized at Van Vigyan Bhawan, New Delhi on 15th and 16th November 2005.

Planning and Programme Division under the Directorate of Research deals with the planning, processing and execution of new research project proposals and review of the ongoing research projects of all the Institutes under ICFRE.

During the year 2005-2006, ICFRE coordinated Research Advisory Group (RAG) meetings at Institute level with user groups like farmers, NGOs, forest based industries and state forest departments. Finally the projects, approved by the RAGs, were placed before VII Research Policy Committee (RPC), the apex advisory body at the council level, which was convened on 22nd and 23rd March 2006.

During VII RPC, 74 new projects were discussed by RPC members including eminent NGO, forestry experts and representative of forest based industries. 31 projects were approved by the RPC and 28 projects having financial layout of less than rupees two lakhs were approved by the sub committee constituted by VII RPC. Two projects were recommended for external funding, and 13 were not approved.

Planning and Programme Division has also prepared an inventory of Completed Research Projects since the inception of ICFRE. A document " An Inventory of Completed Projects of ICFRE Institutes, 1990-2005" was prepared and is being updated continuously. The document is available at the ICFRE website.

The Environmental Impact Assessment Division of the ICFRE undertakes consultancies for EIA studies nationwide for various developmental activities. During the year 2005-2006 following studies have been completed by the Division:

Kudremukh Iron Ore Company Limited (KIOCL), Karnataka

Kudremukh Iron Ore Company Limited (KIOCL) is the largest 100% export oriented mining unit in the country. To fulfill the implementation of Honorable Supreme Court verdict, it was mandatory for KIOCL to prepare the mine closure plan and submit it to the Regional Controller of Mines for approval one year prior to closure of proposed mine. The final mine closure plan for Kudremukh Iron Ore Company Limited was prepared as per the guideline of Indian Bureau of Mines (IBM) and submitted to KIOCL. The mine closure plan has been prepared for the first time in India by ICFRE in coordination with its Institute of Wood Science Technology Bangalore and Central Water and Power Research Station, Pune. The plan submitted has been approved by Indian Bureau of Mines (IBM) and accepted by KIOCL.

View of Lakya dam and mined out area in foreground

Afforestation of grasses and shrubs on mined out areas

Studies on Environmental Impact Assessment, Socio-economic Impact Assessment, enumeration, ecological value, biodiversity loss of gene pool and Environmental Management Plan were completed and the draft report for Bodhghat Hydroelectric Project (4 x 125 MW), Dantewara was submitted to Chhattisgarh State Electricity Board (SEB), Raipur.

The Socio-economic Impact Assessment for the proposed Tapovan Vishnugad Hydro Power Project 520 (4x130) MW for NTPC in Chamoli District of Uttaranchal was conducted and draft report was submitted to NTPC. The Barrage of the project is proposed to be located on river Dhauli Ganga at village Tapovan with underground Power House at Animath in Joshimath Distt. Chamoli.

Project Site-Tapovan
Vishnugad Hydroelectric project

Socio-economic impact of project

Sample check survey and Evaluation studies of National Afforestation Programme, MoEF

Under this assignment, awarded by the National Afforestation and Eco-development Board (NAEB) of MoEF, evaluation studies in respect of coastal shelterbelt plantations of Bhubaneswar, Orissa and Area Oriented Fuelwood Fodder Programme scheme of Jhansi Division of Uttar Pradesh were conducted.

In addition to the above, the following assignments have been awarded to ICFRE:

(i) Monitoring and Evaluation of the National Medicinal Plant Board, Department of AYUSH (Ministry of Health and Family Welfare) funded projects.
(ii) Environmental Impact Assessment studies for Chandigarh Industrial Area Phase III.
(iii) Evaluation studies of Catchment Area Treatment Plan for Tehri Dam Hydroelectric project, Tehri Hydroelectric Development Corporation.
(iv) Evaluation of compensatory afforestation raised by States / Union Territories, under National Afforestation and Eco-development Board and under IX plan of Integrated Afforestation and Eco-development Project.

The Biodiversity, Climate Change (BCC) Division , Directorate of Research, ICFRE has taken up short term and long term policy programmes to address the issues of Climate Change and Biodiversity Conservation. ISO is an international consensus on good management practices with the aim of ensuring that organization can time and again deliver product or services that meet client's quality requirement. The division is making efforts to acquire ISO 9001:2000 Certification for ICFRE / FRI, Dehradun.

A. Climate Change

BCC Division, ICFRE has taken two Externally Aided International Projects related to Climate Change:

1. EU-India Small Projects Facility Programme "Beyond Kyoto: EU-India CDM partnership: Promoting Stakeholder Dialogue and Analysis of barriers to Forestry Mitigation Project" The Overall objective of the Project is to create an enabling environment through dissemination of information and policy reforms for implementation of bilateral CDM Sinks Projects at the local level in India. There was consensus that the role of Sinks Projects including A&R Projects in Climate Change mitigation needs to be strategised both nationally and globally, particularly for the commitment periods beyond 2012.

Biodiversity and Climate Change Division, organized Second International workshop on "Climate Change Mitigation in Forestry Sector: Using Results of Projects, Regional and National Analysis and Project Proposal Preparation", at India Habitat Centre, New Delhi on the 23rd and 24th January 2006 in partnership with Joanneum Research, Austria, Freiburg University, Germany and Lawrence Berkeley National Laboratory, USA as a part of the EU-India Project funded by the European Union within the Small Projects Facility Programme. National and International experts from ministries in Government of India, state forest departments, Academic bodies, Scientific institutions, industries and NGOs working in this field deliberated and shared their experiences in forestry sector for mitigation efforts particularly in context of CDM Projects. Proceeding of above workshop along with recommendation and list of delegates and CD containing session wise presentation was extended to PCCFs of States / UT and Directors of ICFRE regional institutes and to the delegates.

A Website http://euin-arcdm.icfre.org has been created and all the documents including "Knows and Hows for A/R Sink Projects" and FAQ about A/R CDM Projects were published for better dissemination of information on CDM Projects.

2. FORCLIMIT India (MoEF- USEPA Programme Forests and Climate Change Mitigation Networks): Methodology for assessment of Carbon Mitigation Potential of Farmlands, Bazpur (Udhamsingh Nagar, Uttaranchal) and Study for Carbon Sequestration Potential under farm forestry and community forestry, Betalghat (District Nainital, Uttaranchal) were completed. A two days International Workshop on "Methodologies in Forestry Mitigation Projects" was conducted at IIC, New Delhi on 13th and 14th April 2005.

Case studies under FORCLIMIT India Project are in progress namely (i) assessing industrial mitigation potential through LULUCF approach at Singareni Coal Field Bellapalli, Andhra Pradesh and (ii) Developing regional base lines in selected watersheds in the country (Uttaranchal state).

Methodology for Carbon Estimation in Plant biomass was developed and the application of PRO-COMAP model for mitigation potential is in progress.

DG - ICFRE participated in Meeting of COP / MOP - 11 at Montreal, Canada.

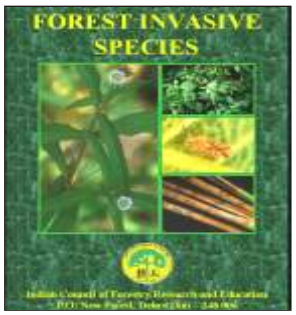
A two day training workshop on 'Climate Change Mitigation: Role of Forestry and Sinks Projects within the CDM Framework' was organized at ICFRE on 29th and 30th December 2005. Thirteen IFS officers of different States participated in this workshop sponsored by Ministry of Environment and Forests, Govt. of India, New Delhi.

B. Biodiversity Conservation

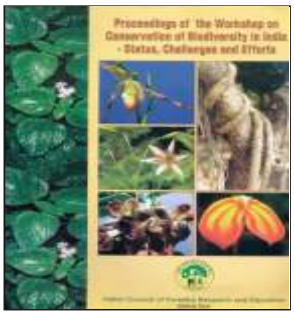
Conservation of national biodiversity has become a priority with negotiations at the international and national forum on the need for conservation. Preservation plots are examples of local level management for conservation of biodiversity. Preservation plots are important instruments for meeting the CBD targets of significantly maintaining or monitoring change in biodiversity.

BCC Division, ICFRE has established a joint venture with its regional Institutes and SFD's to reactivate the process of monitoring biodiversity through rejuvenation of preservation plots created by FRI since 1927 distributed nationwide and other bio rich areas that will provide an early warning of significant changes in the ecological systems of the region through preservation plot network. Fifteen states have confirmed existence and provided status report.

The digitization of 157 old files of Preservation Plots, which were created by FRI since 1927 onward in different States has been completed and recorded in CD for archival purpose in BCC Division.



Forest Invasive Species (FIS) is a priority issue under the Convention on Biological Diversity, accordingly, based on information received from regional ICFRE Institutes, a Brochure was published on 'Forest Invasive Species' as per revised format for Asia Pacific Forest Invasive Species Network (APFISN) which was released by Thiru A. Raja, Hon'ble Minister for Environment and Forests, Govt. of India on 24th January 2006 at India Habitat Centre, New Delhi during two days EU-ICFRE International Workshop.



BCC Division, ICFRE has published Proceedings of the Workshop of "Biodiversity in India Status, Challenges and Efforts" in June 2005. Also contributed in editing and manuscripting Proceedings of the Workshop entitled - Forests for Poverty Reduction: Changing Role for Research, Development and Training Institutions, held on 17th and 18th June 2003, Dehradun, India (RAP Publication 2005/19) sponsored by Asia Pacific Association of Forestry Research Institutions (APAFRI) and Food and Agriculture Organization (FAO) of United Nations Forestry Research Support Programme for Asia and the Pacific (FAO / FORSPA).

FORESTRY EDUCATION

Directorate of Education provides financial support in form of Grant-in-Aid to Universities for strengthening the infrastructural facilities and enhancing teaching and research capabilities of their forestry faculties in order to promote forestry education in the country at university level. The activities undertaken by the Universities under this scheme include construction of college, laboratory and students' hostel buildings; purchase of equipments; purchase of books, periodicals, journals and equipments in libraries; developing glass houses, mist chambers and similar other teaching/ research facilities; developing sports/games and other students' amenities; establishment/strengthening of communication-cum-museum and instrumentation centres; purchase of transport and camping equipments for practical training and extension education; development of computer centre and purchase of mini computers, personal computers, terminals; assistance for preparation of teaching manuals and aids; organization of workshops/seminars/symposia; participation of teachers in national seminars/workshops/symposia; students' study tours and any other such work proposed by the universities and considered necessary by the ICFRE Accreditation Committee.

This Directorate also appoints SRF/RAs for implementation of the projects in the ICFRE institutes and conveys approval of the committees for the selection of JRF in respective institutes. At the same time it also conducts trainings/programmes for scientists of ICFRE and its institutes to update their technical knowledge.

Policy Research Division is a part of Directorate of Education, which reviews and analyse the existing forest policies, statutes and their framework. The Ministry of Environment and Forests, Government of India has constituted a committee of experts under the Chairmanship of D.G., ICFRE and D.D.G. (Education) as the Member Secretary to critically analyze the policies/programmes in the forestry sector and identify gaps and intervention required for their effective implementation. This committee is also suppose to advice Ministry of Environment and Forests, Government of India on forestry policy issues.

FORESTRY EXTENSION

Media and Publication Division looks into the extension activities and strategies being adopted by the Institutes of ICFRE for the dissemination of research findings in forestry sector. This division maintains the monthly account of multifarious activities of ICFRE institutes and keeps MoEF apprised of them. Quarterly Newsletter of ICFRE brings out the latest significant achievements made by the ICFRE institutes. ICFRE Brochure is published with updated information. The reports of ICFRE and its institutes are collected, compiled, edited and published as the Annual Report of ICFRE, which is tabled in Parliament. Editing, vetting and processing of books, brochures, pamphlets and technical reports of ICFRE institutes by this division is mandatory before final publication.

The Statistics Division of this Directorate conducted a National level consultation on Forestry Statistics at New Delhi. As an expert group member ICFRE participated in the National Forest Database Management System (NFDMS) organized by Forest Survey of India (FSI) at MoEF, New Delhi. The division is conducting a sample survey of estimate rates and ratio of timber and non-timber forest products nationwide sponsored by CSO. International Tropical Timber Organization (ITTO) has awarded project on establishment of Network to facilitate collection, processing and dissemination of statistics pertaining to tropical timber and other forestry parameter at National level to the council. Four issues of "Timber/Bamboo Trade Bulletin" (TBTB) were published. Also classes and training courses in Statistics were imparted in FRI Deemed University.

GENERAL ADMINISTRATION

Information Technology Cell, Directorate of Administration, ICFRE caters to all Information Technology needs of the users at ICFRE HQ and FRI. The activities of the cell are LAN-WAN Support; Procurement and Maintenance of Hardwares; E-Governance; Trainings and providing IT Support for the technical presentations in the Meetings, Conferences, Seminars, Workshops etc. The main achievements are :

Network Room

- Upgradation of Local Area Network with a Gigabit backbone at ICFRE Hqrs and FRI was successfully implemented.
- Development and updation of websites - www.icfre.org; rfri.icfre.org; euin-arcdm.icfre.org; marketinfoherbs.icfre.org; and 21apfc_ddn.icfre.
- Project proposals submitted to the Ministry of Environment and Forests, New Delhi, under E-Governance activities.
- Upgradation Plan for MIS / RIS development based on 3-Tier Technology has been submitted to the MoEF, New Delhi.
- Imparted in-house training to officers and staff of ICFRE and its Institutes.
- Provided the faculty support for theory and practical classes of Post Graduate Classes organized by the FRI Deemed University.
- Provided Computer Application training to Ph.D. Students.

ICFRE AWARDS FOR EXCELLENCE

ICFRE Awards of Excellence for the year 2005-06 was awarded to the following for outstanding work in the discipline as mentioned below:

1. Dr. Chandra Prakash Kala, Pauri Garhwal in the discipline of 'Forest Conservation (Biodiversity and Ecology)'.
2. Dr. T. Sekar, IFS, Coimbatore in the discipline of 'Forest Education'.
3. Shri R. Vijendra Rao, Scientist IWST, Bangalore in the discipline of 'Forest Utilization'.

CHAPTER 3

Institute and Centres of ICFRE

Research Institutes

Research Centres

CHAPTER 3.1

Forest Research Institute Dehradun

Forest Research Institute (FRI), Dehradun has its roots in the erstwhile Imperial Forest Research Institute, established in 1906 to organize and lead forestry research activities in the country. The Institute caters, in particular, to the research needs of the Indo-Gangetic plains of Punjab, Haryana, Chandigarh, Uttar Pradesh and Uttaranchal. This Institute also has the status of Deemed University and at present offers three courses leading to M.Sc. degree and two Post-Graduate Diploma Courses, besides awarding Ph. D. degree in Forestry.

PROJECTS COMPLETED DURING THE YEAR 2005-2006

Project 1: Studies on isolation and characterization of polysaccharides of abundantly available seeds of trees/shrubs, leaves, bark and exudate gums [FRI-51/Chem-1]

Sub-project (ix): Chemical Investigation of *Dalbergia sissoo* leaf Polysaccharide [2002-2006]

Findings: *Dalbergia sissoo* leaf polysaccharide was isolated from its leaves by extraction with water. Complete hydrolysis of the polysaccharide followed by GLC and paper chromatography confirmed the presence of rhamnose, glucose, galactose and glucuronic acid. Partial hydrolysis indicated the presence of three oligosaccharides, which were isolated by preparative paper chromatography using Dent's method. Methylation of the oligosaccharides and polysaccharide was done using Hakomori and Purdie methods to study the linkages between oligosaccharides and polysaccharide. Periodate oxidation of the oligosaccharides and polysaccharide was carried out.

Sub-project (x): Chemical modification of Tamarind Kernel Powder (TKP) [2003-2006]

Findings: Reaction conditions were standardized for the preparation of carboxymethyl, cyanoethyl and quaternized products of Tamarind Kernel Powder (TKP). The modified products were characterized by FT-IR spectra and their rheological studies were carried out. Reaction conditions were optimized for grafting of TKP with vinyl monomers. The products were also characterized by FT-IR spectra.

Sub-project (xi): Chemical modification of *Cassia occidentalis* seed gum [2003-2006]

Findings: Reaction conditions were standardized for the preparation products of *Cassia occidentalis* seed gum. The modified products were characterized by FT-IR spectra and their rheological studies were carried out. Grafted products of *Cassia occidentalis* seed gum were prepared using vinyl monomers viz. acrylonitrile, acrylamide and methylmethacrylate.

Project 2: Phytochemical examination for the utilization of leaves, barks, fruits and roots of India forest trees [FRI-53/Chem-3]

Sub-project (iv): Screening of medicinally important plants (i) *Achyranthes aspera,* (ii) *Casearia tomentosa* and (iii) *Clematis roylei* [2002-2006]

Findings: Phytochemical examination of *Achyranthes aspera, Clematis roylei* and *Casearia tomentosa* plants of immense medicinal value undertaken to isolate and identify their active principles.

Essential oil from *Achyranthes aspera* leaves was isolated by hydrodistillation method and characterized using Gas Chromatography-Mass Spectroscopy (GC-MS).

Different extracts of seeds, leaves, roots and stem of the plant were prepared using standard extraction protocol and their column chromatography over silica gel. Their structures were elucidated with the aid of different spectroscopic techniques. The methanol extract of roots was tested on the economic traits of silkworm *Bombyx mori* L. and gave favourable response in improving economic traits notably.

Leaves and roots of *Clematis roylei* were extracted with the solvents of increasing polarity to isolate their respective extracts. An essential oil was also isolated from the leaves and was examined for *in vitro* antibacterial activity by Agar cup plate method against 12 different bacterial strains. The oil showed antibacterial activity against five strains while maximum activity was found to be against *Salmonella typhii.*

Bark of the *Casearia tomentosa* was sequentially extracted with petroleum ether, acetone and methanol and their respective extracts were isolated. No compound could be isolated from other extracts. Their dyeing trials on different fabrics imparted very good shades with good color fastness properties.

Project 3: Chemical modification of cellulose and its industrial uses [FRI-194/Chem-8/ 2002-2006]

Findings: cellulose isolated from cotton linters, *Dendrocalamus strictus*, bamboo was studied for its chemical modification using different substitution reactions. All these derivatives were characterized by IR, and standard chemical methods for their DS and hydroxypropyl contents. These derivatives may possibly be used in food, pharmaceutical and textile industries.

Project 4: Study of plant responses to air pollution for air quality monitoring in Dehradun [FRI-231/Eco-11/2003-2006]

Findings: Identification and quantification of plant biochemical indicators of air pollution through active plant biomonitoring. Biochemical indicators were identified in the leaves of *Mangifera indica*, *Cassia fistula* and *Eucalyptus* hybrid and variation in their quantities were found to be pollution load dependent. These parameters can be used as indicators of air pollution for early diagnosis of stress or as a marker for physiological damage to trees prior to the onset of visible injury symptoms. Just by analyzing these biochemical indicators air quality can be assessed.

Passive plant biomonitoring: Effect of air pollution on the biochemical parameters of already existing plant species at different bioindicator stations was evaluated. Leaf samples of *Eucalyptus* hybrid, *Cassia fistula, Mangifera indica, Ailanthus excelsa* and *Populus deltoides* were collected from different polluted sites at Hardwar Road, Rajpur Road, Chakrata Road and Saharanpur Road in Dehradun and were evaluated for variations in biochemical indicators.

Project 5: Management of natural resources as affected by the socio-economics of rural people of Jhajra watershed in Dehradun district [FRI-251/SF-7/2003-2005]

Findings: As per the study, all the 12 Gram Panchayats of Jhajra rural community are heavily dependent on natural resources for their daily needs and they carry the fuelwood and fodder from 2 to 6 km spending 2 to 6 hours time for their collection and carriage. Poverty alleviation schemes shall be made based on the requirement of the local people.

Project 6: Evaluation of *Chrysoperla carnea* for predation potential against the key defoliators of *Dalbergia sissoo* and Populus [FRI-232/FED-15/2003-2006]

Findings: Eggs of *Chrysoperla carnea* (insect predator) were collected from *Dalbergia sissoo* and *Populus deltoides* plantations from different parts of Uttaranchal & Haryana and reared in the laboratory on the larvae of *Corcyra cephalonica.* Its biology was studied. Laboratory experiments revealed that the larvae of *C. carnea* are predacious over the eggs and larvae of Shisham defoliator, *Plecoptera reflexa* and Populus defoliator *Clostera cupreata* respectively. Based on the results of laboratory experiments this predator could be used for the management of Shisham and Populus defoliators.

Project 7: Evaluation of fertilizers effect on aromatic plants in watershed area for production and productivity [FRI-242 / FSLR-18 /2003-2005]

Findings: To evaluate the fertilizers effect on aromatic plants in watershed area for production and productivity, a field experiment was conducted in Kulhal watershed with two species (*Cymbopogaon citrates* and *Vertiveria zizanioides*) and four doses each of nitrogen and potassium to control the surface soil erosion. Experiment was conducted in randomized block design.

Observations recorded after two years of fertilizer treatments showed that application of fertilizers in tested plants boost up their height and oil production in shoot of *C. citrates* and root of *V. zizanioide.* Plantations of these species are beneficial for decreasing soil erosion and increasing soil productivity.

Project 8: Evaluation of Australian seed sources and families of *Eucalyptus tereticornis* for productivity and genetic improvement [FRI- 203 /G&TP-9/ 2002-2006]

Findings: Significant differences between the provenances and families were observed for growth parameters. Results indicate that significant genetic differences exist between the families and provenances of *E. tereticornis*. The growth traits were inter-correlated with each other. Geographic clonal variation pattern was observed in some of the growth traits. Identified 50 superior trees and marked for their clonal multiplication in a provenance-cum- progeny trial of FRI campus.

Project 9: Economics of cultivation of commercially important medicinal plants [FRI-246 / RSM-14/ 2003-2006]

Status: Data on cost of cultivation and economic returns for Kalmegh, Tulsi, Satavar, Ratti, Aswagandha, Kuth, Dolu, Kutki and Salampanja collected from the cultivators of Haryana and Uttaranchal, for working out the economics of cultivation.

Project 10: Contribution of forestry and human development index of forest dependent community of Jaunsar area [FRI-248/Stat-1/2003-2006]

Findings: Linkages between forest contributions has been explored.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Inventorization and monitoring of biodiversity of threatened wetland sites of Doon Valley and surroundings, Uttaranchal [FRI-250/Bot-33/2003-2006]

Status: Monitoring of floral diversity of wetland sites in the vicinity of Doon valley was carried out. Taxonomic evaluation of 50 species typical of wetland sites was made for systematic accounting.

Project 2: To develop propogation technique i.e. micro-propagation of economically important bamboos - *Arundinaria falcata* and *Bambusa balcooa* [FRI-219/G&TP-10/2002-2006]

Status: Tissue culture protocol for economically important Hill Bamboo (*Arundinaria falcata*) was developed. *In vitro* shoot multiplication is standardised; 9-10 fold shoot multiplication was obtained. 90-95% rooting was obtained. Tissue culture raised plants were hardened and acclimatised.

Project 3: Development of protocol for clonal multiplication and germplasm conservation of some medicinal plants [FRI-243/G&TP-14/2003-2007]

Status: Developing protocol for micropropagation of medicinal plants *Oroxylum indicum* and *Gymnema sylvestre* are in process. *In vitro* shoot were multiplied and *in vitro* rooting was standardized in *Oroxylum indicum.*

Project 4: Inventorization of multipurpose trees and shrubs for domestication and their implication in agroforestry for socio-economic upliftment of rural sector of Dehradun [FRI-199/SF-5/2002-2008]

Status: Records of growth parameters such as height, diameter, etc. and crop yield have been taken.

Project 5: Studies on isolation and characterization of polysaccharides of abundantly available seeds of trees/shrubs, leaves, bark and exudate gums [FRI-51/Chem-1]

Sub-project (vii): Chemical investigation of *Prosopis juliflora* seed polysaccharide [2000 2006]

Status: Methylation of the *Prosopis juliflora* seed endosperm polysaccharide by Hakomori and Purdie method was carried out and further methylated polysaccharide was derivatised to its alditol acetate derivatives for GLC analysis. Molecular weight determination of the *P. juliflora* seed endosperm polysaccharide was carried out. NMR spectral studies of polysaccharide and oligosaccharides has been done.

Project 6: Bioecology of insect pests of Paulownia and enumeration of their natural enemies [FRI-196/FED-11/2001-2008]

Status: Paulownia nursery and plantations at New Forest, Devipur, Sahaspur (Uttaranchal) and Saharanpur (UP) were surveyed to find out insect pests spectrum. Biological studies on an important defoliator of Paulownia, *Spodoptera litura* revealed 27% mortality of Ist instar larvae in the laboratory.

Experiments on nutritional behaviour of *Eupterote undata* were initiated on the foliage of *Paulownia fortunei*. Initial studies are indicative of its nutritional preferences towards Paulownia as the larva of *E. undata* in its last instar was recorded feeding 261 gms of Paulownia foliage over a period of 14 days whereas it fed only 34 gms of poplar, 1.45 gms of Teak and only 0.431 gms of Toon foliage when provided with multiple choice.

During insect survey at Sahaspur (Dehradun) second instars larvae of *Spilarctia oblique* were collected on *Paulownia fortunei. Brachymeria lasus* Walk. (Hymenoptera: Chalcididae). The parasitoid is recorded for the first time on *S. oblique.*

Laboratory culture of four species of egg parasitoid, Trichogramma on the eggs of *C. cephalonica* was maintained during the period.

Project 7: Bioecological studies on the insect pests of bamboo and their management [FRI-144/FED-8/2001-2007]

Status: Regular observations were taken pertaining to the incidence of insect pests feeding on bamboo at New Forest, Kalsi and Dehradun Forest Divisions in the experimental plots. *Phloeobius crassicollis* (Coleoptera : Anthribidae) was recorded for the first time damaging green culms of *Bambusa bambos*. Eggs are laid at nodes and the larvae bore in the green culm feeding inside the culm. Pupation takes place just above the hollow at nodes by making oval pupal cocoons. Lifecycle is annual. Chemical control of *Oregama bambusae* was carried out by using systemic insecticide as internodal injections.

Project 8: Studies on the termite diversity of Northern India, with special reference to species composition in relation to different tree species [FRI-275/FED-19/2004-2007]

Status: Regular surveys were conducted in and around Dehradun, Saharanpur and Chhicharauli to collect termites and study the damage and extent of damage caused by termites to the nurseries and plantations. Two new species of the genus Angulitermes and Macrotermes *(*Family Kalotermitidae) have been identified.

Identified 34 species of termites (169 vials) belonging to 3 families *(*Kalotermitididae, Rhinotermitidae and Termitidae) and 9 genera, of which 11 are new to geographical distributional records. Four new species belonging to genera, Neotermes (*N. sen-saramai*), Glyptotrermes (*G. roonwali*), Angulitermes (*A. bhagsunagensis*) and Macrotermes (*M. punjabensis*) were recorded.

Psammotermes rajasthanicus Roonwal and Bose- a semiarid species has been found first time from Punjab. Twenty nine vials of termites from Delhi have also been identified which includes seven new record.

Project 9: Integrated pest management of mandate species in nurseries and plantations with special reference to biopesticides and microbial pesticides (*Dalbergia sissoo* and *Populus deltoides*) [FRI-198/FED-13/2002-2007]

Status: Identified 12 important insect pests on *Dalbergia sissoo* and 14 important insect pests on *Populus deltoides*. All the pests were studied for their biology, energy budget, damage potential and population fluctuation.

To achieve the management of important pests two strains of *Bacillus thuringiensis* was sprayed and proved highly effective with 100% mortality to the larvae of *Plecoptera reflexa, C. cupreata,, E. undata, D. eridantis* and *Phalantha phalantha* in the laboratory in 72 hours.

Eleven new fungi were identified as entomopathogenic on the above insect pests. Three fungi were mass-produced and tested for their efficiency in the laboratory.

Commercially available four neem products viz. Neemexel, Achook, Nimbicidin and Neemazal were tested for their efficacy against the major pests of shisham and poplar. The results showed 100% mortality with specific concentration in various pathogens.

Different parts of 50 plants/weeds were collected for identification of biopesticidal properties. Crude extract of 35 plants/weeds showed biopesticidal properties.

Different concentrations of the extracts *J. curcas* Eucalyptus leaves, Acorus rhizome and *Adhatoda vesica* leaves were formulated and tested against the major pests. Significant mortality rate of leaves was recorded in the laboratory.

Project 10: Upgradation and computerisation of National Insect Reference Collection (NIRC) [FRI-233/FED-16/2003-2008]

Status: Taxonomy of Parasitic Micro-Hymenoptera (Chalcidoidea) Parasitoides of Psyllids: Ten new species of genus Psyllaephagus parasitising different species of psyllids, have been identified. Description of all these species has been completed. Work on parasitoids of Diaspidid scales was carried out with the identification of five new species - two belonging to genus Neococcidencyrtus, and one each of Adelencyrtus, Epitetracnemus and Coccidencyrtus.

Eulophid Parasitoids (Aceratoneuromyia and Euderus): Described a new species of Euderus parasitising *Alcidodes ludificator* (Curculionidae) a serious pest of *Gmelina arborea* nursery and young plants in the north-east India. Data of 7,200 species, totalling 12,000, has been incorporated into the database.

Project 11: Identification and updating of Braconid parasites (Hymenoptera) of major insect pests in National Insect Reference Collection (NIRC) and Doon Valley [FRI-234/FED-17/2003-2007]

Status: Survey and collection of braconid parasites were done from different sites of Doon Valley. Two sps of genus *Apanteles*, 1 sp. of genus *Chelonus* and *Choerbus* sp. of subfamily Alysiinae were identified.

Project 12: Studies on enhancement of natural durability of bamboo and plantation grown species with conventional/ecofriendly preservatives [FRI-236/FPD (WP)-43/2003-2008]

Status: Chir and Poplar treated with ZiBOC 0.5 are in under periodical observation five Bamboo species treated with 4% Boric Borax solution got destroyed after 6 months. 5 bamboos species treated with 4% CCA samples are still normal. Treatability of *Bambusa nutans* culms by CCA (4%) after different times of green felling was carried out. Treatment of fresh green round *Bambusa nutans* without branches by modified boucherie process and by sealing their cut branches ends by fevicol and dobefil with hardner was carried out and it was found that freshly cut bamboos can be treated faster and cheaper without branches.

Project 13: Exploration of copper lignin complexes for wood preservation and effect of post treatment processes on precipitation or fixation in wood [FRI-252/FPD (WP)-44/2003-2006]

Status: Different treatment methods to treat Mango wood with Copper Lignin complex A and B was tried. Periodic inspections show that the treated samples are performing well while the controls show very slight termite attack. Studied the efficacy of prophylactic treatments of black liquor with and without Copper sulphate, against sap stain fungus *Altenaria alternata* on *Populus deltoides* (Poplar). To complete protection of Poplar can be achieved for a longer duration by prophylactic treatment of black liquor and copper sulphate at various dilutions.

Project 14: Assessment of Shisham die-back (decline) in Northern India and its remedial measures [FRI-245/Path-12/2003-2008]

Status: Seedlings of shisham, which showed resistance in the initial pathogenecity trial, were stressed for seven days in water and inoculated with *F. solani* by root dip method for 24 hours.

Maximum survival was noticed in *Pseudomonas fluorescens* treated trees, followed by mixture of *Trichoderma viride, P. fluorescens* and Chloropyrophos. Lowest survival was recorded in control.

Project 15: Screening for disease resistance in genetic material raised under tree improvement programmes [FRI-207/Path-13/2002-2007]

Status: At Hissar clone of *Dalbergia sissoo* were assessed for disease and various clones 5,87,304 and 88 showed various of diseases.

Families of Eucalyptus (Australian germplasm) were screened against Cylindrocladium blight disease in nursery and plantation and families 20, 72 and 73 showed resistance. Root rot pathogen *Ganoderma lucidum* was found to be encouraged in presence of the root nodule forming bacterium Rhizobium, the latter encouraging the growth and spore germination of the former.

In a testing trial of F1 progeny hybrids of *Eucalyptus citriodora* and *E. torrelliana* in field, a new canker disease caused by *Phomposis* sp. along with its perfect stage in *Chrysoporthe* sp.

Project 16: Biological Control of *Lantana camara* and *Parthenium hysterophorus* by fungal pathogens [FRI-206/Path-12/2002-2007]

Status: *Lantana camara* and *Parthenium hysterophorus* infested sites around Allahabad, Varanasi and Kangra area of Himachal Pradesh especially areas near Palampur, Dharamshala and Una were surveyed and diseased samples were collected. Isolation of fungi was done from these samples. Pathogens of *Lantana camara* were screened for synergistic effect of different herbicides and adjuvants by poisoned food technique. Glasshouse experiments were conducted to find out sub-lethal doses of six herbicides on *Lantana camara*.

Project 17: Working Plan for Reserved Forest of Forest Research Institute Estate

Status: The removal of dead trees as per working plan prescriptions has been carried out. The up keep of reserve forest of FRI is in progress along with collection of data on various parameters consisting inputs and outputs. The production of seedlings in nursery is also in progress.

Project 18: Development of suitable Silvicultural practices for JFM [FRI- 180/ Silva - 14/2001-2006]

Findings: Data with respect to socio-economic structures, silvicultural strategies and ecological conditions of the protected as well as unprotected forests of 12 JFM villages from different altitudes of Uttaranchal have been collected, compiled and analysed. It was found from the studies that productivity of the JFM protected forests of the villages have been improved by increasing regeneration status of few species due to various silvicultural strategies adopted such as correct lopping, pruning, weeding, thinning, plantations and rotational grazing.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006

Project 1: Exploration, ethnobotanical evaluation and preservation of rare and endangered flora of Jaunsar-Bawar [FRI-298/Bot-43/2005-2008]

Status: Two collection trips have been made to different parts of the study area and 300 plant specimens were collected. Two hundred plants have been identified.

Project 2: Assessment of the wood quality parameters in seed raised plantations of different age series of *Dalbergia sissoo* Roxb. [FRI-299/Bot-44/2005-2008]

Status: Wood quality parameters are being collected.

Project 3: Evaluation of the principle chemical constituents of medicinal plants available with NWFP division [FRI300 / Chem-14/2005-2008]

Status: Analysis of *Andrographis panniculata* was carried out in respect of andrographoloide content, ash content, acid insoluble and water soluble ash, alcohol soluble and water soluble extractives.

Project 4: To study ecological succession in restored mined lands [FRI-302/Eco-19/2005-2008]

Status: Phytosociological studies have been carried out in restored mined areas and adjacent natural forests at Maldeota. Litter, plants and soil samples have been collected and their chemical analysis is in progress.

Project 5: To study the undergrowth ecology of natural and man made forests of Tarai belt of Uttaranchal [FRI-301/Eco-18/2005-2008]

Status: Six hundred fifty and 868 trees ha^{-1} were observed under moderately and partially disturbed teak plantation (1980) whereas it was 733 and 834 in case of natural forests. In case of moderately disturbed natural forest biomass was increased by 9% than partially disturbed natural forest. The preliminary observations indicate that disturbances to the forests are changing undergrowth ecology partially to man made forests.

Project 6: Evaluation of natural termite resistance in timber species [FRI-303/FED-20/2005-2008]

Status: Regular surveys were conducted to collect termite nests for laboratory testing of the timber species. Wooden blocks of *Grewelia robusta*, *Eucalyptus tereticornis* and *Populus deltoides* made and are being tested for their natural termite resistance against termite. Wood of six imported timber species were collected from the local market to study the Wood Anatomy Branch for their authentic identification.

Project 7: Bioecology and nutritional behaviour of polyphagus insect pests with special reference to *Spilarctia obliqua* [FRI-304/FED-21/2005-2008]

Status: Nurseries and plantations at Bahadrabad, Sahaspur, Herbartpur and Yamunagar were visited. The larvae of

Spilarctia obliqua collected from various sites were brought to the laboratory and reared on the leaves of Paulownia and Poplar. Experiments on the nutritional behaviour of *S. obliqua* were initiated.

Project 8: Effect of *Populus deltoides* plantation on shade loving medicinal plants [FRI-305/SF-8/2005-2011]

Status: Site selected and plantation of poplar has been completed at Demo Co., Premnagar, Dehradun and are maintained plot at above. Two fields with 3 years old poplar of farmers has been selected at village Kuahedi (district Haridwar). Selected plot planted with shade loving medicinal plants. Regular monitoring and maintenance is in progress.

Project 9: Tree crop interactions: Effect of *Melia* species on crops [FRI-306/SF-9/2005-2011]

Status: Survey work on current agroforestry practices with special reference to Melia spp. in five districts viz. Hoshiarpur, Patiala, Roopnagar, Nawashahar and Jalandhar in Punjab State has been completed. A nursery of *Melia* sp. has been established at Central nursery, FRI.

Project 10: Effect of Pine and Oak Forests on agriculture crops [FRI-327/SF-10/2005-2008]

Status: Survey for site selection to conduct the study is in progress and different sites in Pauri, Uttarkashi and Chamoli districts of Uttaranchal have been visited for the purpose.

Project 11: Effect of Ammonia Fumigation on glue line strength of plywood from plantation species [FRI-312/FPD(CW)-57/2006-2008]

Status: The logs of Poplar and Eucalyptus were procured and converted them into veneers by rotary peeling. Preliminary experiments were carried out to assess the effect of Ammonia Fumigation on glue shear strength.

Project 12: Evolving kiln schedules under vacuum drying for selected plantation species [FRI-308/FPD (WS)-53/2005-2008]

Status: Work has been initiated on drying of Poplar through vacuum technique. A preliminary experiment was conducted to understand the drying behaviour of poplar planks under different combinations of pre-heat temperatures and vacuum levels.

Project 13: Velocity gradient induced single glass modified solar kiln for drying of timber and NWFPs [FRI-310/FPD(WS)-55/2005-2008]

Status: Fabrication of the modified kiln is in progress.

Project 14: Studies on effect of plank width on drying rates and seasoning degrades with special references to low girth plantation species [FRI-313/FPD(WS)-58/2005-2007]

Status: Preliminary experiments on drying pattern of planks of different width of poplar have been conducted.

Project 15: Development of ecofriendly water repellent preservative finishes for handicrafts items [FRI-307/FPD(WP)-52/2005-2008]

Status: Samples of mango wood were treated with 3% solution of Copperised Cashew Nut Shell Liquid (CR-CNSL) by dipping method. Treated samples were given five different polish treatments and their gloss was measured. Studies on the effect of Humidity and UV radiation on the performance of different treatments are being carried out.

Project 16: Bending and compression properties of small diameters round plantation timbers [FRI-311/ FPD(TM) 56/2005-2008]

Status: Small diameter plantation timber of *Eucalyptus* spp. (Eucalyptus), *Dalbergia sissoo* (Sissoo) and *Melia azaderach* (Persian lilac) will be tested in round form. Eucalyptus logs have been procured for testing.

Project 17: Evaluation of physical and mechanical properties of *Leucaena leucocephala* (Subabul) and classification and grading of timber for different end uses [FRI-309/ FPD(TM) 54/2005-2008]

Status: Fifteen logs were procured. Marking as per IS 2455 were made and the logs were converted into scantlings. The scantlings were segregated into two groups for testing in green and dry conditions. The scantlings meant for testing in dry condition were stacked for air-drying. Layout plan was drawn for testing in green condition and specimens were prepared. Testing in green condition has been completed.

Project 18: Prediction of plants for plantation on 'a soil' based on ionic properties of soil and plant roots [FRI-317/FSLR-22/ 2005 2008]

Status: Experimental pots were procured; two types of soil were collected from field and analyzed to know their initial properties. Soils were filled in pots and five species of plants were transplanted in pots. Experimental pots were maintained providing equal irrigation as per need. Six months after transplantation, growth attributes of plant were recorded, soil samples collected, prepared and their analysis started.

Project 19: Studies on soil geological and geomorphological linkages with different forest communities for sustainable management of Uttaranchal forests [FRI-314 / FSLR-19 /2005-2008]

Status: Five different sites consisting of *Pinus roxburghii, Quercus leucotrichophora* and *Dalbergia sissoo,* mixed and barren land (Control) on the basis of different vegetation, parent material and altitude for collection of samples were identified in Kempty range of Mussoorie forest. The soil and rock samples were collected, processed and prepared for analytical work. Physical and chemical analysis of soil and chemical analysis of rocks is in progress.

Project 20: Effect of different plantations on soil properties and carbon store [FRI-315/FSLR-20/2005-2008]

Status: Three sites, under Poplar and Eucalyptus plantation and one site under Shisham plantation were selected in Uttaranchal and Haryana. Three sampling points were selected at each site under Poplar, Eucalyptus and Shisham plantations in both the states. Soil samples were collected from these sampling points from predetermined depths. Soil samples collected from field, processed in laboratory and analysis are in progress.

Project 21: Soil and Vegetation Survey and preparation of Pedonarium in New Forest, Estate [FRI-316/FSLR-21/2005-2008]

Status: The New Forest Estate was reconnoitered for selection of site for soil sampling. Grid sampling design was adopted for soil investigation. The soil analysis is in progress. The vegetation map is under preparation.

Project 22: Genetic evaluation of selected genotypes for exploring clonal forestry potential in *Dalbergia sissoo* [FRI/319/G&TP-16/2005-2008]

Status: A number of plus trees were selected and harvested from a progeny trial consisting base materials from *Dalbergia sissoo* growing areas including Gonda, Lal Kuoan and other adjoining parts of Bihar and Uttar Pradesh. The seeds from seed bearing trees were collected and processed for raising the progeny trial. The seedlings have been raised and kept ready for progeny trial. The land has also been earmarked for this purpose in Chandiapur, Uttaranchal. The plus trees were coppiced and propagated clonally. They are being planted in the VMG. Clonal trial of *Dalbergia sissoo* has been raised at three locations of Punjab, in Completely Randomized Block Design with 9 plants per replication.

Project 23: Establishment of breeding arboretum of Eucalyptus and production of interspecies hybrids [FRI/318/G&TP-15/2005-2010]

Status: Open pollinated seeds and clonal material of different *Eucalyptus* sp. have been collected from different sources. Seeds were sown in pots and progenies were raised. Phenological observation has been recorded regarding flowering and fruiting in different *Eucalyptus* sp. growing at FRI campus. Cleaning operation in field was carried out for establishment of breeding arboretum.

Project 24: Development and multiplication of superior bioactive clones of *Stevia rebaudiana* [FRI 320/NWFP-19/2005-2008]

Status: Three accessions of *Stevia rebaudiana* have been collected from Uttaranchal and introduced under field conditions for assessing their performance.

Project 25: Evaluation of appropriate technology and its adoption as applicable in rural environment [FRI-321/PLO-3/2005-2008]

Status: Survey few villages on Dehradun- Shimla Road. Villagers were motivated to raise Bamboo seedlings in their area, Harbajwala village was selected, two-days Bamboo training programme was organised at the Rangers College, City Centre, Dehradun. General fields visit of the participants to the Central nursery was also undertaken. The seedlings were distributed.

Project 26: Regeneration study on *Quercus semicarpifolia* and *Carpinus viminea* [FRI- 324/ Silva-28/2005-2008]

Status: Identification, survey and selection of natural population of *Carpinus viminea* at different locations (Chopta, Gopeshwar, Mandal) in Kedarnath Forest Division were made, seeds collected from the same localities and seed morphology and biology were carried out in respect to seed length, width, colour, shape, 1000 seed weight, moisture content, number of seeds in 1 kg. Seeds were kept on different temperatures i.e. room temperature for storage study.

Project 27: Development of technology for cultivation of commercially important under exploited Lesser Known Tree Species (LKTS) [FRI-322/Silva-26/2005-2008]

Status: The experiments were laid down in nursery with different media. Seed parameters for Ficus seeds were studied as per standards of ISTA. Cuttings of (*Cordia dichotoma, Ficus auriculata, F. glomerata* and *F. palmata)* were planted in nursery with different concentrations of rooting hormones. *F. palmata* gave best rooting in identified concentration.

Project 28: Multilocation trials of promising clones of *Gmelina arborea* Roxb. [FRI-326/Silva-30/2005-2008]

Status: Vegetative propagation material from 27 promising clones of *G. arborea* was collected from Rain Forest Research Institute, Jorhat. The cuttings were given rooting hormone treatment and planted in the shade house at FRI for multiplication.

Project 29: Field Evaluation of New Clones of Poplar [FRI-323/Silva-27/2005-2008]

Status: Established the nursery of Poplar consisting of 200 clones. These clones have been developed by Forest Research Institute, Dehradun.

Project 30: Development of Forest Fire Control Tools [FRI-325/Silva-29/2005-2008]

Status: The drawing and designing of forest fire control tools have been completed. Ten sets of the forest fire tools have also been fabricated and the tools are under trial.

PROJECTS COMPLETED DURING THE YEAR 2005-2006
(Externally Aided)

Project 1: Developing bioclimatic indices for important species existing under agroforestry and departmental plantations for different agroclimatic zones of Punjab [FRI-217/Bot-32/External/2002-2005]

Findings: Suitable tree species for agroforestry and departmental plantations for different agroclimatic zones of Punjab has been identified. Optimum range of bioclimatic indices and soil characteristics for different species have been identified.

Project 2: Creation of Germplasm Bank of commercially important tree species of Punjab [FRI-178/Bot-28/External/2001-2005]

Findings: Established three germplasm banks of fifteen commercially important tree species of Punjab. Five outstanding clones of *Dalbergia sissoo* were released in honour of Shri A.S. Dogra, PCCF, Punjab for his long contribution in the field of forestry research and management.

Project 3: Identification, taxonomy, properties and uses of different species of Shoreas of the Malay Peninsula [FRI/191/Bot-30/External/2002-2005]

Findings: The study on intra- and inter-species variations in the dimensions of different wood elements and density of Balau, Meranti Pa'ang (White meranti), Meranti damar hitam (yellow meranti) and Red meranti group of Malay Shorea were completed. Dichotomous and card key was prepared for the each group for identification.

Project 4: Problem of forest regeneration of Sal (S*horea robusta*) and its associates in Dehradun Forest Division with special reference to fire, overgrazing and human interference [FRI-256/Bot-35/External/2004-2006]

Findings: Assessment of regeneration status of Sal (*Shorea robusta*) in three selected localities (Raipur, Lachhiwala and Barkot Range) of Dehradun Forest Division of Uttaranchal was completed. Soil samples from different locations with special reference to burnt, unburnt, human interference, grazing and control areas were analysed for minerals components viz. phosphorus, potassium and organic carbon. Leaf litter was also collected and estimate for nutrients. Fuel load capacity vis-a-vis the effect of litter thickness on seed germination of the project area was estimated.

Project 5: Prospecting for botanical pesticides - An All India Coordinated Research Project [FRI-188/Chem-7/External /2002-2006]

Findings: Seventy nine extractives of different parts of the selected plant species were prepared using petroleum ether, chloroform and methanol which were screened against the selected pests of household and agriculture importance. Thirteen plant extracts of six plant species exhibited activity against the above insects.

Isolated fatty oils from seeds of 27 plant species. The fatty acid composition of the oils was determined by Gas Liquid Chromatography of the methyl esters.

Project 6: Chemical screening of the oil seeds and development of seed handling practices and plantation trial of some high oil yielding tree species in the Himalayan region [FRI-223/Chem-9/External/2003-2006]

Findings: Demonstration plots of *Sapindus mukorossi* have been raised over 2.0 ha and 0.7 ha at Barkot range, Dehradun Forest Division and FRI campus, respectively, and periodical grant data's were recorded.

Seedlings of *Putranjiva roxburghii* raised from 4 sources were transplanted over 2 ha area in Jakhan Block, Barkot range, Dehradun Forest Division at 3m X 3m spacing in randomized block design and survival and growth data of the same were recorded at six months interval. Demonstration plot of *Prinsepia utilis* was also established in Mussoorie Forest Division. Oil content in the seeds of the species was estimated.

Project 7: Novel chemo-enzymatic technology for the food fibre from Guar/*Cassia tora* Gums [FRI-225/Chem-10/External/2003-2006]

Findings: Depolymerization of guar gum was carried out by partial hydrolysis with acid and enzymes isolated from the germinating seeds of Guar (*Cymopsis tetragonolobus*) and Pawar (*Cassia tora*). Conditions of depolymerization were optimized with acid enzymes process. Five different stages of germination were selected for the enzyme isolation from Guar and Pawar seeds. The acid treated Guar gum was further depolymerized by above optimized condition of enzyme action and also quantity of enzyme used and time of reaction were optimized for both *Cymopsis tetragonolobus* and *Cassia tora* separately to obtain depolymerized Guar gum of very low viscosity.

Project 8: Long term impact of monoculture on site productivity and resource conservation [FRI-177/Eco-08/External/2001-2005]

Findings: Actual biomass calculated by harvesting trees of *Eucalyptus* hybrid, *Dalbergia sissoo*, *Acacia catechu* and *Populus* sp. at various Forest Divisions of Punjab. Productivity of all the sites calculated and prediction equations developed for each component of all the species.

Project 9: Inventory of forest insects [FRI-218/FED-14/External/2002-2005]

Findings: Inventory of forest insects was prepared comparising of 15,908 species of insects. This includes morphological characters, distribution, biology and control. Insects belong to 21 orders. Digital photographs of 4,477 insects were also incorporated. HTML files for 1,251 species of insect was also prepared.

Project 10: Evaluation of Radiata pine from New Zealand [FRI-184/FPD-38(CW)/External/2002-2005]

Sub-project (i): Evaluation of natural durability and treatability under Indian conditions

Findings: *Pinus radiata* of New Zealand origin is found to be non-durable in nature. The heartwood portion out side and adjacent to pith of this species falls in the "C" class, whereas heart wood juvenile portion falls in the "B" class as far as treatability is concerned according to Indian standards. Termites badly destroyed control and affected the CCA treated samples of *Pinus radiata* at 8 and 12 Kg/m^3 retentions, whereas no attack on higher retentions of treated samples were observed. Untreated *Pinus radiata* samples were badly damaged within 24 months of installation in the field trials at different centers. However treated samples with CCA and creosote fuel oil are performing well.

Sub-project (ii): Evaluating the suitability for general purpose, shuttering, marine plywood and block board

Findings: The sub-project completed and report accepted by the funding agency.

Project 11: To establish manufacturing process and market utilization of Eucalyptus wood for value added products for domestic and export market [FRI-185/FPD-39 (WS)/External/2001 2005]

Findings: The utility of *Eucalyptus* hybrid in making various products through different processes was studied, and the market potential of wooden floor tiles out of this species were emphasized.

Project 12: Genetic improvement and production of nursery planting stock of Khair, Shisham and Kikar [FRI-170/G&TP-7/External/2000-2005]

Findings: Clonal seed orchards of three species Khair, Shisham and Kikar (1.0 ha each) were established at Bir Sanur Patiala and Hoshiarpur (Punjab). Vegetative propagation strategies of Kikar (*Acacia nilotica*) and Khair (*Acacia catechu*) were developed and implemented for raising the plus tree ramets for the establishment of their CSOs. Progeny trials of Khair and Kikar comprising families of 40 plus trees of each species were established at Bir Sanur Patiala. Promising stands of Khair (5.0 ha) and Kikar (5.0 ha) have been finalized as seed stands.

Project 13: Analysis of population genetic structure and diversity in Himalayan Pines using molecular markers [FRI-221/G&TP-12/External/2002-2005]

Findings: RAPD (Random Amplified Polymorphic DNA) conditions with particular reference to the quantity of DNA, Mg concentration, annealing temperature and time, extension time and number of cycles in the PCR have been standardized for Himalayan pines. Polymorphic primers have been screened. The information obtained through the polymorphic gels in different species have been scored and recorded in binary form. Genetic diversity in *Pinus roxburghii, P. wallichiana, P. gerardiana* and *P. kesiya* has been studied showed a considerable differentiation among the populations of *P. roxburghii, P. wallichiana* and *P. kesiya*. However the differentiation was less in *P. gerardiana*. The molecular based phylogeny of the Indian pines was resolved with the help of RAPD markers. The UPGMA dendrogram revealed that the Chir Pine (*P. roxburghii*) is closely related with Blue Pine (*P. wallichiana*). These two species are further related with *P. kesiya.* The distantly related species with the other three pines was found to be *P. gerardiana*.

Project 14: Development of Agro-mediculture models for sustainable diversified farming in Uttaranchal and Haryana [FRI-214/NWFP-15/External/2002-2005]

Findings: The project resulted in development of four models for cultivation of medicinal plants under the shade of agroforestry species like Eucalyptus, Poplar and horticultural species like Prunus, and Mango. These models have been found to be biologically compatible, physically possible and economically viable. The medicinal plant species recommended for cultivation under the above mentioned tree crops are *Withania somnifera*, *Asparagus racemosus*, *Ocimum sanctum* and *Andrographis paniculata.*

Development of agro-mediculture models for sustainable diversified farming

Project 15: Demand and supply of medicinal plants and produce grown / found in Haryana [FRI-291/NWFP-18/External/2004-2005]

Findings: Surveys of 15 districts of Harayana for the demand and supply of some selected medicinal plants is under progress. The manufacturing units / traders are being contacted for collection of actual demand of medicinal plants in the state of Haryana.

Project 16: Study on inventorisation, assessment of their demand and supply and potential of commercialisation of medicinal plants in South-West Haryana [FRI-269/NWFP-17/External/2004-2005]

Findings: Extensive field surveys in the forest areas as well as non-forest areas of three districts of South-West Haryana were carried out and medicinal plants occurring in the area were recorded.

Technical data of various species was collected from published literature, electronic sources besides local communities.

Herbarium samples were prepared and handed over to the State Medicinal Plants Board. Final technical report is being compiled.

Project 17: Study and preventive measures of dying phenomenon of *Acacia nilotica* and *Dalbergia sissoo* in Haryana [FRI-286/Path-19/External/2005-2006]

Findings: The state was divided into three agroclimatic zones and surveys were made to assess the mortality of Kikar and Shisham. The diseased specimen were collected and the pathogens were identified. Maximum mortality in *Dalbergia sissoo* was observed in agroclimatic zone 1 due pathogen *Ganoderma lucidum*. In case of *Acacia nilotica* maximum mortality was found in agroclimatic zone III, caused due to *Ganoderma lucidum*.

Biotic stresses, old age of trees, landscape changes, variation in rainfall and temperature patterns, invasion by *Prosopis julifora* and *Capparis* spp. were found affect adversely Shisham and Kikar plantations and therefore morality was observed. Nitrogen concentration was higher in soil under dead trees. Chemical analysis of soil and plant samples has been completed.

Project 18: Evaluation of Microbial status of organic farming [FRI-271/Path-16/External/2004-2006]

Findings: The DST funded project under the *Women Scientist Scholarship Scheme* addressed the changes in conventional and organic farming soil in relation to beneficial microbes and physico-chemical properties. Different crops medicinal plants and trees were scanned for their microbial profile. General mycorrhizal status of different kinds of plants is quite low. In phosphate solublizers, fungi are predominating. Except organic carbon there is not much change between different parameters of soil properties.

Project 19: Studies on interrelationship between production level and marketing of important forestry species in Punjab [FRI-174/RS&M9/External/2000-2006]

Findings: Field work and data analysis completed.

PROJECT CONTINUED DURING THE YEAR 2005-2006
(Externally Aided)

Project 1: Development of suitable propagation technology of three *Terminalia* sp. [FRI-261/Bot-40/External/ 2003-2006]

Status: Developed vegetative propagation technology through mature cuttings as well as shoot cuttings in winter and summer seasons. Growth data of seedlings were recorded. Rooting response of cuttings of Terminalia has been carried out.

Project 2: Evaluation and standardization of the methods employed in identity of the medicinal plants employing woods of Himalayan and Sub-Himalayan tract [FRI-276/Bot-41/External/2004-2007]

Status: Microstructure, ultrastrucure studies of Indian species of Cinnamomum and photomicrographs taken for the diagnostic features of some species of Cinnamomum are under progress.

Project 3: Micropropagation of Chir Pine (*Pinus roxburghii*) and Shisham (*Dalbergia sissoo*) [FRI-222/Bot-13/External/2002-2006]

Status: In *Pinus roxburghii* embryogenic cultures were successfully established. Developed procedures for rapid multiplication of Chir Pine through forced axillary branching. Adventitious buds were successfully induced on the surface of cotyledons on cytokinin medium.

Superior clones of *Dalbergia sissoo* were established in tissue culture from the shoot hedges grown in the vegetative multiplication garden of FRI. Basal media formulation and culture conditions were standardized. Somatic embryogenesis from immature cotyledons obtained successfully.

Project 4: Micropropagation of promising F_1 Interspecific hybrids of Eucalyptus and field plantations [FRI-220/ G&TP-11/ External/ 2002-2006]

Status: Techniques were standardized for tissue culture plant production of FRI hybrids of Eucalyptus. Field trial of two of these hybrids at eight different Agroclimatic locations of the country has been completed.

Project 5: Network programme for establishment of demonstrations of Bamboo plantations in Uttaranchal [FRI-257/Bot-36/External/2004-2007]

Status: Tissue Culture plants of *Dendrocalamus asper* were produced on large scale and planted at different places of Uttaranchal State.

Project 6: Development of Tissue culture technique for protocol development of *Bambusa balcooa* and *Melocanna bambusoides* [FRI-258/Bot-37/External/2004-2007]

Status: Development of protocol for micropropagation of *Melocanna bambusoides* and *Bambusa balcooa* is under progress. *In vitro* shoots were multiplied.

Project 7: Enrichment, improvement and development of botanical garden and species specific arboreta of FRI [FRI-260/Bot-39/External/2003-2006]

Status: Financial assistance for the works to be carried out under 2nd installment is awaited from the MoEF, New Delhi.

Project 8: Identification, development and utilization of natural dyes from the forest plants of Uttaranchal [FRI-249/Chem-12/External/2003-2006]

Status: Several trials were conducted to develop the process for the isolation of natural dye from *Eucalyptus* hybrid (leaves and bark) and *Populus deltoides* (bark). *Lantana camara* (leaves) and *Pinus roxburghii* (needles) on a pilot

plant scale. Dyeing trials were performed using the isolated dye and color fastness properties of dyed fabrics were determined. Physicochemical properties of the dyes were determined. A number of shades with very good color fastness properties were obtained.

Project 9: Utilization of economic potential of Parthenium [FRI-262/Chem-13/External/2004-2007]

Sub-project (i): Preparation of composites

Status: Phenol formaldehyde resin was prepared and analysed using commercial grade phenol and formaldehyde. Particle boards were prepared. For reducing the water absorption of boards wax emulsion was also used for making particle boards. These boards were tested for various physical and mechanical properties as per relevant IS specification.

Sub-project (ii): Preparation of alpha cellulose and handmade paper

Status: Cellulose isolated under optimized conditions was analysed for alpha, beta and gamma cellulose, ash content, lignin and DP. Conditions for carboxymethyation of alpha cellulose to prepare caboxylmethyl cellulose were optimized with respect to NaOH concentrations, time, and temperature to achieve more than 1 DS.

Project 10: Impacts of tourism on environment of Roopkund and Pindari areas of Nanda Devi biosphere reserve of Uttaranchal [FRI-280/Eco-15/External/ 2004-2007]

Status: Vegetational studies socio-economic surveys along the trek route, collection of soil samples was carried out.

Project 11: Garden of the Great Arc [FRI-263/Eco-12/External/ 2004-2008]

Status: Plantation of all the forest types and avenue plantations have been completed. Tree Grooves, Nakshatra Vatica and Slope stabilized. Development of Picnic garden has also been completed. Besides these watercourse stabilization has been attempted. Nearly 80% of the area has been developed.

Project 12: Ecorestoration studies in Uranium Mines [FRI-265/Eco-19/External/ 2004-2008]

Status: Collection of plant specimens from mining belt and adjoining areas has been completed for chemical analysis. Collection of soil/tailings, soil from adjoining forest belt has been collected and analysed.

A rapid ecological appraisal of the impact of Uranium Mines and its tailings at Jaduguda were assessed.

Species have been selected for plantation on tailing pond area as well as for raising greenbelt on the periphery of tailings. Based on the root penetration studies following species have been identified for tailings. *Jatropha curcas, Albizzia lebbek* and *Acacia auriculiformis* have been selected for greenbelt.

Project 13: Development of ecorestoration model for Iron Ore Mines of Bihar and Orissa [FRI-179/Eco-9/External/2001-2006]

Status: Parent rocks and soils/mine spoil from all the selected sites have been collected and analyzed to study the mineralogical changes in rock fragments and soils as influenced by restoration and successional changes in floristic composition. Phytosociological studies in all the sites conducted and Important Value Index (IVI) has been calculated. Evaluation of survival and growth of plant species of different sites has been recorded. Ethnobotanical survey in all the 12 villages in the vicinity of mining area has been completed.

Project 14: Restoration of biodiversity in the hills of Kujapuri Siddhapeeth following Badrivan restoration approach [FRI-264/Eco-15/External/2004-2007]

Status: Planting of native forest/fodder, ornamental, horticulture and species of sericulture importance was done in forest and village private lands around Kujapuri temple. Meetings with villagers, Mandir Samiti were organized to create awareness about planting of trees and restoring bio-diversity in the Kujapuri hills.

Project 15: Utilisation of Sisal fibre for making composites and handmade paper [FRI-268/FPD-49/External/2004-2006]

Sub-project (i): Preperation particle boards

Status: Particle boards were prepared at various pressure, resin %, and wax emulsion % using different ratio of sisal and parthenium particles. These particle boards were then tested for various physical and mechanical properties as per relevant IS specification.

Sub-project (ii): Isolation of fibres

Status: 100% Sisal fibre Particle boards were prepared. For reducing the water absorption of boards, wax emulsion was used. Boards were tested for various physical and mechanical properties as per relevant IS specification. Pulp from Sisal fibre was prepared and sheets of different thickness were lifted.

Project 16: Biotechnological approaches for improvement of plant species with special reference to pulp and paper [FRI-267/FPD-48/External/2004-2006]

Sub-project (i): Chemical composition

Status: 145 samples of *Leucaena leucocephala* and one sample of *Leucaena diversifolia* collected. Lignin content, anatomical and physical parameters have been evaluated for more than 500 samples. About 100 individuals have been short listed for further selection from the 500 samples received from participating institutes.

Sub-project (ii): Studies on Pulp and Paper qualities

Status: Dust of 750 samples of *Leucaena* sp. were made for proximate analysis. Lignin, Holocellulose, Extractives and Ash percentage in case of subabul (*Leucaena* sp.) collected from different Geographical region showed wide variation.

Sub-project (iii): Anatomical studies

Status: Standardization was carried out for variation in radial direction, with height and between branch and main stem.

Project 17: Efficacy testing of the insecticide -ACTARA-25WSG against termites [FRI-266/FED-18/External/2004-2007]

Status: First phase of the laboratory testing and field trial of the insecticide Actara-25 WSG completed. For evaluation of comparative efficacy of Actara, two more insecticides- Endosulfan and Chlorpyriphos were tested against termites. Endosulfan has given better results in the laboratory.

Regular surveys were conducted in the Sal forests to collect termite nests of *Microcerotermes beesoni*.

Monthly observations were made on the mortality of Eucalyptus and Popular plants due to termites in the field trial being conducted in FRI campus. Three insecticides are being tested with four different dosages in three replications. The field trial was laid down as per a statistical design provided by the Statistical Branch, FRI.

Project 18: An interdisciplinary approach to analyze the dynamics of forest and soil degradation and to develop sustainable agroecological strategies for fragile Himalayan watersheds [FRI-187/FSLR-13/External/2002-2006]

Status: The field work and laboratory work were completed. The data was processed and interpreted in consultation with the action group leaders of Norway and Netherlands.

Project 19: Study of pathogenic and molecular variability in *Fusarium solani* causing Shisham (*Dalbergia sissoo*) Wilt [FRI-272/Path-17/External/2004-2007]

Status: A total of 129 isolates of *F. solani* were collected from all over the country. Out of this 53 isolates representative of high infection zone in north India were taken for further study. Thirty eight isolates were tested for morphological growth, sporulation, colour pattern on four different nutrient media. Other parameters studied. Pathogenicity trials against the known susceptible source was carried out with 16 isolates.

A new twing canker disease of *Terminalia arjuna* by *Fusarium solani* along rodside plantations

Project 20: Researches on natural decay resistance of juvenile timbers like poplars [FRI 283/Path-18/External/2004-2007]

Status: Samples of different clones of *Populus deltoides* were collected and subjected to accelerated laboratory tests. All tested clones showed resistance against brown rot fungus.

Project 21: Studies on fungal infestation, mycotoxin elaboration and induced biochemical changes associated with edible oilseeds of forest origin [FRI-270/Path-15/External/2004-2007]

Status: The mycotoxin producing fungi isolated from fruits/ seed kernels of *Buchanania lanzan*, *Juglans regia*, *Prunus armeniaca* and *Shorea robusta* collected from different locations of Uttaranchal were screened for their mycotoxin producing potential. Fungal infestation significantly reduced Protein, starch and oil content of the four oil seeds.

Project 22: Preparation of local volume tables of Khair, Sal, Shisham and Teak [FRI-255/RS&M-15/Extenal/2003-2005]

Status: Local volume table of Khair has been prepared. Field data of Sal and Shisham being analysed for preparation of volume tables.

Project 23: Preparation of Working Plan of Chandigarh Forest Division and Management Plan of Sukhna Wildlife Sanctuary [FRI-273/RS&M-15/External/ 2004-2006]

Status: Draft plan for Sukhna Wildlife Sanctuary was prepared. Field work for the preparation of Working Plan of Chandigarh completed.

Project 24: Networking forest plantations in a crowded world: Optimizing ecosystem services through improved planning and management strategies funded by E.U. under ECCP [FRI-288/RCS-1/External/2005-2006]

Status: Survey in villages is being undertaken for assessment of goods and services by local people. First year progress report has been accepted by the EU.

Project 25: Development of mechanism for computation and forecast of growing stock in strip forests of Haryana taking into account the year wise plantation and survival of relevant species [FRI-289/RCS-2/External/2005-2007]

Status: Data has been collected from various sites i.e. canal and road side from three districts and analysis is being done to develop the model.

Project 26: Development of Technological package for the production and quality evaluation of seeds of important medicinal plant species [FRI-285/Silva-22/External/2004-2007]

Status: The seeds of 70 species of medicinal plants were collected from Ranikhet, Tiuni, Muni Ki Reti Herbal Nursery, Mata Raj Rajeshwari Nursery and Munsiyari. Seed morphological parameters were recorded. Seedlings were transplanted in polybags for observing the survival percentage.

Project 27: Studies on Himalayan Pines [FRI-175/Silva-12/1995-2006]

Sub-project 1: Seed technology

Status: Morphological observations were recorded. A total of 17 seed sources of blue pine were collected from different localities of Uttaranchal and Himachal Pradesh. Seed biology in respect to cone were carried out. Seeds were kept in low temperature cabinet for storage study. Seeds of chilgoza pine were also collected from 5 different sources of Himachal Pradesh.

Sub-project 2: Nursery and planting technology

Status: Established nursery trial to study the effect of soil mixture in promoting root development of bareroot seedlings of *P. roxburghii*. The nursery experiment to determine optimum age for undercutting of Chir Pine seedlings is also in progress. The comparison of field performance of bareroot seedlings vis-à-vis containerised seedlings showed that the overall performance of bareroot seedlings is relatively poorer than plants raised in polythene bags.

Sub-project 3: Plant physiology

Status: Seven seed sources of *Pinus roxburghii* are being screened for their water stress tolerance behaviour. Biochemical analysis in context of polyphenol, amino acids and carbohydrate of seven different seed sources of *Pinus roxburghii* are being done. Variability of 20 seed sources of *Pinus wallichiana* (Kail Pine) through isozyme studies has been done.

Sub-project 4: Investigation a diseases of Blue Pine (*Pinus wallichiana*)

Status: The status of diseases of Blue Pine (*Pinus wallichiana*) were assessed in Himachal Pradesh, Uttaranchal and Jammu & Kashmir.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Expert system for Indian woods, their microstructure, identification, properties and uses [FRI-277/Bot-42/External/2005-2008]

Status: The data on the physical properties and uses of wood is being collected and stored.

Project 2: Development of micropropagation protocol for clonal multiplication and germplsam conservation of *Swertia chirata* Buch.-Ham. A medicinally important herb [FRI-332/Bot-46/External/2005-2006]

Status: Development of protocol for clonal multiplication of *Swertia chirata* is under process. A series of experiments were conducted for sterilization of explant of *Swertia chirata* and the sterilization technique was standardized. Axillary bud break was achieved from a single bud.

Project 3: *Ex-situ* Conservation of some critically endangered and rare plants of Uttaranachal [FRI-277/Bot-42/External/2005-2008]

Status: A list of rare and endangered plants of Garhwal has been prepared. Palm *Trachycarpus takil* has been introduced in the FRI Botanical Garden.

Trachycarpus takil-an endangered endemic palm grown in poly bags for planting in its origin habitat

Project 4: Development of Live Red data Book [FRI-277/Bot-42/ External/ 2006-2009]

Status: A list of rare and endangered plants of Kumaon has been prepared.

Project 5: Creation of germplasm bank of medicinally important tree species of Punjab [FRI-336/Bot-50/2006- 2009]

Status: The seeds of 40 trees of *Emblica officinalis*, 80 *Terminalia bellirica*, 50 *Terminalia chebula* were collected and the seed characteristics study was carried out. The seeds were sown in plastic trays for growing seedlings.

Project 6: Studies on population status and berberine content in different provenances of *Berberis aristata* DC in H.P. and standardization of its propagation techniques [FRI-329/Chem-15/External/2005-2008]

Status: Five root samples were received from Himalayan Forest Research Institute, Shimla, processed for the standardization of conditions for the estimation of berberine.

Project 7: Alkaline Peroxide Mechanical Pulping (APMP) bleaching [FRI-331/C&P-17/External/2005-2007]

Status: Conditions to produce APMP pulp from sarkanda was optimized. The pulp possessed all physical and optical properties. Dewatering experiments were carried out.

Project 8: Forest fire monitoring and management [FRI-295/Eco-External/17/ 2005-2006]

Status: Pre-fire vegetation survey for fuel load determination, and fuel moisture have been carried out under pine and Sal forests in Nainital Forest Division, Nainital. Other field data such as soil temperature, soil moisture, and vegetation were also collected and analysed. Vegetation data were collected for ground, understorey and tree components.

Project 9: Income generation for women in rural areas of Uttaranchal through vermicomposting of organic solid waste into manure [FRI-/Eco-16/External/ 2005-2008]

Status: Eight villages (Shivpuri, Kotada, Aamwala, Kandoli, Phoolsaini, Bhagwanpur, Rajawala, and Telpura) have been selected to create awareness among the rural women to adopt vermicomposting technique for additional income generation. On-campus training in F.R.I. campus was organized to train the women from different villages on vermiculturing, waste segregation, mixing with cowdung and finally composting using earthworms. Vermicompost and earthworms were distributed to some of them. Household kitchen wastes/organic solid wastes have been collected from FRI campus and subjected to vermicomposting for biofertilizer preparation.

Project 10: Deployment of the promising F1 hybrids of *Eucalyptus citriodora* and *Eucalyptus torelliana* for establishment of vegetative multiplication garden and their field trials [FRI/338/G&TP-17/External/2005-2008]

Status: The natural hybrids have been collected from the arboretum. Mature hybrids have been grafted for the establishment of VMG.

Project 11: Follow up project on advance genetic improvement in seed production areas, seed orchards and progeny trials of different forest tree species in Punjab [FRI/339/G&TP-18/External/2006-2009]

Status: Survey of all the improved stock and the measurements of SSO, Patiala, to be converted to advance generation SSO was completed. Field data collected for creation of SPA of Khair and about 5 ha area has been finalized for establishment of advance generation CSO of Eucalyptus.

Project 12: Genetic improvement of *Asperagus racemous* (Wilf) to enhance root production and saponin content [FRI/340/G&TP-19/External/2006-2009]

Status: The plants and seeds from different regions were collected, germinated and kept ready for planting. The root stock for saponin content has also been collected.

Project 13: Technology transfer and development of a model village by skill up gradation and capacity building of rural communities for socio-economic upliftment [FRI-287/PLO-1/External/2005-2008]

Subtitle: Development of Model Village Nursery

Status: Villages Sherpur, Harbajwala and Badonwala on Dehradun- Shimla road were selected for the development of medicinal plant nursery. Local villagers were contacted and created awareness regarding the importance of medicinal plants and other important forestry tree species by organizing group meetings. Through a questionnaire the data pertaining to the requirement of the plant species, field problems, their present socio economic status is being collected. With the help of a NGO individuals from Harbajwala and Badonwala villages were selected and accordingly a training programme for 5 days regarding the techniques for developing a medicinal plants nursery was organized. For the establishment of Modern Nursery, City Ranger College has been selected as a demonstration-cum-information centre for the local villagers.

Project 14: Technology transfer and development of a model village by skill upgradation and capacity building of rural communities for socio-economic upliftment [FRI-297/PLO-2/External/2005-2008]

Subtitle: Integrated Utilisation of Lantana

Status: A campaign to create awareness related to 'Integrated Utilisation of Lantana' amongst the villagers of Bishanpur Kandoli, Sahaspur Block, Dehradun was organised. Training programme on the utilization of Lantana was organised at the Ranger's College Campus. During the training period participants prepared small articles such as pen stand, waste paper basket, small baskets and paper tray etc. Demonstration of the use of stalk puller prepared by the institute was given to the trainees. Process of obtaining the natural dye from the leaves of Lantana was also explained to the trainees. Various stages involved for the preparation of board from Lantana were demonstrated to the trainees in the Forest Product Division. A visit to Tehri Garhwal was undertaken as per the request made from Mount Valley Development Association. Live demonstration of natural dye from the leaves of Lantana and article was shown to villagers. A survey of the villages was conducted to know their socio-economic status.

Project 15: Collection and dissemination of market information on commercially important medicinal plants of Uttaranchal [FRI-282/RSM-16/2005-2008]

Status: Market prices of commercially important medicinal plants collected from Ramnagar, Tanakpur, Saharanpur and Delhi markets published and disseminated throughout the country. Four issues of quarterly newsletter have been published.


Introduction of commercially important medicinal plants in NWEP nursery

Project 16: Preparation of Working Plan / Management Plan for Dadra & Nagar Haveli Forest Division [FRI-328/NWFP-15/External/2005-2008]

Status: Field tours for enumeration and collection of data undertook and data compiled. Previous Working Plans were reviewed. The preliminary Working Plan Report has been submitted to the sponsoring agency.

Project 17: Development of genetically superior planting material and cultivation technology for increasing productivity of *Jatropha curcas* [FRI-286/Silva-23/External/2005-2008]

Status: The natural stands of Jatropha in different forest divisions of Uttaranchal were surveyed for the selection of Candidate Plus Trees (CPTs). A total of 149 CPTs were selected in 16 stands. Seed samples from different stands/provenances in Uttaranchal, Haryana, Punjab, Himachal Pradesh, Rajasthan and Assam were collected for provenance trial of the species. Seed samples of accessions have been sent for oil estimation to TERI, Jabalpur. Experiments on effect of different type of containers and storage environment on oil content; and germination studies in different storage conditions are in progress. A provenance trial of 32 provenances was established in Prem Nagar Dehradun. Three sites have been selected for laying out experiments on spacing, fertilizer, irrigation and pruning regimes of the species. About 30,000 seedlings have been raised in nursery at these sites. Cuttings from CPTs had been collected and planted for rooting in the nursery. Passport Data have also been collected for each CPT.

Sub-project (I): Seed technology

Status: Seeds of *Jatropha curcas* were collected from 13 different places of Uttaranchal and processed to estimates the fatty oil content in them.

Project 18: Genetic improvement of *Jatropha curcas* for adaptability and oil yield [FRI-293/Silva-24/External/2005-2010]

Status: Survey was conducted for the availability of *Jatropha curcas* germplasm in the states of Uttar Pradesh, Punjab, Himachal Pradesh and Haryana. Plantations/stands were identified and Candidate Plus Trees (CPTs) were selected, marked and germplasm (cuttings, seeds) was collected along with passport data. Cuttings from a total of 48 CPTs have been collected and planted for rooting. Seed samples of some accessions have been sent to NBRI for oil content estimation. Germplasm of *Jatropha glandulifera* of Uttar Pradesh and *J gossypifolia* (cutting) from Haryana and UP has also been collected. Cuttings of elite/unique accession of Jatropha have been exchanged among different collaborating centres. Cuttings have been collected and planted for rooting. Site has been identified in Agra for laying out the experiments with the species.

Project 19: Development of silvicultural practices for promoting cultivation of *Taxus baccata*, *Rhododendron arboreum* and *Phyllanthus amarus* [FRI-294/Silva-25/External/2005-2008]

Status: Survey for natural distribution of *Taxus baccata*, *Rhododendron arboreum* and *Phyllanthus amarus* was conducted in Uttaranchal state. Areas were marked for further studies and cuttings of *T. baccata*, *R. arboreum* and wildlings of *P. amamrus* and *R. arboreum* were collected and planted for rooting in nursery. The experiments to

standardize seed and nursery technology of *P. amarus* are also in progress. Cuttings of *R. arboreum* were collected and planted in nursery for rooting after treating. Cuttings of *T. baccata* were treated and planted in poly-house for rooting. The experiments have also been designed for developing a protocol for early rooting of stem cuttings in low cost propagation chambers with these species.

Project 20: Raising of demonstration plantations for augmenting fuelwood and fodder resources and promoting income generation in two villages of Uttaranchal [FRI-343/Silva-31/External/2006-2007]

Status: Reconnaissance survey has been done and two villages, selected in consultation with key persons of the villages in Uttaranchal.

Project 21: Sample surey to update rates and ratios of Minor Forest Products and Timber in India [FRI-294/Stat-2 /External/2005-2006]

Status: Data has been collected and submitted to ICFRE for further analysis.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	10	18	30
External Projects	19	27	19
Total	29	45	49

TECHNOLOGY ASSESSED AND TRANSFERRED

Technology for the manufacture of "Modified boucherie equipment for the treatment of green Bamboo" was transferred to M/s Garnet Tools, 2D, Industrial Area, Ujjain Road, Dewas.

EDUCATION AND TRAINING

Training organized

1. Training on Nursery techniques for raising medicinal plants at FRI City Centre, Dehradun from 22nd to 25th June 2005.
2. Training programme on the integrated utilization of Lantana at FRI City Centre, Dehradun from 26th to 30th September 2005.
3. A training programme on the integrated utilization of Lantana was organised in the ranger's college campus.
4. Free training on vermicompost to ladies of rural area of Uttaranchal at FRI, Dehradun from 25th to 28th October 2005.

5. Training programme on the integrated utilization of Lantana at Kharawa in village, Rajpur, Dehradun from 15th to 19th February 2006.
6. A training programme on the integrated utilisation of Lantana was organised at the Gram Panchayat Bhawan of village Khrawain, Post Office Kulhan, Nangal Hatnala, Dehradun.
7. Training programme on utilization of Bamboo at FRI City Centre, Dehradun on 23rd and 24th March 2006.
8. A two days Bamboo training programme was organised at the Rangers College, City Centre, Dehradun for the selected farmers of the Harbajwala village under the project "Evaluation of Appropriate Technology and its Adoption as Applicable in Rural Environment."
9. Short Term Training Courses were organized for officials of Government of India, State Forest Departments, Public Sector Undertakings, NGOs and representatives from various Industries on Exposure to Field Identification of Timbers; Nursery and Plantation Technology; Plywood Manufacture; Management of NWFP for Sustainable; Development of Green Belts; Hi-Tech Nursery and Plantation Technology; Urban Forestry and Landscaping; and Environmental Problems & Bioremediation Techniques.

Attended

1. Dr. H.S. Ginwal, Scientist D and Dr. Ashok Kumar, Scientist C has attended the "Third Country Training Programme on Tree Improvement of Fast Growing Species" at Yogyakarta, Indonesia from 5th to 18th March 2006 with the financial support from Japan International Cooperation Agency (JICA).
2. Dr. Vineet Kumar visited Polytechnic University, New York and worked as a Post Doctoral visiting scientist on chemoenzymatic modification of halouronic acid and chemical modification of oligopeptides using reverse equilibrium protease catalysis.
3. Rakesh Kumar, Scientist B, Praveen Onial, RA I and Raj Dev Rawat, RA visited Northern India Textile Research Association, Ghaziabad to study Reference Bench top Spectrophotometer and other instrumention techniques related to quality control of natural dyes on 9th February 2006.
4. Dr. V.K. Varshney attended a training on Value added products covering aromatic chemicals, fragrance and flavor creation methodology from 19th to 27th September 2005 at Fragrance and Flavor Development, Centre, Kannauj (U.P.), India.

LINKAGES AND COLLABORATION

National

1. Linkages were developed with National Institute of Technology, Jalandhar during the project formulation for Technology Improvement of Sports Goods manufacturing.
2. Linkages were developed with Sport forum, Jalandhar when their 12 members visited Forest Products Division on 1st March 2006 and team of Jalandhar visited various factories at Jalandhar associated with Sports Forum.
3. Linkages were developed with Department of Forestry, HNB Garhwal University during collection of sample for CSIR funded project.
4. Linkages were developed with Forest Department Jaipur, Forest Department Bundi, Forest Department

Hanumangarh, Forest Department Haldwani, Forest Department Roorkee, Forest Department Hardwar, Forest Department Ranikhet and Forest Department Narendranagar Division.

5. Linkages were developed with various wood & wood products manufacturer and user industries, important among them are: NTPC, Talchar; NTPC, Barnyhat, Meghalaya; BIS, New Delhi; Northern Coal Fields Ltd. Singrauli; Delhi Development Authority; Asahi India Glass Ltd., Taloja; Reliance Industries Ltd., Jamnagar; Garnet Tools, Dewas; PPDC, Meerut; IMPCL, Mohan; Star Paper Mills, Saharanpur; Sports Forum, Jallandhar and National Mission on Bamboo Applications(NMBA)
6. Linkages with the state forest Department of Uttaranchal for field planting of *Putranjiva roxburghii* in 2.00 ha area in Jakhan Block, Barkot Range, Dehradun Forest Division and *Prinsepia utilis* in Mussoorie Forest Division and also for *Jatropha curcas* plantations.

International

1. An EU Research Project on "Interdisciplinary approach to analyse the dynamics of forest and soil degradation and to develop sustainability agroecological strategic fragile Himalayan watersheds" is in progress. The Netherlands, U.K., Norway, Pakistan, Nepal and India are working in this project.
2. Undergraduate student from USA (Rice Uni.) for information about tourism in Nanda Devi Biosphere Reserve, Uttaranchal.

PUBLICATIONS

Book

Soni, P, Veena Chandra and S.D. Sharma (2005). Mining Scenario and Ecorestoration Strategies (eds.). Jyoti Publishers & Distributors, Dehradun.

Brochure

A Brochure on "Studies on Himalayan Pines".

Quarterly Newsletter

Four issues of the Quarterly Newsletter " Market Information on Medicinal Plants".

Proceeding

Srivastava, R. K Hooda, A. K, Singh, Y. P, Thapliyal, M. and Ombir Singh (2006). XII Silviculture Conference. Forest Research Institute, Dehradun, February 1-3, 2006.71 p.

Technical Bulletin

Kaushik S, Singh Y.P, Gupta S. and Dinesh Kumar (eds.). (2005). Envis Forestry Bulletin (Forest Products Special, Vol. 5). 76p.

CONSULTANCIES

Long term consultancies

1. Installation of steam-heated kiln at J & K Handicrafts Srinagar (J&K Handicrafts Corporation) funded by J&K handicrafts (S&E) corporation, Srinagar, Jammu and Kashmir for a period of 3 years. The consultancy amount is Rs. 16.5 lakhs. This consultancy is for installing a steam heated kiln for M/s J&K Handicrafts (S&E) Corporation, Srinagar and maintaining it for 2 years. The installation has been completed and staff of J&K Handicrafts has been trained in kiln operation. The maintenance contract is on and will be over in November 2006.
2. Installation of solar kiln at IMPCL factory premises, Mohan (IMPCL) funded by IMPCL, Mohan, Almora Dist., Uttaranchal for a period of 2 years. The consultancy amount is Rs. 3,37,200. This consultancy is for installing a solar kiln for M/s IMPCL, Mohan and maintaining it for 1 year. The kiln has been installed and handed over to the client after successful trial and training of their staff. Maintenance contract is on and will be over in July 2006.

Short term consultancies

1. To Star Paper Mills, Saharanpur for prevention of decomposition in stored poplar wood.
2. To M/s Hukkeri Brothers, Kohlapur for preparation of katha from *Acacia catechu* against a consultancy fee of Rs. 10,000/-.
3. Development of Green Belts to Greater Noida Development Authority for two days. An amount of Rs. 20,000/ was charged.
4. On-site consultancy to SRF Ltd., Indore (M.P.) during 9th and 10th September 2005.
5. On-site consultancy to Asahi India Glass Ltd., Taloja (Maharashtra) during 29th to 31st August 2005. Gave a training consultancy to the same firm on "Wood Utilisation Aspects" during 9th to 12th January 2006.
6. On-site preliminary consultancy to the Sports Forum, Jallandhar to identify and tackle the problems faced by the wooden sports industry on short and long term bases.
7. About 485 wood samples examined and identified and revenue of about Rs. 23,45,000/- earned.
8. Revenue earned through various consultancies, testing and other services above Rs. 26 Lakhs.

CONFERENCES/MEETINGS/WORKSHOPS/SEMIMARS/SYMPOSIA/ EXHIBITIONS

Organized

1. National Technology Day was celebrated on 11th May 2005.
2. Forest Research Institute Dehradun celebrated the World Environment Day on 5th June 2005 with the start of running for the Environment in which the forest officials, Scientists, Scholars, staffs and children participated.
3. A training programme on Eco-sensitization was organised by Extension Division at Kandoli (Bishanpur) village and a lecture on Rural Development Technologies on Socio economic upliftment of Rural people. The technologies developed by FRI such as Natural Dyes, Compost preparation, Lantana articles including Board preparation from Lantana etc. were highlighted.
4. Hindi Saptaha at FRI, Dehradun from 19th to 23rd September 2005.
5. Vigilance awareness week at FRI, Dehradun from 07th to 11th November 2005
6. Forest Research Institute, Dehradun participated in Uttaranchal International Trade Fair (UITF-2005) from 5th to 12th November, 2005 and was sponsored by NABARD.
7. Regional Workshop on Challenges and Opportunities of Forestry Extension on 17th and 18th November 2005
8. XII Silviculture conference at FRI, Dehradun from 1st to 3rd February 2006.
9. National Conference on Ecology and Environment at FRI, Dehradun on 27th and 28th February 2006.
10. A two days National Workshop on Forestry Education in India: Issues and Opportunities was organised in the Convocation room of the FRI by Deemed University on dated 20th March 2006. Around 200 eminent scholars and experts from various universities, government and non-government organizations and research institutes participated in the workshop. The main theme of the workshop was status of forestry education, linking forestry education with research and extension and with other disciplines and job opportunities in forestry sector.
11. World forestry day was celebrated in the Forest Research Institute on 21st March 2006. Besides this some of the technologies developed by the institute such as Macro proliferation technique of Bamboos, Natural Dyes

from forest biomass, preparation of Herbal Gulaal, Kathaa from Gambier and herbal agarbattis etc were shown to the public. Integrated utilization of the Eucalyptus, Poplar and Lantana for the formation of furniture etc. was also demonstrated.

Attended

1. Dr. A. N. Shukla participated in National symposium on 'Changing Concepts of Forestry in 21st Century' at Dr. Y.S. Parmar Univ. of Horticulture and Forestry, Nauni, Solan (H.P.) and XII Silviculture Conference, at Forest Research Institute, Dehradun.
2. Dr. N.S.K. Harsh participated in National Conference on 'Biopesticides: Emerging Trends (BET-2005') at Institute of Himalayan Bioresource Technology (CSIR), Palampur and 'Tree Biotechnology: Indian Scenario' held at Tropical Forest Research Institute, Jabalpur.
3. Dr. Y.P. Singh participated National Conference on 'Forest Ecology and Environmental Priorities in 21st Century", held at Forest Research Institute, Dehradun and 'Plant Science Research in India: Challenges and Proapects' held at Botanical Survey of India, Dehradun.
4. Shri V.K. Jain, Dr. Vimal Kothiyal and Shri Sachin Gupta have attended a workshop on 'Uttaranchal Wooden Souvenir Workshop' at Srikot, Srinagar, Garhwal organized by Uttaranchal Handicraft and Handloom Council.
5. Dr. Vimal Kothiyal, Head, Forest Products Division made a presentation on 'Technologies in Forest Products Involving stake holders' in the ICFRE society meeting at Ministry of Environment and Forests, New Delhi.
6. Shri Rajesh Bhandari, Shri Ajmal Samani and Dr. Anil Negi participated in national seminar-cum-exhibition 'Bam Fest2006' at Bhubaneswar, Orissa.
7. Dr. Vineet Kumar participated in a symposium on 'Innovations at the interface of polymers and biology' held at Polytechnic University, New York.
8. Dr. K. Vishwanathan, Vineet Kumar and Gross, R. presented paper on Oligopeptides from protease catalysis: sources of macromers and functional polymers in National Science Foundation Industry/University Cooperative Research Meet at Centre for Biocatalysis and Bioprocessing of Macromolecules, Polytechnic Unviersity New York.

9. Rashmi presented paper on *Jatropha curcas*: A potential source of Biodiesel in New horizons in lipids and specially oleo chemicals and lipids Expo 2005 held at IICT, Hyderabad and a paper on two new saponins from medicinally important seeds of *Achyranthes asper* in IUPAC sponsored second International Symposium on Green/Sustainable Chemistry held at Chemistry Department, Delhi University, Delhi.
10. Dr. V.K. Varshney attended the workshop on Intellectual Property Rights (IPR) on Herbs and Herbal Products held at India International Centre, New Delhi.
11. Dr. (Mrs) P. Soni participated in several workshops and meetings such as the MODIS data utilization workshop, Space Application Centre ISRO, Ahmedabad, Facilitating Forestry Mitigation Projects in India: Promoting Stakeholder Dialogue and Capacity Building at ICFRE, Seminar on International Law Issues and Multilateral Environment Agreements, Third International Seminar on Plants and Environmental Pollution and TPDM Meeting on Uranium Project at Atomic Energy Commission, Mumbai.
12. Dr. (Mrs) Laxmi Rawat attended several workshops and meetings such as National Symposium on Changing Concepts of Forestry in 21st Century at Y.S. Parmar University Horticulture and Forestry, Solan, Integrated Management of Natural Resources of Mountains at GB Pant University, Pantnagar, Ecosystem Services and Ecological Economics: Himalayan Mountain Context.
13. Shri A.K. Tripathi participated in the workshop on MODIS Data utilization at SAC-ISRO, Ahmedabad, Management of Municipal solid wastes and plastic wastes at Dehradun, Strategic Planning, Silviculture Conference, Strategising Hill Tourism, and Biomass Briquetts Workshop.
14. Shri H.B. Vasistha and Dr. Mridula Negi attended National Symposium on changing concepts of Forestry in 21st Century. Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, Solan.
15. Scientist has attended the National Congress of Entomology held at Punjabi University, Patiala.
16. Dr. Veena Chandra was invited to deliver a lecture on Herbarium Techniques and its role in taxonomy in the National Seminar on Recent Trends in Plant Taxonomy held at Sarojini Naidu Govt. Girls PG (Autonomous) College Bhopal and Silver Jubilee Symosium on Ethnobotany in the new millennium at NBRI, Lucknow.
17. Dr. Sangeeta Gupta, Scientist D, Wood Anatomay attended 6th Pacific Regional Wood Anatomy Conference Kyoto, Japan.
18. Scientists of Botany Division participated in XXIII All India Botanical Conference and National Symposium on Plant science Research in India: Challenges and Prospects.

AWARDS

1. Dr. Mridula Negi received S.K. Seth Prize for best paper in Ecology and Environment entitled "Evidences of Climate change and its impact on structure and function of forest ecosystem".
2. Ms. Himani Bhatia received a Best Paper Award for her research paper entitled "The family leguminosae rich source of galactomannans" in Recent advances in science : a prospective presented in a "National Symposium on Recent Advances in Science: A perspective" held at Dolphin (PG) Institute of Bio-Medical and Natural Sciences, Dehradun from 3rd to 5th June 2005.
3. Dr. Veena Chandra received the Prof. Bashir Ahmad Razi Medal from the Association of Plant Taxonomists, India for her contribution to Plant Taxonomy and Ethnobotany at NBRI, Lucknow on 29th March 2006.

DISTINGUISHED VISITORS

1. David Daniel, Ambassador of Israel in India visited on 4th April 2005.
2. Dr. Mohammad Zakir Hussein, Director, Constituency, IDCN, Asia Region, Bangkok, Thailand visited on 12th May 2005.
3. Nikhat Sattar, Head, Regional Emerging Programmes, IUCN, Asia Region, Bangkok and Karachi visited on 12th May 2005.
4. Justice Cyraiac Joseph, Chief Justice, Uttaranchal High Court visited on 25th May 2005.
5. Pradyut Bardoloi, Minister of Forests, Govt. of Assam visited on 4th July 2005.
6. Lucie Edwards, High Commissioner for Canada visited on 21st July 2005.
7. Shri Maheshwar Murmu, State Forest Minister, West Bengal visited on 25th October 2005.
8. Dr. R. Lalthangliana, Honable Minister of Environment and Forests, Mizoram vistited on 11th February 2005.
9. Shri Namo Narain Meena, Minister of State for Environment and Forests, Govt. of India visited the Forest Products Division and familiarized with the technologies developed and research activities going on in the Division on 1st February 2006.

FOREST RESEARCH INSTITUTE
(DEEMED UNIVERSITY)

Forest Research Institute, Dehradun was conferred the status of 'Deemed University' by the Ministry of a Human Resource Development, Government of India, New Delhi vide Notification No. F-9-25/89 U-3 dated

6.12.1991. After the conferment of Deemed University status academic activities of the Institute have increased tremendously and it has been fostering research and education in Forestry, environment and other allied disciplines in a more meaningfull and productive way. Besides turning out students having formal academic and practical education of University standard in specialized areas of study such as, Forest Economics and Management, Wood Science and Technology, Environment Management, Plantation Technology, Biodiversity Conservation to man responsible position in forestry research, wood based industries and plantation activities, the Deemed University has been fostering pioneering research in specialized areas under Ph.D. Programs.

Academic Courses and Admission

The FRI (Deemed University) has been offering the following academic courses on a regular basis:

1. M.Sc. Forestry (Economics and Management)
2. M.Sc. Wood Science and Technology
3. M.Sc. Environment Management
4. Post Graduate Diploma in Biodiversity Conservation
5. Post Graduation Diploma in Management of Non Wood Forest Products
6. Six month Certificate Course in Pulp and Paper Technology.

The M.Sc. courses are of two years duration whereas post graduation diploma courses are of one year duration and the certificate course in Pulp and Paper Technology is only of six months duration The intake capacity of each course is 25 in M.Sc; 15 in PG. Diploma courses of Natural Resource Management, 22 in PG. Diploma courses of Management of Non Wood Forest Products and 15 in six month certificate course in Pulp and Paper Technology.

Admissions to these courses are made on the basis of a candidate's performance in All-India competitive Entrance Test.

During the year 2005-2006 ninetynine students were admitted in all the above six courses. At present the total strength of the students in all courses is 98.

Lectures on above mentioned courses were delivered by internal faculty. Visiting faculty were also invited from IIRS, WLI, IGNFA, DAV (PG) College, and retired scientists from these institutions were also invited to deliver lectures on specific topics.

Besides regular lectures programme and dissertation/project work on specific topic relevant to their course, students were also sent to one month industrial attachment to different industries/ organizations. Local excursion, short and long study tours and trainings were also organized during the academic session.

During the year 2005-07 ninety five students were admitted. The strength is as follows.

1	M.Sc. Forestry (Economics and Management)	- 20
2	M.Sc. Wood Science and Technology	- 25
3.	M.Sc. Environment Management	- 21
4.	P.G. Diploma in Biodiversity conservation	- 6
5.	P.G. Diploma in Management of Non Wood Forests Product	- 14
6.	Certificate courses in Pulp and Paper Technology	- 9
	TOTAL	**95**

Extra Curricular Activities

1. Students of FRI-DU attended and participated in the workshop "Forestry Education in India" held by FRI-Deemed University.
2. The annual convocation of S.F.S College on 12th April 2006 was attend by the students of FRI- DU. Annual sport meet held from 28th to 30th September 2005 for FRI, Dehradun were also attended by students.
3. A Cultural program "Ankur-the Beginning of Growth" was held on 24th February 2006 by the students and research scholars of the Deemed University.

Students welfare Activities

1. F.R.I. (Deemed University) provide medical facilities to its students.
2. Hostel accommodation is available in F.R.I. Campus.
3. The facilities for indoor games and common room are provided to the hostlers.
4. Library and Computer facilities are available to the students.

Other Activities

1. Prof. S.P Singh, Vice Chancellor, Garhwal University visited F R I on 12th December 2005 for taking viva-voice of Ph.D. Scholar.
2. Students of FRI (Deemed University) attended Silvicultural meet from 1st to 2nd February 2006 held in FRI, Dehradun
3. Opening Ceremony of National workshop on Forestry Education in India on 20th March 2006.
4. Campus interviews were conducted for M.Sc and PGD courses. Six students from M.Sc. (WST) courses and six students from M.Sc. Forestry and M.Sc. Environment Management courses have been selected in different industries/organization.

Ph.D. Programme

Research is an essential function of a National Institute like the Forest Research Institute (Deemed University) and increasing emphasis is being given to this important aspect of academic pursuit. Highly qualified

Foresters/ Scientists and talented Research Scholars have continued to be active in the frontier areas of research and their efforts have been generally supported by sponsoring agencies like the ICFRE, UGC and CSIR, etc. With the support of these organizations coupled with the guidance of talented researchers, which the Institutes and established Research Centers have, the research activities under Ph.D. Program have increased manifolds. At present 436 Research Scholars have been registered including registration of 62 Research Scholars in the current year. During the year 42 Research Scholars have been awarded Ph.D. degree.

Placement

The students passing out of the FRI Deemed University also have the facility of placements through placement coordinator. The campus interviews are arranged every year for students of all the disciplines.

Following is the placement detail of our students for last two academic years.

Year	Course	No. of Students	Placement/Permanent appointment in agency
2004-06	M.Sc. Wood Science and Technology	2	C. L. Gupta, Moradabad.
		4	Evergreen Industries, Gurgaon.
		2	Ria Enterprises, Rajdhani Pasic Nangloi, Delhi
		3	Punjab Ply, Yamunanagar,
		4	Rama Woodcraft, Rudrapur
2004-06	M.Sc. Forestry	5	Foundation of Ecological Securities, Anand, Gujrat.
		1	Permanent job in BILT
2004-06	M.Sc. Environment Management	1	Foundation of Ecological Securities, Anand, Gujrat
2004-06	Management of N.W.F.P.	1	Permanent job in Vaidyanath Pharmaceutical, Jhansi.

NATIONAL FOREST LIBRARY AND INFORMATION CENTRE

The National Forest Library and Information Centre (NFLIC) is richest in document collection in South and South-east Asia and has been providing all types of library and information services to its users viz. reference, referral, lending, reprography, current awareness, inter-library loan, retrieval of information from machine readable databases, etc.

During the year a total of 27,339 books were loaned to the users for outside reading. Besides, 58,343 documents were consulted inside the library.

The document collection was enriched by the addition of 1424 documents out of which 110 books were purchased at a cost of Rs. 3.53 lakhs and 1,314 books were received as gratis.

The NFLIC subscribed to Indian and foreign periodical titles at a cost of about Rs. 44.12 lakhs. It also received about 300 periodical titles as gratis. Besides, back issues of 39 periodical titles were also acquired at a cost of Rs. 9.21 lakhs.

The binding of loose issues of periodicals and old books is an essential library activity. During the year, 400 sets of periodicals and 150 sets of reports, etc. were got bound at a cost of Rs.32,500/-

The NFLIC has been selling ICFRE publications through its Book Depot. During the year 566 books, 30 VCDs and 2 VHF cassettes were sold which earned revenue of Rs. 1,53,317/-.

The Ministry of Environment and Forests, Govt. of India established an ENVIS Centre on Forestry at NFLIC. The Centre, during the year enriched the following databases by the addition to new references, which have internet accessibility through the website of the Centre having URL:www.frienvis.nic.in: Indian Forestry Abstracts, Joint Forest Mangement, *Prosopis juliflora*. Forests and Environment are in Press, Current Forestry Literature. A new database on Poplars was compiled. Besides, the contents pages of Indian and foreign journals, forest cover of India, state wise and then district wis, announcements of forthcoming national and international conferences, seminars, symposiums, training courses were also put up on the website. The ENVIS Centre on Forestry published 12 issues of ENVIS News Digest, and a thematic issue of ENVIS Forestry Bulletin on Forest Products, during the year.


Centenary Year
FOREST RESEARCH INSTITUTE
DEHRADUN
Forest Research Institute
Dehradun
2006

Centenary Year of Forest Research Institute (1906-2006)

Forest Research Institute (FRI), Dehradun celebrated Centenary Day on 5th June 2006. The inaugural function was chaired by Shri N.D. Tiwari, Hon'ble Chief Minister of Uttaranchal. Shri Nav Prabhat, Forest Minister of Uttaranchal; His Excellency Mohammed al-Amin Issa Kabashi, Minister of Agriculture and Forestry, Sudan; His Excellency Azhari Khalafalla, Minister of Agriculture in Gerzia State, Sudan, His Excellency Abdalmahmood Abdalhaleem, Ambassador of Sudan; Shri Hans Raj Josan, Forest Minister, Punjab; Shri J.C. Kala, Director General and Special Secretary, Ministry of Environment and Forests; Shri G.K. Prasad, DG, Indian Council of Forestry Research and Education (ICFRE); PCCFs and senior officers and scientists from different States and organizations such as, Forest Survey of India; Indira Gandhi National Forest Academy (IGNFA); Wildlife Institute of India and representatives from the industries and NGOs were present on this historic occasion. A film on research activities of FRI was shown to the delegates. The officials who had been serving in the institute for the last 40 years were honoured. A souvenir and United States Department of Agriculture (USDA) Pine project document were also released on this occasion. The first Brandis Memorial lecture was delivered by Dr. M.S. Swaminathan on "Forests Custodians of India's Ecological, Hydrological and Food Security Systems" on 6th June 2006.

Historical perspective

Dehradun has been a Centre for forest related activities since 1878 when a college was established for training Rangers and Foresters. The Institution was taken over by the Government of India in 1884 and Forest Research was linked with forest education from the time since the Research Officers/Foresters were appointed in 1906. These officers took an important part in the training of the students. Initially four officers of the Indian Forest Service, and one specialist were appointed in 1906 when the Institute first began to take shape.

In 1906, a few small isolated buildings were used, which were soon found to be insufficient, and in 1914 a large building with laboratories was erected at Chand Bagh (now Doon School). It was expected that these buildings would suffice for many years to come, but the development of the forest resources of India made great strides during the War and every effort was made to render the country less dependent on foreign supplies. The Industrial Commission in 1918 highlighted the necessity for expanding the Institute to meet the rapidly increasing demands of the country and stated that the equipment provided was entirely inadequate, and emphasized the necessity for increasing the number of Research officers.

The Board of Forestry supported these proposals and the Government of India decided to acquire a large estate near Dehradun, to equip it with modern buildings, apparatus, and adequate staff. The workshops were completed and made operational in 1924, and the main building was occupied during the period from the year 1926 and 1928. The cost of the new Forest Research Institute was about Rs. 90 lakhs. The institute included a large number of residences of different classes, costing from Rs. 600 to Rs. 60,000. The main building was designed by Sir C.G. Blomfield of Delhi and the work was carried out by Sardar Ranjit Singh under the Supervision of Mr. Rouse, Chief Engineer, Mr. F.T. Jones, Superintending Engineer and Mr. Uttam Singh, Executive Engineer of Delhi Province.

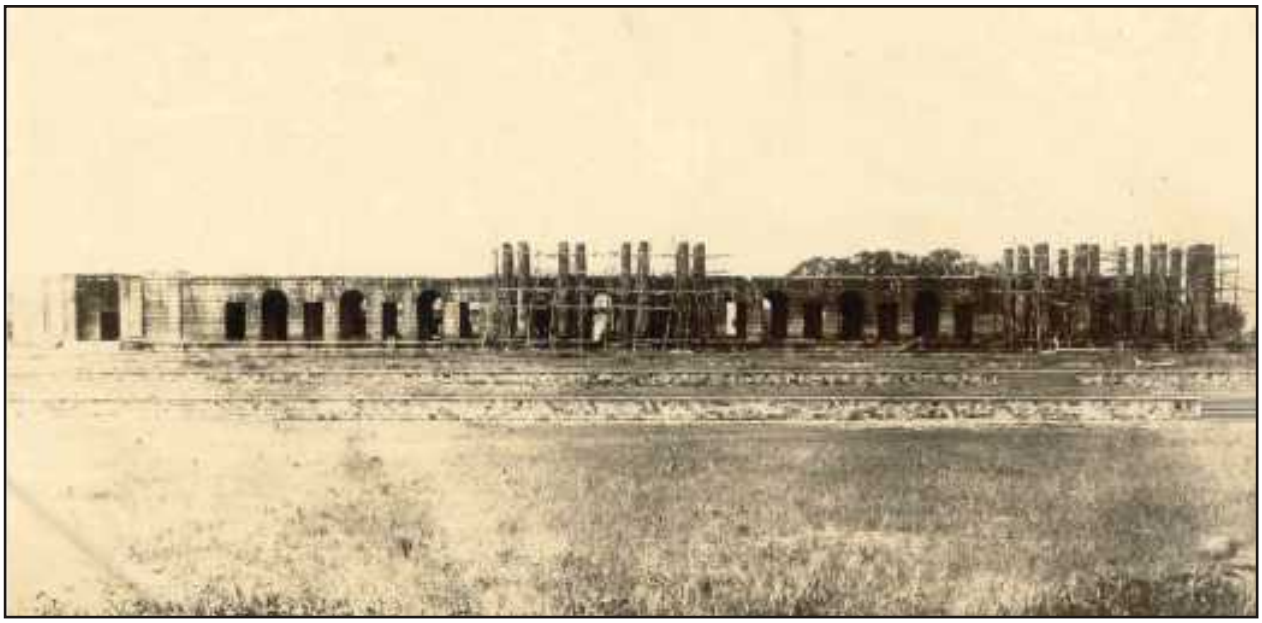
Set in the sylvan surroundings of Doon Valley, the Forest Research Institute is proud testimony to the foresight and vision of foresters and administrators of yesteryears. The majestic main building of the Institute, construction of which took nearly 7 years, has a plinth area of 2.8 ha (7 acres). The whole estate covers 480 ha (1,200 acres), but later 52 ha (130 acres) was handed over to the Railway Board for a training college, and 2.4 ha (6 acres) were leased to a company which provided electric power to the new buildings. A considerable part of the institute land was covered by experimental plantations of chir pine, sal, and teak, and the Silviculturist, Botanist and Officer in Charge of Minor Products (now NWFP) all had their experimental gardens.

There are six museums, with floor space of 26,000 square feet, and the ordinary rooms designed for laboratories and offices cover about 63,000 square feet.

His Excellency the Viceroy Lord Irwin while inaugurating the building made the following observations:

"This Forest Research Institute is, I believe, the largest and most complete in the British Empire if not in the whole world and its completion is an event in which India may well take pride. I remember that my first thought seeing the layout of the Institute three years ago was that the building and their setting were in every way worthy of the great forests with which this country is endowed and of the fine work that has been, is being and is yet to be done towards their development and utilization for the benefits of the people of India. I feel that those who have planned and those who have found the money for this Institute have been inspired by no unworthy conception of its potential value to the life of India. Research is the essential counterpart of the splendid work that is carried on from day to day and from year to year by the officers of the Indian Forest Service, often in face of danger and generally in that isolation which is a stern test of character and of devotion to duty".

MEMORIES



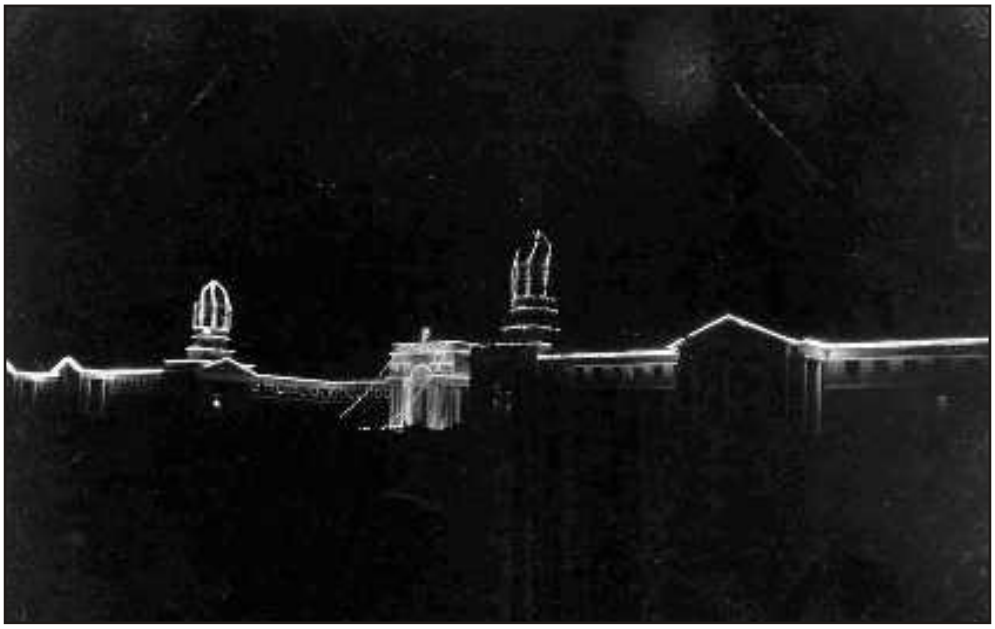
FRI Main Building under construction

East Block of FRI Main Building under construction

West Block of FRI Main Building under construction

Front view of FRI Main Building

Backside view of the FRI Main Building



Lighting on the occasion of 25th Anniversary of the FRI Main Building

Ceremonial Plantations by Dignitaries

His Excellency the President of India,
Dr. Rajendra Prasad planting the Sal sapling:
6th December 1956

His Excellency the President of India,
Shri V. V. Giri planting the Kadam sapling:
3rd August 1972

Hon'ble Prime Minister of India,
Smt. Indira Gandhi planting the Rudraksha sapling:
19th December 1981

His Excellency the President of India,
Shri R. Venkataraman planting the
Sita Ashok sapling: 13th January 1989

His Excellency the Governor of U.P.
Shri Moti Lal Vora Planting
the Rudraksha sapling:29th July 1993

Hon'ble Minister of Environment and Forests, Government
of India, Prof. Saifuddin Soj planting the Chinar sapling:
12th June 1997

His Excellency the Vice President of India,
Shri Krishna Kant planting the Harad
sapling: 28th May 1999

Hon'ble Minister of Environment and Forests,
Government of India, Thiru T. R. Baalu planting
the Aonla sapling : 26th May 2000

Hon'ble Minister of Environment and Forests,
Government of India, Thiru A. Raja
planting the Kachnar sapling: 3rd August 2004

Distinguished Visitors

Hon'ble Prime Minister of India,
Pandit Jawaharlal Nehru: 12th December 1953

Shri K. M. Munshi: March 1954

His Excellency the President of India,
Dr. Rajendra Prasad: 6th December 1956

Shri Jagjivan Ram: 31st March 1970

His Excellency the President of India Giani Zail Singh: 2nd April 1984

His Excellency the Vice President of India, Shri Bhairon Singh Shekhawat: 11th October 2004

CHAPTER 3.2

Institute of Forest Genetics and Tree Breeding Coimbatore

The Institute of Forest Genetics and Tree Breeding (IFGTB) is a national institute formed in April 1988 under the Indian Council of Forestry Research and Education (ICFRE), an autonomous Council under the Ministry of Environment and Forest, Government of India. It was formed by up-gradation of the Forest Research Centre (FRC), Coimbatore under the Forest Research Institute and College, existing since 1959. Certain other organizations and schemes viz., Forest Soil-cum-Vegetation Survey (FSVS), Coimbatore, Disease and Insect Survey (DIS), Coimbatore, Indo-Danish Project on Seed Procurement and Tree Improvement (IDPSPTI), Tropical Pines Research Centre (TPRC), Kodaikanal, Eucalyptus Research Centre (ERC), Ooty and Environmental Research Station (ERS), Ooty were also merged with the FRC to form the Institute.

PROJECTS COMPLETED DURING THE YEAR 2005-2006

Project 1: Genetic variability and selection in natural population of *Artocarpus* sps. [IFGTB/RP1/2000-2006]

Findings: Natural populations of *Artocarpus integrifolia*, *A. hirsuta* and *A. lakoocha* have been identified in Tamil Nadu and Kerala. Within population variation are being compared between populations.

A progeny trial of selected trees in different populations of *A. integrifolia* was raised in Kolli hills. A Seed Production Area (10 ha) of *A. hirsuta* has been established at Palode (Kerala). Isozyme standardisation was done for two enzymes. Genetic distance was calculated between identified populations of *A. integrifolia*. The natural regeneration status of all three *Artocarpus* sps. was studied at Topslip area.

Project 2: Evolving Clonal Propagation Technology for Teak to Improve Productivity [IFGTB/RP2/2000-2006]

Findings: Clonal propagation technology for superior Teak trees and clonal seed orchard seedlings has been developed. Superior Teak trees with good stem form, height and girth were selected in different locations of Kerala and being multiplied clonally and assembled in the clone bank. The rooting performance of different Teak clones has been studied. Field trials were established with improved planting stock of Teak in Kerala and Tamil Nadu and evaluated. The growth performance were assessed. A clonal trial of Teak established at Nilambur (Kerala) was evaluated and compared with the traditional plantation raised through Teak stumps.

Project 3: Selection of potential mycorrhizas and other beneficial microbes for the reclamation of bauxite mine spoils [IFGTB/RP10a/20022005]

Findings: Tree species such as *Acacia auriculiformis, Casuarina equisetifolia, Eucalyptus camaldulensis* and *E. tereticornis* were raised successfully with mine spoils as a potting medium with the biofertilizers amendment of (*Arbuscular mycorrhiza*) AM and other microbes. Thereafter, the seedlings were directly transplanted (1.5 acre) at bauxite mine spoils Yercaud for reclamation.

The growth and survival of the seedlings is found satisfactory. The biomass of the seedlings also recorded increase due to nutrient supply from the biofertilizers. This technique is cost effective for reclamation of mine spoils without using top soils.

Project 4: Study on market dynamics relating to important non timber forest produce in Tamil Nadu [IFGTB/RP19/2002-2006]

Findings: Information on collection, quantity, marketing structure, middleman role etc were gathered from 18 LAMPS' from the past 12 years data with information on socioeconomic details of local tribal people who are dependent on NTFP collection and related activities. Details of NTFP production, sale and participation of VFC and NTFP seedlings planted under JFM activities have been collected from Madurai, Coimbatore and Salem divisions.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Genetic improvement of *Eucalyptus tereticornis* through control hybridization andmolecular characterization [IFGTB/RP3/2002-2005]

Status: Controlled pollination experiment was conducted in a control selfed *E. tereticornis* family pollen parent of *E. saligna* was control pollinated with *E. tereticornis* and five hybrid families have been harvested. Two full sib trials (28 months old) have been evaluated and 15 hybrids in combinations of *E. tereticornis x E. pellita*, *E. tereticornis x E. grandis* and *E. tereticornis x E. alba* have been selected for clonal propagation.

Project 2: Enhancing productivity in *Casuarina* sps. through inter-provenance and inter-specific hybridization [IFGTB/RP30/2003-2008]

Status: Inconsistency in rooting of matured cladode cuttings from 10 years old trees of *Casuarina junghuhniana* sub sp. *timoresnsis* was overcome by coppicing and pollarding selected trees and rooting coppice shoots with 80-90% success. Rooted cuttings are assembled in a potted orchard and involved in inter-provenance and interspecific control pollination experiments. Evaluated open pollinated progeny of hybridization orchard in field tests for growth, form and flowering traits and identified putative interspecific hybrids.

Project 3: Estimation of gene diversity and enhancing seed production in seedling seed orchards of Eucalyptus, Casuarina, Acacia and Teak [IFGTB/RP31/2003-2008]

Status: Fertility studies were taken up in Acacia and Eucalyptus orchards established at different locations for the second successive year. In the moist location at Panampalli in Kerala, *E. camaldulensis* showed a high proportion of fertile trees whereas *E. tereticornis* had low proportion of fertile trees. In the dry site at Pudukkottai in Tamil Nadu, proportion of fertile trees was low in both *E. camaldulensis* and *E. tereticornis*. In *Acacia auriculiformis*, 60% of the trees effectively contributed in seed production at Panampally whereas only 12% of the trees contributed in effective seed production at a comparatively dry location (Sadivayal) in Tamil Nadu.

Project 4: Genetic transformation of Eucalyptus and Casuarina to enhance salinity tolerance [IFGTB/RP6/2002-2005]

Status: Superior genotypes identified were screened for *in vitro* regeneration responses. Clones showing the highest and lowest response for axillary bud induction were identified. Different parameters determining optimum cocultivation conditions for introduction of Osmotin gene in *Eucalyptus tereticornis* were assessed. Hypocotyl tissues of Casuarina were assessed for *in vitro* regeneration response in different plant growth regulator combinations.

Project 5: Isolation of somaclonal variants of *Casuarina equisetifolia* for salinity tolerance [IFGTB/RP8/2002-2007]

Status: *Casuarina equisetifolia* appeared to be recalcitrant to the somatic embryogenesis. Several media and hormone combination tested for obtaining regeneration of callus. Increasing concentration of Cytokinins (BAP and Kinetin) upto 5.00 ppm also failed to regenerate the callus. Fresh inoculation carried out for obtaining callus for regeneration and screening experiments. 72 hrs of treatment resulted in death of the callus in all the treatments. Screening of callus tissues in the salt / sea water containing media continued.

Project 6: Identification, isolation, evaluation and mass production of native fungi for the management of teak and raternal stem borers [IFGTB/ RP21/2002-2007]

Status: Four isolates of entomopathogenic fungi (3 isolates trapped from the soil samples and 1 isolate from the cadaver) were identified authentically as *Beauveria bassiana* (2 isolates), *Trichoderma harzianum* (1) and *Paecilomyces variotii* (1).

Out of 15 isolates of entomopathogenic fungi so far obtained, 7 of them (5 trapped from the soil samples and 2 isolates from the infested cadavers) were selected as potential through lab tests against the targeted pest *Indarbela quadrinotata* and *Sahydrassus malabaricus*.

The seven potential isolates were also tested for pathogenicity on the third targeted pest teak stem borer *Alcterogystica cadambae* in lab condition and found none of them effective.

In order to understand the epidomology of the promising isolates against the targeted insects in the field condition, a preliminary field level experiment in respect of *S. malabaricus* with *Clerodendrum viscosum* as a primary host plant was carried out. Spot application on the frass mat made by the insect at the entry hole and injection through the bore hole. The results indicated that the injection method was found effective resulting 100% mortality with all the three concentrations used. .

The 7 potential isolates (5 trapped from the soil samples and 2 isolates from the infested cadavers) at three different concentrations were also evaluated under field conditions on the targeted pest *Indarbela quadrinotata* with *Casuarina equisetifolia* as a host plant at a coastal plantation of Tamil Nadu and *Sahydrassus malabaricus* with teak as host plants at an inland plantation at Ranni Division Kerala.. In the case of *I. quadrinotata* the spore solution was

sprayed on the frass tunnel made by the larvae. The results indicated that the spore concentrations 10^{10} and 10^{8} were effective in controlling the pest causing 100% larval mortality. Where as the lower concentration 10^{6} was less effective causing only 25% larval mortality.

In the case of *S. malabaricus* the spore solutions were applied by three different methods. The results indicated that the second and third methods were effective resulting 100% mortality with all the three concentrations used.

Standardized a method of mass production of entomopathogenic fungi on a cheaper media of coffee husk waste derived out of coffee fruits.

Project 7: Testing of promising plant derived chemicals against key pests (Component: Bioactive compounds from *Acacia nilotica* (Babul) against the major defoliators of forestry tree species) [IFGTB/RP22/2000-2005]

Status: The possibility of using natural extracts of different tissues of *A. nilotica* to reduce insect damage, especially in the forestry insect pests and as antimicrobial activity by inhibiting mycelial growth of some of the fungal isolates. Comparative studies on testing of biopesticidal properties of hexane, methanol and ethyl acetate extracts of *A. nilotica* leaves, flower, pods, seeds and twigs at different doses were tested at different developmental stages. Of these, Hexane extract exhibited toxic effect and induced larval mortality due to larval weight loss, antifeedancy, ovicidal and pupal mortality in the case of teak defoliators. Twigs did not express any toxic effect in terms of antifeedant and other biological properties. The possible factor relating to the lower survival and reduced growth of larvae are due to the antibiotic effect of some secondary metabolites. The present investigation considerably substantiates the hypothesis that plant allelochemicals may have chronic effect on the growth of herbivores.

Project 8: Testing and evaluation of selected existing control methods for key diseases of *Casuarina* spp. With reference to blister bark and root-rot [IFGTB/RP24/2002-2007]

Status: Scheduled fungicide applications to the saplings at the experimental trials of *Casuarina equisetifolia* at Panampally, Kerala and *Casuarina junghuhniana* at Pondicherry were done and further surveys at periodical intervals for the occurrence of the targeted diseases blister bark caused by *Trichosporium vesiculosum* and root-rot caused by *Ganoderma lucidum* carried out at these trials.

Persistence of inoculated ecto- and endomycorrhizal fungi in the roots and rhizosphere soils of the treated saplings was analysed and found that the AM fungi associated well with the roots and the rhizosphere soils as compared to ectomycorrhizal fungi.

Project 9: Natural Regeneration Studies on Important Trees in Silent Valley National Park, Kerala [IFGTB/RP32/2004-2009]

Status: Sample plots of 50 m x 50 m were laid out, four each in different ecosystems like forest and grasslands, and one in Forest Grassland Ecotone at Sairandri area in Silent valley National Park for the study of natural regeneration of trees

of Silent valley. Observations on number of individuals of trees, seedlings and saplings, their Girth at Breast Height (GBH) of trees, etc. was recorded for trees species. Initial observations revealed that natural regeneration of dominant evergreen species are well except for few species. Edge species regenerate well in grasslands.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006

Project 1: Evolving silvicultural practices for *Casuarina junghuhniana* ssp. *timorensis* [IFGTB/RP 33/2005-2009]

Status: The project envisages evolving silvicultural techniques for *Casuarina junghuhniana* ssp. *timorensis* in terms of both nursery and plantation techniques. To study the nursery requirements of the species 59 seed lots weighing around 115 kg were collected from identified trees from Panampally, Sadivayal and Pondicherry. After processing of the fruits around 5.75 kg seeds were obtained. Seeds have been sown in the nursery beds for carrying out various nursery trials to assess the potting media requirements, container requirements as well as bio fertilizer requirements of the species.

Project 2: Studies on seed handling and storage behaviour of important NTFP species [IFGTB/RP 34/2005-2008]

Status: Fruits of *Calophyllum inophyllum* were collected at different maturity stages from Courtrallam area and tested for germination capacity. Germination test was conducted on sand medium in the nursery beds during the month of September. Stony seeds significantly recorded the highest germination compared to other maturity stages.

Mature fruits collected from Anaikatti during November were also tested for germination after depulping. Pretreatments with various media soaking in cowdung slurry were imposed and compared with control. Germination percentage were recorded by the pretreatments respectively while control showed 100% germination. Studies indicate that yellow-green stage of fruit maturity favours germination without any pretreatment requirement for *Calophyllum inophyllum.*

Fruits of *Decalepis hamiltonii* were collected, germination studies are being carried out.

Gradation in fruits of Calophyllum
(green, black and bat eaten fruits)

Project 3: Status and Floristic Diversity of Sacred Groves The Only Remnants of Natural Forests in Alappuzha District, Kerala [IFGTB/RP35/2005-2008]

Status: Enumerated 292 sacred groves, covering 25 villages. Considerable variations were observed with respect to extent of these groves and species composition. A total of 125 species (Trees 64, Shrubs 46 and Herbs 15) of flowering plants belonging to 61 families were identified from these sacred groves.

Project 4: Studies on the diversity of bee fauna of the Nilgiris [IFGTB/ RP36/2005-2008]

Status: Information on the study area was collected from the Divisional Forest Officers of the Nilgiri South, North and Gudalur Forest Division, Wildlife Warden, Mudumalai Wildlife Sanctuary and Mukurthi National Park. The extent of forest types, grasslands and forest plantations were collected from the forest offices. Obtained the necessary permission from the Principal Chief Conservator of Forests and Chief Wildlife Warden, Tamil Nadu Forest Department, Chennai, to carry out the fieldwork.

Project 5: Studies on the population structure and reproduction of *Pterocarpus marsupium* in Tamil Nadu and Kerala [IFGTB/RP 37/2005-2008]

Status: Initial reconnaissance surveys have been carried out in Siruvani forests of Coimbatore division to identify populations for long term phenological studies as well as for reproductive studies. The distribution of the species i.e its occurrence from the foothills up to 2000 mts altitude were carried out to assess the population structure.

Project 6: Identification of conserved motifs in genes conferring salt tolerance to develop strategies for gene isolation from salt tolerant tree species [IFGTB/RP 38/2005-2008]

Status: Data mining of both nucleotide and protein sequences of gene conferring salt tolerance was carried out. Thirty sequences of AtNHx and 5 sequences of Osmotin have been downloaded from available databases in the world wide web. Multiple sequence analysis of these sequences is being carried out to identify conserved regions in these gene sequences. A format for a structured database comprising 29 different fields for both the nucleotide and protein sequences has been designed for development of the database.

Project 7: Genetic improvement of *Acacia auriculiformis* through half-sib progeny selection [IFGTB/RP39/2005-2010]

Status: Tree selection was carried out in two seedling seed orchards established by IFGTB at Karunya and Panampally. A total of 150 trees were selected based on stem form, branching habit and growth from these orchards. Single tree seed collections from selected trees were made during February and March 2006. Half-sib progenies will be raised through these single tree seed collections.

Project 8: Phenotypic selection, reproduction and propagation in *Ailanthus excelsa*: Perspectives for Safety Matches Industry and Farmers in Tamil Nadu [IFGTB/RP 40/2005-2009]

Status: Reconnaissance survey has been completed in different agroclimatic zones of Tamil Nadu. A total of 125 phenotypically superior trees have been identified in different locations. Collection of phenological data, seeds/ planting materials are being carried out from the different identified populations as well as from the Tamil Nadu Forest department plantations.

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: (Phase-I) Evaluation of breeding efficiency and genetic gain in seedling seed orchards of Eucalyptus and Casuarina in South India (Funding Agency: International Foundation for Science, Sweden) [IFGTB/EF-RP4/2002-2005]

(Phase-II) Estimation of effective population size in progeny of first generation seedling seed orchards of Eucalyptus and Casuarina

Status: Fertility difference between trees was estimated in four seed production areas and a natural stand of Teak in South India.

3 years Genetic gain trail of
Casuarina - Sadivayal,Tamil Nadu

Project 2: Estimation of gene diversity and drift pattern in natural stands and plantations of forest tree species in South India (Funding Agency: SIDA, Sweden) [IFGTB/EF-RP6/2003-2006]

Status: Two genetic gain trials each of Eucalyptus and Casuarina that were established in different locations to test the performance of seed collected from the seedling seed orchards were evaluated for the second year growth. Significant difference in growth between progeny of Eucalyptus orchards was observed at the dry site at Karunya in Tamil Nadu. The differences were not significant in the comparatively moist site at Dandeli. The difference between Casuarina orchard progeny was significant at Karunya but not at Pondicherry.

Project 3: Evaluation of reproductive success in seed orchards of Teak in India (Funding Agency: International Foundation for Science, Sweden) [IFGTB/EF-RP8/2003-2006]

Status: Fruit morphology was characterized through image analyzer and seed filling quantified to X-radiography for all the seed sources. Germination potential and seedling production in each seed source were determined through nursery experiments. Principal pollinators of teak were identified based on frequency of visit, foraging behaviour and pollen load carried by different species collected from seed orchards. Pollination by nectarivorous birds in Teak was reported for the first time.

Project 4: Full sib production in selected high yielding Tamarind clones of Tamil Nadu (Funding Agency: Tamil Nadu Forest Department) [IFGTB/EF-RP14/2003-2006]

Status: Control pollination programs were conducted in 30 high yielding Tamarind clones belonging to Vellore, Hasanur and Periakulam regions of Tamil Nadu. Hybridisation experiments to combine the red tamarind with high pulp yielding clones were carried out in five different agro climatic zones. Forty full sib control pollinated families have been harvested. A full sib progeny trial cum seedling seed orchard consisting six control-pollinated families was established during February 2006 at the State Forest Research Institute Campus, Kolapakkam in Tamil Nadu.

Project 5: Germplasm collection and production of improved planting stocks of *Terminalia chebula* Retz and *Terminalia bellerica* [IFGTB/EF-RP-/2005-2008]

Status: Reconnaissance survey was carried out to identify the populations of *Terminalia chebula* and *T. bellerica* in Kerala and Tamil Nadu. Vegetative propagation of both the species through branch cuttings has been attempted. Seed samples have been collected from five populations for raising seedlings and further characterization.

Project 6: Reproduction and Population Structure in Bruguiera and Ceriops: Implication on Conservation [IFGTB/EF-RP- /2005-2008]

Status: Studies on population structure and phenology were initiated in *Ceriops tagal* in Pitchavaram, Tamil Nadu. The species shows very patchy distribution, family structures are very rare. Flowering is noticed during April-May. Fruiting continues through October-November.

Project 7: Genome evaluation and characterization in Casuarinas and Eucalyptus for improving productivity and conservation (Funding Agency: Department of Biotechnology, Government of India) [IFGTB/EF-RP5/2002-2005]

Status: The project aimed at identifying DNA markers for economically important traits like adventitious rooting in cuttings and pulping trait in *Eucalyptus tereticornis*. Three putative RAPD markers and four specific SSR markers were identified in non rooting clone of *E. tereticornis*. Two putative RAPD markers were also identified in 100% rooting clones. These putative markers will form the foundation for generating trait specific markers which in future will lead to marker assisted selections in improvement programmes.

Project 8: Identification of broad spectrum antifungal protein from elite medicinal plants for control of plant pathogens (Funding Agency: Department of Biotechnology, Government of India) [IFGTB/EF-RP7/2003-2006]

Status: In *Acorus calamus*, a Peroxidase belonging to the type III heme - dependent Peroxidase super family was identified using LC-MS MS. The tissue localization revealed the presence of the protein mainly in the epidermal tissues and lumen of xylem vessels of the leaf. The protein showed 37% sequence coverage with putative bacterial induced Peroxidase from *Oryza sativa.* The protein inhibited the hyphal extension of phytopathogens like *Trichosporium vesiculosum, Macrophomina phaseolina* and *Fusarium moniliforme.*

Project 9: Refinement of *in vitro* multiplication protocol for *Bambusa nutans* and *Dendrocalamus giganteus* (Funding Agency: Department of Biotechnology, Government of India) [IFGTB/EF-RP17/2004-2007]

Status: *In vitro* shoot proliferation methods for large-scale multiplication of mature clumps of *Bambusa nutans* and *Dendrocalamus giganteus* were developed. Nodal segments were inoculated and high frequency shoot multiplication cultures were established in the modified MS medium containing coconut milk. Anatomical studies showed the presence of preexisting root primordia in microshoots, hence based on the peroxidase activity and internal auxin concentration of microshoots, media composition was devised for the expression of roots. *In vitro* rooting was obtained in *D. giganteus* and excellent rooting was obtained in *B. nutans. In vitro* roots were produced after treating the shoots with Glucose and IBA followed by hormone free medium containing Sucrose.

Project 10: Performance of micro and macropropagated planting stock of selected five commercially important bamboo species (Funding Agency: Department of Biotechnology, Government of India) [IFGTB/EF-RP18/2004-2007]

Status: Field demonstration trials were established for micro and macropropagated planting stock of commercially important species of bamboos like *Bambusa bambos, Dendrocalamus strictus* and *Pseudooxytenanthera stocksii*. Growth data was recorded on the parameters like number of shoots, height of the tallest shoot, girth of the tallest shoot, number of internodes, internodal length of the tallest culm and number of newly produced culm per year. Survival percentage of the bamboo plants in the field after three months of planting was 85.5%. Initial observations showed that

the tissue culture raised plants of *O. stocksii* produce more number of shoots per culm followed by seed raised plants of *D. strictus*. Lowest number of shoots produced by the seedling raised plants of *B. bambos.* An average of 4 to 5 new culms were produced in one year time in all the species. Clonal collections of different bamboo species were assembled as germplasm garden.

Project 11: Selection and clonal propagation of commercially important medicinal plants (Funding Agency: National Medicinal Plants Board, Government of India) [IFGTB/EF-RP 19/2004-2007]

Status: Work to standardize clonal propagation of medicinal plants initiated. Rooting of branch cuttings achieved for *Tinospora cordifolia, Terminalia bellerica* and *Aegle marmelos*. Collected cuttings of *Oroxylum indicum, Terminalia bellerica, Terminalia chebula, Saraca asoka* and *Phyllanthus emblica*. Experiments are in progress to standardize clonal propagation through rooting of branch cuttings obtained from Kerala forest areas.

Project 12: Germplasm conservation and establishment of seed stands for production of quality seeds and seedlings (Funding Agency: National Medicinal Plants Board, Government of India) [IFGTB/EF-RP9/2003-2006]

Status: Germplasm assemblage and seed handling - *Aegle marmelos* CPTs were identified in 14 new locations. Mature fruits were collected from the selected trees and seedlings raised and maintained in the nursery. Fruit parameters were recorded for 28 accessions. Seeds extracted from mature fruits collected from 28 CPTs were studied for variability. The seed physical traits like the 2D surface area, length, breadth, equivalent diameter, perimeter, roundness, aspect ratio and fullness ratio were measured using an image analyser (Leica Quantimet - QWin 500). The images of the seeds were captured using a CCD camera. The images were then calibrated to actual scale and measured using the software QWin.

Collected tubers of *Asparagus racemosus* from 9 new locations. Fruits collected from Punsai Puliampatti were studied for seed parameters. Pretreatment study to improve seed germination in *Emblica officinalis* was conducted. Among 12 different pretreatments, soaking in a solution of 50 ppm Benzyl Amino Purine (BAP) and 1000 ppm Giberellic acid (GA_3) for 24 hours improved the germination in Kurumalai source to 65%. Soaking in 1000 ppm GA_3 for 24 hours gave 47% germination in Kulipatti and 39% germination in Devikulam sources.

Gymnema sylvestre cuttings were collected from 8 different locations and rooted in the nursery without any growth regulators. The rooted seedlings were hardened and maintained in the nursery. Collected fruits of Gymnema from Dhimbham and studied for seed germination. Seedlings of *Rauwolfia serpentina* obtained are maintained in the nursery. The seedlings were often infected with scale insects which were controlled by regular chemical spraying. *Saraca asoca* seeds were collected in a selected tree at Kottakkal and raised about 500 seedlings. The plants were given nutrient drenching at regular intervals and hardened with proper care.

One tree of *Strychnos potatorum* was identified in Nellimalai near Mettupalayam, the root suckers were collected and maintained in the nursery. Pretreatment, moisture reduction and storage trials were also attempted. The seeds were found to possess physiological dormancy since they required growth regulator treatment for germination. Seeds did not tolerate desiccation and storage of fresh seeds in wet vermiculite prolonged seed viability. Cuttings of *Tinospora cordifolia* were collected from 8 different sources and propagated vegetatively. Effect of seed moisture and

storage temperature on germination of Tinospora was studied. Results showed that reducing seed moisture content to 5 % and storing at 10°C is the most ideal condition for storing *Tinospora cordifolia* seeds.

Establishment of Medicinal Plants Seed Production System

Established seed production system for medicinal species in an area of about 1 ha at Anaikatti, Tamil Nadu. Hardened seedlings were transported from the institute nursery to the planting site, distributed according to the planned design and planted. In total, seedlings raised from 24 accessions of *Aegle marmelos*, 6 accessions of *Saraca asoca*, 18 accessions of *Asparagus racemosus*, 15 accessions of *Gymnema sylvestre*, 28 accessions of *Tinospora cordifolia* and 6 accessions of *Emblica officinalis* and 2 accessions of *Oroxylum indicum* were planted in randomized design.

Project 13: Characterization of tropical and temperate forest seeds with reference to seed storage behaviour (Funding Agency: SIDA, Sweden) [IFGTB/EF-RP10/2003-2006]

Status: Seeds of *Persea macrantha*, *Hydnocarpus alpina* and *Azadirachta indica* were collected from different forests/ agro-climatic zones. Lowest safe moisture content and storage temperatures were assessed for each source. The viability status of each of these seedlots was assessed. Seeds of about 20 different species present in different forest types were collected and tested for their tolerance to liquid nitrogen temperature. The seeds were directly plunged into the liquid nitrogen for 1 hour and tested for viability. These seeds were also studied for moisture content and drying rate. Seed storage behaviour and germination methods for *Myristica dactyloides, M. fragrans, Strychnos nux-vomica, Embelia ribes* and *Symplocos cochinchinensis* were studied.

Project 14: Establishment of Agroforestry models with Medicinal Plants and Trees for Conservation, Propagation and Utilization (Funding agency: National Medicinal Plants Board) [IFGTB/EF-RP16/2004-2007]

Status: Established about 4 ha of Amla based agroforestry models in 10 farmers' fields with medicinal plants (*Withania somnifera*), under farmland condition. Amla based agroforestry system registered maximum tuber yield of

Amla - Horse gram based agroforestry system in Coimbatore, District of Tamil Nadu

64 kg/acre. Effect of different spacing of Withania was assessed and the results showed that tuber yield varied from 31 to 76 kg/acre under various spacing. By considering market preference on tuber size, spacing of 15 x 15 cm and 20 x 20 cm recorded optimum tuber yield and produced marketable tuber size of Withania tuber. Further, in the established Amla based agroforestry plots, imposed various treatments viz. organic manures like FYM, vermicompost and mulching treatments and assessed the growth performance.

Also, established, 2.0 ha of Pungam and Neem based agroforestry plots with quality planting material of identified superior parent trees.

Project 15: Evaluation of superior planting stock of *Acacia mangium* in agroforestry systems at different eco-climatic zones of Kerala and Tamil Nadu (Funding agency: NABARD) [IFGTB/EF-RP11/2003-2006]

Status: About 1000 seedlings were raised at IFGTB and another 1000 clonal planting stocks of Mangium hybrid have been procured from Mysore Paper Mills, Karnataka for evaluation under agroforestry systems in Tamil Nadu and Kerala.

A. mangium plantations were raised in four farm fields in western zone of Tamil Nadu covering an area of 2.5 acres and in two farm fields in southern zone of Tamil Nadu in an area of 1.5 acres. Another 0.5 acre of land in Chullimadai in Central Zone of Kerala was planted with Mangium hybrids.

Initial soil samples collected from six farm fields have been processed and analyzed for various physical and chemical characteristics. Monitoring of the growth of Mangium in these farm fields is in progress. Best growth was observed in southern zone of Kerala (Omallur) with mean height of 6.0 m and mean gbh of 18.5 cm at the age of 18 months.

Project 16: Development of integrated pest management package for forest nursery insect pests of some economically important tree species (Funding agency: Department of Science and Technology, Government of India) [IFGTB/EF/RP13/2003-2006]

Status: Incidence of insect pests like defoliators and sapsuckers in forest nursery seedlings were studied through regular surveys carried out at various nurseries maintained by the State Forest Departments of Tamil Nadu, Pondicherry and Kerela. Major pest problems were recorded. An unidentified leaf rolling curculionid on *Sizigium cumini* was recorded in Tamil Nadu and Pondicherry. Kerala, unidentified thrips in *Acacia mangium* and *Hyblaea puera* on *Tectona grandis* were recorded. Field survey also revealed the presence of few indigenous natural enemies of some of the insect pests. A Pest Calendar for nursery seedlings is prepared and updated. Influences of biotic and abiotic factors on pest build up were studied.

Project 17: Exploitation of mycorrhizal systems in the Nilgiris Biosphere Reserve Area (Funding agency: Ministry of Environment and Forests, Government of India) [IFGTB/EF-RP15/2004-2007]

Status: Surveys were undertaken for collection of roots, soil and basidiomata samples for characterization of both ECM and AM fungi from different forest ecosystems such as Sholas, Grasslands, man-made plantations at regular intervals in the Nilgiri Biosphere Reserve areas of Nilgiri Hills, Tamil Nadu.

Distribution of 20 different ECM were recorded from different study sites under various host trees like *Acacia* spp., *Cupressus* spp., *Eucalyptus* spp. *Hopea* spp. and *Pinus* spp.

Some of the species of ECM fungi such as Alnicola, Astroporina, Hebeloma, Leucophleps, Lycoperdon and Russula were reported for the first time in association with the said host trees.

Estimation of percent colonization and spore population of AM fungi in the roots and soil samples collected from various study areas revealed the occurrence of 3 genera viz., Acaulospora, Gigaspora and Glomus.

Pure cultures of different isolates of the ECM fungi viz., *Laccaria fraterna*, *Lycoperdon* sp., *Russula* sp., *Scleroderma citrinum*, *Suillus* sp. and *Suillus subluteus* were raised and maintained for further studies.

An experiment was conducted to screen the efficacy of both ECM and AM fungi on growth improvement of *Acacia auriculiformis* in glass house conditions.

Project 18: Ecorestoration for Tsunami devastated coastline of Andaman Group of Islands (Funding agency: Department of Biotechnology, Government of India) [IFGTB/EF-RP 20/2004-2007]

Status: Seeds and seedlings of *Casuarina equisetifolia* were collected Casuarina Bay, the place where the Casuarina is distributed naturally for planting the coast line. For the purpose multiplying the Casuarina nurseries have been established at Casuarina Bay (North Andaman) Kadamtala (Middle Andaman) and Kalatang (South Andaman). The Kalatang nursery is being improved into a Model Nursery. Frankia nodules have been collected from the population in Andaman Islands which are being used for inoculation of all the seedlings. Soil samples have been collected for identification and isolation of VAM fungi. This work is in progress to improve the planting stock. The project envisages the planting of 60 ha. Area over a period of 3 years. So far 6.5 hec. Area has been planted at Casuarina. 40 persons from the Tsunami affected areas have been engaged in the planting related activities and 3137 mandays of employment have been generated. Training on nursery techniques of *Cauarina equisetifolia*, use of biofertilizers was conducted for about 250 staff and labour at 12 different places.

Project 19: Establishment of Bamboo Model Plantations In Different Agro-Climatic Zones of Tamil Nadu Using Quality Planting Stock (Funding Agency: Department of Biotechnology, Government of India) [IFGTB/EF-RP 21/2005-2008]

Status: The project objective is to raise 100 ha demonstration trials of quality planting stock of seven bamboo species viz *Bambusa bambos, B. tulda, B. nutans, B. balcooa, B. vulgaris, Dendrocalamus strictus*, and *Pseudoxytenenthera stocksii* in six agroclimatic zones of Tamil Nadu. Production of planting stock for raising demonstration trials for the

first year initiated. Tissue culture activities for mass propagation and nursery activities related to infrastructure development, vegetative propagation through rhizome splitting and rooting of culm cuttings are in progress.

Project 20: Development of yield assessment methods for *Eucalyptus* sps. and *Anacardium occidentale* using Image analyzer (Funding agency: Tamil Nadu Forest Plantation Corporation) [IFGTB/EF-RP 22/2005-2007]

Status: Methods for image grabbing, frame and image standards were developed. Field studies were conducted for 3D calibration of images. Methodology for the technique was standardized. Relationship between height and diameter was studied.

Project 21: Bamboo Location Trials (BLT) (Funding agency : National Mission on Bamboo Applications (NMBA), Technology, Information, Forecasting and Assessment Council (TIFAC), Department of Science and Technology, Government of India) [IFGTB/EF-RP 23 /2005-2007]

Status: The project envisages carrying out multilocational species trial - involving 8 species of Bamboos viz., *Bambusa bambos, Bambusa balcooa, Bambusa nutans, Bambusa tulda, Bambusa vulgaris, Dendrocalamus asper, Dendrocalamus giganteus* and *Dendrocalamus hamiltonii* as well as field trials to study the performance of micro and macro- propagated plants and nutrient and water management studies using *Bambusa bambos, Bambusa balcooa and Bambusa nutans.* Planting stock received from various Institutes are being maintained and hardened for field planting. Efforts to increase their numbers through rhizome splitting are also underway to augment the quantity of seedlings for the trials proposed to be laid out during the forthcoming rainy season.

Project 22: Development of post harvest techniques for seed production in Jatropha (Funding agency: Department of Biotechnology, Government of India) [IFGTB/EF-RP 24 /2005-2008]

Status: Survey was conducted at Attapadi, Periathadagam, Sathyamangalam, Annur and Punsai Puliyampatti for identifying high fruit yielding trees of *Jatropha curcas*. Fruits were collected and parameters such as fruit yield, fruit weight, seed weight, No. of seeds per fruit, total seed weight per fruit, total shell weight per fruit, seed moisture, oil content etc. were recorded. Standardized the extraction of Jatropha oil by Soxhlet Method. Oil was extracted from the seeds of different sources and characterized the oil properties such as Acid number, Saponification number and Iodine value. The oil content in shell, kernel and seed as a whole were determined so as to understand the variation in oil recovery.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	4	9	8
External Projects	-	22	-
Total	4	31	8

EDUCATION AND TRAINING

Training organized/provided

1. Training organized on Biodiversity of Rain Forests with special reference to Silent Valley National Park on 19th May and 18th July 2005 for SFS Officers, SFS College, Coimbatore
2. Training on Seed Handling of selected tree species and Seed Handling techniques of commercially important medicinal plants on 15th and 16th July 2005, respectively for Farmers and Foresters of Pondicherry Forest Department.
3. Training on Tree crop interactions agroforestry models for higher returns and cultivation of medicinal plants and farm land on 16th July 2005 for farmers of Pondicherry.
4. Training on Molecular defense in plants on 2nd September 2005 for students of Karpagam Arts and Science College, Coimbatore.
5. Training on Ecological census techniques on 10th October 2005 for Deputy Rangers, Foresters and Guards of Kerala Forest School, Walayar.
6. Training on Mycorrhizal Biofertilizer Techniques Isolation, Identification, Multiplication and Application on December 2005 to March 2006 for students of Tamil Nadu.
7. Training on Nursery technique for raising Casuarina and vegetative propagation of *Casuarina equisetifolia* and Bamboos from 16th January to 7th February 2006 for officials of Forest Department, Andaman Nicobar Islands.
8. Training on Nursery techniques for quality seedling production on January 2006 for officials of Forest Department, Andaman Nicobar Islands.
9. Training on diversity of insects associated with *Casuarina equisetifolia* in Tamil Nadu on 24th February 2006 for students of Dept. of Zoology, Bharathiar University, Coimbatore.
10. Training on Nursery techniques for quality seedling production on March, 2006 for officials of Forest Department, Andaman Nicobar Islands.
11. Training on Genetic improvement and domonstration of Andaman Padauk (*Pterocarpus dalbergioides* Roxb.) on March 2006, Andaman Forest Department.

Training received

National

Shri T. Gunasekaran attended training on Advanced Forest Management at IGNFA, Dehradun from 17th to 28th October 2005.

LINKAGES AND COLLABORATION

Collaborative work is being implemented for identification and benchmark studies in Gene Pool Conservation Area (GPCA) in Kerala with people's participation. Under this programme Dr. C. Kunhikannan, visited Periya VSS area, Periya range, Manandavady, Wayanad District, Kerala for identification of Gene Pool Conservation Area (GPCA) during May, 2005.

Taxonomic identification of Morus species was initiated with Central Sericultural Germplasm Resource Centre (Central Silk Board Ministry of Textiles Government of India) Hosur, Tamil Nadu. In this direction Dr. N.Venkatasubramanian visited the centre and thirteen *Morus* species (*Morus australis, M. multicaulis, M. alba, M. laevigata, M. rotundifolia, M. cathya, M. sinensis, M. thomsirenge, M. indica, M. serrata, M. taeliafolia* and *M. nigra*) were collected and herbarium specimens prepared for further taxonomical studies.

PUBLICATIONS

Books published

Kunhikannan, C. and Gurudev Singh, B. (Eds.) (2005). Strategy for Conservation of Sacred groves, Institute of Forest Genetics and Tree Breeding, Coimbatore.

CONSULTANCY

Dr. B. Nagarajan, Scientist-D offered consultancy to the Andhra Pradesh Forest Department on Strategies for Tamarind Improvement between from 31st March 2005 to 5th April 2005.

CONFERENCES/MEETINGS/WORKSHOPS/SYMPOSIA/EXHIBITIONS

Workshops / Seminars attended

National

1. Customs Policies and Procedures on 23rd May 2005 at Coimbatore.
2. A National Program of Red-Listed Species using Biotechnological Approaches on 18th and 19th July 2005 at Bannerghatta Biological Park, Bangalore.
3. Diversity of Ectomycorrhizal Fungi in the Nilgiri Biosphere Reserve Area of South India and their future potential from 15th to 17th September 2005 at Bharathiar University, Coimbatore.
4. Intellectual Property Rights in Bioinformatics and Biotechnology on 15th and 16th September 2005 at Bioinformatics Centre, Pondicherry University.

5. Innovative HPLC and analytical solutions on 12th September 2005 at Coimbatore.
6. Study on the Salt Tolerance of Different Ectomycorrhizal Fungi on 7th and 8th October 2005 at Tamil Nadu Agricultural University, Coimbatore.
7. Database and its Applications in Agriculture on 26th and 27th October 2005 at Tamil Nadu Agricultural University, Coimbatore.
8. Global Conference-II, Indian Society of Mycology and Plant Pathology from 25th to 29th November 2005 at Rajasthan College of Agriculture, Udaipur, Rajasthan.
9. Site management of exotic forest plantations in southern India from 8th to 10th November 2005at KFRI, Peechi.
10. Biosafety Considerations for Evaluation of Transgenic Crops from 7th to 14th November 2005 at NBPGR, New Delhi.
11. IInd National Conference of the Western Ghats Forum on 1st and 2nd December 2005 at Southern Forest Service College, Coimbatore.
12. Emerging Technologies and Resistance Dynamics in Insects and Crop Plants from 2nd to 4th December 2005 at Chennai.
13. Biodiversity of insects: Challenging issues in Management and Conservation from 30th January to 3rd February 2006 at Bharathiar University, Coimbatore
14. National Seminar on Biodiversity and Conservation on 5th and 6th January 2006 at Government Victoria College Palakkad, Kerala.
15. Intellectual Property Rights on January 2006 at Institute of Wood Science & Technology, Bangalore.
16. Integrated Coastal Zone Management Plan for Andaman & Nicobar Islands on January 2006 at Port Blair.
17. The second dialog meeting between the Protection of Plant Varieties and Farmers Rights Authority and the Agricultural System in Tamil Nadu, Pondicherry and Karnataka state on 1st February 2006 at Tamil Nadu Agricultural University, Coimbatore.
18. National Seminar on Fungal Biodiversity, Biotechnology and Bioinformatics and 32nd Mycological Society Meeting on 2nd and 3rd February 2006 at Sri Bhagawan Mahaveer Jain College, Jayanagar, Bangalore.
19. Bamboo Location Trials, Bambusetum and Propagation from 14th to 16th February 2006 at GB Pant University of Agriculture and Technology, Uttaranchal.
20. Tree Biotechnology: Indian Scenario on 9th and 10th February 2006 at TFRI, Jabalpur.
21. Geographical Information Systems at Forest Survey of India on February 2006 at Forest Survey of India, Port Blair.
22. Mangrove Conservation in Andaman Islands and around the World organized by Coastal Poor Development Action Network India on 2nd March 2006 at Port Blair.
23. Down stream process and Bioprocess on 10th March 2006 at Department of Biotechnology, Kumaraguru College of Technology, Coimbatore.

24. Techniques in Biological Sciences on 10th March 2006 at Kerala University.
25. Recent Advances in Teak Research and Management in Central India on 17th and 18th March 2006 at Forest Development Corporation of Maharashtra Ltd, Nagpur.
26. Secondary Timber Species and Bamboo Management for sustainable yield and Development on 27th March 2006 at Forest College and Research Institute, Mettupalayam, Tamil Nadu Agricultural University.

International

1. Globalization of traditional, complementary and alternative systems of medicine from 16th to 18th March 2006 at Tamil Nadu Agricultural University, Coimbatore.

DISTINGUISHED VISITORS

1. Shri Suresh Chandra, Special Secretary, Ministry of Environment and Forests, Government of India visited the Institute on 30th August 2005.
2. Dr. P.S. Rao, Chairman, Expert committee Bamboo Network Programme and task force member of DBT, Ministry of Science and Technology, visited the Institute on 26th September 2005.
3. Prof. Jae-In Park, Director, School of Forest Resource, Chnugbuk National University, South Korea visited the Institute on 20th and 21st February 2006 and made presentation on Tree Breeding in South Korea.

MISCELLANEOUS

Service rendered

1. Plants and plant products slated for export were examined and subjected to the appropriate quarantine measures. 881 Phyto-sanitary Certificates were issued to various organizations and individuals
2. Queries relating to the pests and diseases problems of Rosemary Pongamia and Eucalyptus clone referred by the State Forest departments and Forest Development Corporation of Tamil Nadu and Andhra Pradesh were attended and provided appropriate solution.

Grass Forest Museum

Collection management, upkeep and maintenance, visitor's service and educational service were undertaken. The museum received a total of 7004 visitors during the year.

Maintenance of Seed Bank

1. Seeds of various important species viz. *Tectona grandis, Acacia auriculiformis, A. mangium, Azadirachta indica, Casuarina equisetifolia, Eucalyptus camaldulensis* and *E. tereticornis,* etc. were collected from CPTs, SSPA/SSO/CSO/ Provenance Trial Plots at different localities of Tamil Nadu, Andhra Pradesh, viz. Panampally, Pudukottai, Pondicherry, Sadivayal, Tholpetty etc. Seeds of the many of above species were supplied to other divisions of the Institute, SFDs, Paper mills and NGOs on request and on payment.
2. Seed testing for viability, seed count and purity were conducted and test results were provided to various clients and researchers.

Computer Support

1. Local Area Network established and maintained with Compaq /Cerebra Net Server with Windows 2000 server and Linux as Operating system and Windows 2000 Professional, Windows XP, as nodes. More than 83 desktop systems are connected to the LAN. Structured cabling with manageable switches in each floor and fibre optics connectivity to extension building is provided.
2. Intranet Server maintained to provide in-house information to researchers such as ongoing and completed Project details of ICFRE and externally aided projects, different reports submitted such as Annual Reports, Annual Action Plan etc., research assets of the Institutes such as CSO's, SSO's, SPA's of different species, instruments available in different Lab, formats of different reports, Action plan of scientists/officers, tour plan of officers, purchase procedures, email ID's of IFGTB and ICFRE officers.
3. Web server, mail server maintained using 512 KBPS leased line for hosting Institute's web site and Internet access to researchers.

Library and Documentation

- The Library has a collection of 8170 books, 30 Indian journals, nearly 285 back volumes, other research reports, seminar proceedings, tour reports and non-subscribed periodicals.
- The Library provides services to the researchers, foresters and University students. The library facilitates access to wide range of information and documentation to the state forest departments and other research oriented institutes.
  a) Reference and bibliographic service

b) Circulation service
c) Current awareness service like i) new addition to library, ii) new arrival of periodicals and iii) new arrivals of library literature
d) Literature search through Internet
e) CD ROM service facilities, and
f) Document delivery services through reprographic services.

CHAPTER 3.3

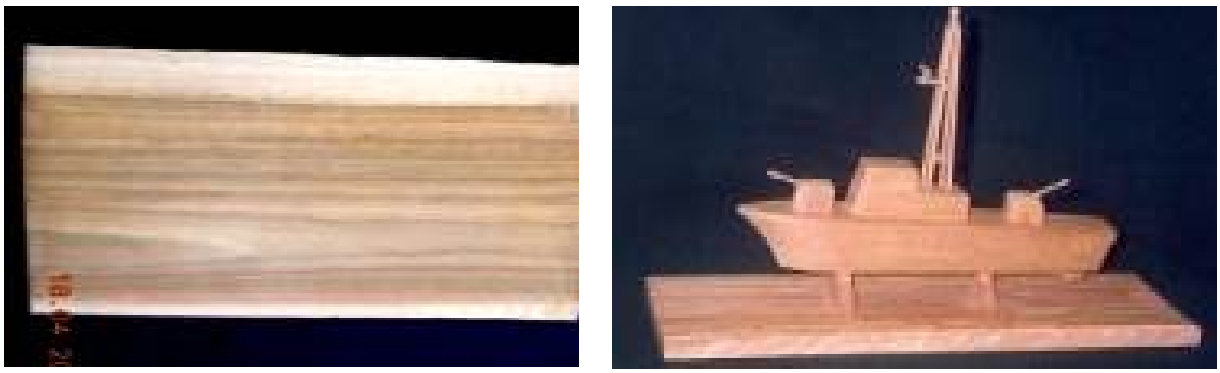
Institute of Wood Science and Technology Bangalore

The Institute of Wood Science and Technology (IWST), Bangalore formed in 1988, is mandated to conduct research on Wood Science and Technology as its national objective and focuses its research on important forestry research needs of the States of Karnataka, Andhra Pradesh and Goa at regional level. Taking into consideration the expertise available and contributions made, the Indian Council of Forestry Research and Education (ICFRE), Dehradun has assigned the Institute the status of Centre for Advanced Studies in the areas of Improved Utilization of Wood, Mangroves and Coastal Ecology and Research on Sandal. The focus of research being carried out at IWST is in consonance with and in response to the aims of National Forest Policy in the areas of utilization of timber and non-timber products and increasing productivity. The Institute mainly aims to develop strategies for use and production of wood and other forest products in a way that sustain their supply.

PROJECTS COMPLETED DURING THE YEAR 2005-2006

Project 1: Evaluation of wood quality parameters of plantation grown *Eucalyptus citriodora* for different end uses [IWST/WPU/X09/2002-2006]

Findings: Data on physical, mechanical and anatomical properties were generated on 20 years old trees obtained from Yeslur range of Sakleshpura, Hassan district, Karnataka. Significant variation was found in bark thickness. Heart wood percentage was found to be correlated with bark thickness. Significant variation within tree and between tree variation in respect to specific gravity of wood, fibre characteristics and vessel characteristics were observed. The data obtained indicates its suitability for constructional purposes like poles, beams and rafters. Experiences of the artisans have indicated the potential of this timber for making export oriented artifacts. Physical and mechanical properties generated on 20 years *E. citriodora* indicated that wood is suitable for furniture, construction and for lacquer ware craft.



Wood of *Eucalyptus citriodora* and an artifact made out of it

Project 2: Assessment of wood quality of *Simarouba glauca* for its timber value [IWST/WPU/X10/2003-2006]

Findings: Data for stem wood and branch wood on anatomical, physical and mechanical properties of plantation raised juvenile wood characteristics were obtained. Office of the Development Commissioner, Handicrafts Bangalore, found out that the wood has a very good potential as an alternate timber for handicrafts for domestic consumption. There is no

Handicrafts and turnery articles made of *Simarouba glauca*

report of making handicrafts from this timber so far. Study suggested that the timber is dimensionally stable due to low shrinkage and may be utilized for the purposes where high dimensional stability is required. It has a great potential as alternate timber for handicrafts.

Project 3: Use of sonic and ultrasonic testing techniques to evaluate wood strength of plantation species - A non-destructive test method [IWST/WPU/X17/ 2003-2006]

Findings: Strength properties of three timber species were evaluated using non-destructive testing technique. A relationship was established between the values obtained by non-destructive and conventional test methods. Result of the study will be helpful for the assessment of quality and detection of defects in converted timber/logs by non-destructive technique and it will also improve the selection criteria of timbers for better utilization for various purposes.

Project 4: Evaluation of treatability of selected refractory species [IWST/WSP/ 2002-2006]

Findings: To ensure adequate absorption of preservatives in such species pretreatments like ponding, steaming and incising techniques have been employed by various researchers worldwide. In this direction *Eucalyptus* sp. are considered to be refractory to treatment. In this present case ponding process as a pretreatment has been employed to

evaluate the treatability of *Eucalyptus* hybrid. No uniform penetration was observed across the treated samples. The assay test indicated that samples ponded for 2 months showed almost equal absorption as that of 4 months ponded samples.

Project 5: Analytic studies on viscoelastic behaviour of wood and tree biomechanics [IWST/WSP/X06/2002-2005]

Findings: A model was developed on the principles of viscoelasticity to explain time dependent behaviour. This model was applied on experimental results of creep and stress relaxation. Viscoelastic behaviour was studied using four element model, consisting of one Maxwell body (having one spring and one dashpot in series) and Kelvin body (having one spring and one dashpot in parallel). Irreversible deformation, delayed and instantaneous elastic behaviour are explained through this model. Four element model was studied to find the roles of its different components. Dashpot of Maxwell body, which describes the viscous flow and irreversible creep, is related to the slow movement of woody constituents like cellulose, hemicelluloses, and lignin under the influence of external load. Studies proposed will provide a fundamental understanding of deformation of wood and will suggest ways to control it. It also provides a platform for future work related to defects in wood.

Project 6: Studies on fibre formation in wood [IWST/WSP/X07/2002-2005]

Findings: A model based on thermodynamic parameters has been developed for the description of the formation of one dimensional fibrils from disordered fluid. Analysis of defects in crystalline lattice of cellulose as a mechanism for the paracrystalline nature of cellulose were made. Processes of crystallization with simultaneous polymerization were analyzed as a possible mechanism of fibre formation in wood. Result of the study suggest possibilities in control of fibre formation and hence may find uses in tree improvement.

Project 7: Performance and evaluation of selected bamboo species treated by modified Boucherie process [IWST/WSP/X44/2004-2006]

Findings: Freshly felled bamboo species *Dendrocalamus strictus*, *Pseudoxytenanthera stocksii* and *Bambusa arundinaceae* were treated with CCA, CCB and Boric Acid Borax by modified boucherie process.

Observation of specimens after one year of exposure and field trials showed that all the treated as well as the untreated specimens are all in sound condition. In future it will give the real data on the efficacy of the preservative as well as the treatment.

Project 8: Chemical induction of heartwood in Sandal [CFP-001/ 2000-2006]

Findings: Faintly heartwood formed core material in treated and control plants was measured (after 6 dose of treatment) for extractive content (Benzine and alcohol in 2:1 ratio) and this clearly indicates that the formation of heartwood in treated plants is at an early stage than in control plants. Percentage of sandalwood oil in faintly heartwood formed core samples material and control plants was measured by UV spectroscopic method.

Project 9: Gender identification of *Garcinia indica* and *Simarouba glauca* using isoenzyme studies and assessment of fruit characters, yield and market potential of *Garcinia indica* in Karnataka state [IWST/CFP/X39/2004-2006]

Findings: Laboratory test method, based on electrophoresis, was developed for characterizing male and female plants of *Garcinia indica* and *Simarouba glauca*. Early determination of gender of these plants will enable the grower to maintain a proper ratio of male and female plants right from the beginning for proper pollination and fruit yield.

Peroxidase colour reaction (BPR) for gender identification in *Garcinia indica*

Peroxidase colour reaction (GPR) for gender identification in *Simarouba glauca*

Project 10: Studies on teak heartwood borer *Alcterogystia (cossus) cadambae* moore and its management [IWST-29/WBD-9/2000-2006]

Findings: The studies on bioecology and methods for monitoring and managing the pest have been completed. The pest population in the field was monitored using electrically and solar powered light traps. Management of the pest using nematodes, *Bacillus thuringiensis* and neem products were tested in the laboratory as well as field conditions and were found effective. The detail study on the pest and its ecology and findings on suitable management strategies is very useful for the proper growth of the tree and utilization of teak wood.

Project 11: Standardization of protocol for viability testing and prolonging the viability and vigour of *Santalum album* seeds in storage [IWST/TIP/2003-2005]

Findings: The sandal seeds with the three different moisture content were stored at five different storage temperatures for 18 months. These were periodically tested for viability.

The adsorption isotherms obtained at different temperatures were subjected to BET analysis. High correlation was observed between experimentally obtained isotherm and those obtained by theoretical analysis. The present study would help in better understanding the effect and the relationship between temperature and moisture content on the viability of seed during storage.

Project 12: Genetic screening of *Jatropha curcas* an important biofuel species of dry areas [IWST/TIP/2003-2006]

Findings: Estimated the variation in oil content in 24 accessions of *Jatropha curcas*. Clonal germplasm bank was established at Nallal field station comprising 24 accession and each accession comprising 5 ramets. The study showed statistically significant differences for all the parameters studied. It was found that the provenance Kaivara Hills with an oil percentage of 44.23 percent was most promising. Other promising provenances were Kolar and Magdi with oil percentage of 39.40 and 35.33 percent respectively.

Project 13: Evaluation of genetic variability and mating system analysis of *Aegle marmelos* Corr. and *Feronia elephantum* Corr. using isoenzyme markers [IWST/TIP/ X42 /2004-2006]

Findings: Seeds of six genotypes of *Aegle marmelos* were sown for germination for variability studies. Isozymes marker studies using different enzyme systems. In both the species all the isozymes studied polymorphic with two loci. In *Aegle marmelos* isozymes analysis showed consistent variation among clones. In *Feronia elephantum* less heterozygosity was observed among natural population and clones.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Evaluation of culm quality before, during and after flowering in bamboo (*Bambusa bambos* and *Dendrocalamus strictus*) species [IWST/WPU/ X14/2003-2007]

Status: Within culm variation in starch content by gravimetric from base to top has been completed in *Bambusa bambos* (after flowering). Histo-anatomical studies carried out in relation to starch content, total proteins and phenolics in a culm of already flowered *Bambusa bambos*. Testing carried out for different strength properties (static bending MOE and MOR, compression parallel to grain) in air-dry condition on after flowering stages of *Bambusa bambos*.

Project 2: Assessment of wood quality of *Tectona grandis* (Teak) clones from Thithimathi (Karnataka) and Andhra Pradesh [IWST/WPU/X15/2003-2007]

Status: Analysis of physical properties of Teak clones has shown higher standard specific gravity of Thithimathi clones as compared to Haliyal clones. Evaluation of mechanical properties in air-dry condition is carried out. Increment core samples of Teak clone were collected from CMA at Meredumilli, Andhra Pradesh. Collection of initial moisture content and whole core specific gravity data of these cores is completed.

Project 3: Studies on fracture mechanics in solid wood and wood composites using acoustic emissions [IWST/WPU/X16/2003-2007]

Status: Longitudinally compressed samples have shown characteristic fracture patterns. Microscopic observations of the longitudinally compressed specimens revealed a characteristic fracture band of buckled fibres and branching failure lines were also observed. Notched teak wood samples were tested in crack opening mode under in bending for determining the fracture toughness. Teak wood exhibited more fracture toughness in LT plane than in LR plane. Acoustic activity (cumulative signal intensity) was found to be increasing with the application of increasing loads and also with time till the sample failure.

Project 4: Characterization and identification of imported timbers available in the timber markets and sea ports [IWST/WPU/X43/2004-2007]

Status: Collected timbers from Visakapatnam and Mangalore port and timber markets of the town for various samples, and also from Bangalore timber market collected 25 species of timbers. A draft copy of information series titled "A guide to some Imported Timbers in south Indian markets" was prepared on 25 species of Imported timbers in which information on the trade name (original country's), family to which it belongs, other common names, distribution, general appearance, weight and specific gravity, some information on mechanical properties, seasoning, durability, preservation and uses were given to help the public.

Project 5: Studies on the gas permeability of secondary species of timbers [IWST/WSP/2003-2008]

Status: The permeability of *Acacia auriculiformis* has been studied to understand its behaviour towards impregnation of preservatives as well as drying, where liquids are removed. It is observed that considerably a very low flow rate occurred in longitudinal direction of the wood, but in transverse direction a very little flow occurred.

Project 6: Influence of pretreatment techniques on the treatability of hardwood species grown in Karnataka [IWST/WSP/X3/2004-2007]

Status: The wood of *Eucalyptus grandis* has been procured and further experimentation has been initiated.

Project 7: Polymerization filled composites [IWST/WSP/2003-2006]

Status: Polymerization of ethylene using filler supported catalyst at elevated pressure was completed. Using this new 'Polymerization Filling Technique', we have achieved one step formation of homogeneously filled composites with high degree of filler content in a high pressure polymerization reactor using slurry process. Studies on effect of time on polymerization yield and catalyst activity has been completed. Studies on effect of monomer concentration on polymerization kinetics have also been completed. Polymerization of ethylene using the filler supported catalyst with different concentrations of catalyst/cocatalyst continues and is expected to be completed. The effect of mass transfer resistances on Rate of polymerization with time is being studied.

Project 8: Studies on drying characteristics of plantation timbers in dehumidifier drying kiln (Old title: Development of seasoning schedules for plantation timbers using dehumidification based drying) [IWST/WSP/X32/2004-2007]

Status: Drying behaviour of plantation grown timbers namely Eucalyptus, Silver Oak, Casuarinas and Rubber wood were studied in the desiccant based dehumidifying wood drying system. There was no significant difference in the magnitude of drying degrades with two drying conditions in case of Eucalyptus.

The drying trial with Silver Oak (*Gravellia robusta)* wood was carried out. Some of the wood samples exhibited excessive distortion and surface checking after drying. This might be due to higher temperature of drying.

In this study, potential of acoustic measurements in monitoring moisture content in boards during drying and in sorting out extremely poor quality material before drying was explored. Acoustic velocity in boards increased with reduction in moisture content.

Acoustic velocity measurements were taken in all the boards after drying. There was a good association between acoustic velocity in boards before drying and after drying.

Drying studies with Casua rinas and Rubber wood were also carried out.

Project 9: Studies on natural durability of treated and untreated timbers of secondary species [IWST/WSP-X34/2004-2007]

Status: *Lophopetalum wightianum, Lagerstromia lanceolata* and *Artocarpus heterophyllus* specimens were treated by Full Cell process with 3 preservatives CCA, CCB and Creosote and Furnace oil 1:1, for 4 different levels of absorption. The treatment schedule for all the three species for different loadings of absorption were developed. The treated specimens along with the untreated control specimens are exposed to the field test in Test Yard.

The observations of the control specimens of these 3 species show that *Lagerstromia lanceolata* is the most durable one and *Lophopetalum wightianum* is least durable one.

Project 10: Wood fibre plastic composite foams with improved cell morphology by continuous process [IWST/WSP/X37/20042006]

Status: A series of polystyrene wood fibre/wood flour composite materials having 10, 20, 30 and 40 weight % of wood were prepared as reported in the last report. The die which was fabricated in November 2005 for foaming experiment was not suitable and the experiments using this die have failed. The design of the die was modified and now the die with new design is ready.

Project 11: Development of colouring reagents based on enzymesubstrate reaction for differentiating oil yielders of sandal in field [IWST/CFP/ X12/2002-2007]

Status: Colour reaction using Guiaicol and benzedine substrate was carried out with large number of sandal plants of known oil content for verification of results.

Results of the colour reactions have been verified in the field.

Project 12: Studies on the sucking pest complexes of Sandal and their management [IWST/WBD/X13/2004-2007]

Status: Among the 44 sucking pests found breeding on sandal, 42 pests belonging to twelve families were identified to the species level and eight species are reported for the first time. They are *Fiorinia fioriniae* (Diaspididae), *Icerya aegyptiaca, I. purchasi, I. seychellarum, Hemaspidoproctus cinerus* (Margarodidae), *Ferrisia virgata, Nipaecoccus viridis* and *Pseudococcus longispinus* (Psuedococcidae).

Project 13: Role of Fungi biodeterioration of timber under marine conditions [IWST/WBD/X35/2004-2007]

Status: CCA and CCB treated test samples of *Paraserianthes falcataria* and *Mangifera indica* were exposed to seawater in inter-tidal zone at Fishing harbour jetty, Vishakapatnam Port Trust. Periodically, one set of samples was retrieved, biological growth was observed, and weight loss of each sample was recorded and brought to IWST for further studies. Temperature and salinity of water also recorded regularly. Isolation of bacteria, actinomycetes and fungi are being done from infested samples by using various media.

Project 14: Impact of disturbance on canopy insect biodiversity: an assessment of forest health [IWST/WBD/2003-2007]

Status: The project aimed at standardizing the methodology for sampling insects from the emergent canopies of the rainforests of the Western Ghats, generating preliminary data on the diversity and comparing insect diversity in the disturbed canopies with the undisturbed ones. During the current year pre-monsoon samples were drawn from four canopies of *Vateria indica*. About 30,000 individuals collected so far have been sorted.

Project 15: Investigations on the resistance of commercially available bamboo species in Karnataka against insect borers and termites [IWST/WBD/X45/2004-2008]

Status: Length wise durability of 2 commercially available Bamboo species, *Bambusa bambos* and *Dendrocalamus strictus*, against termites and borers are being tested. These 2 species of Bamboo were treated with 8 chemicals and are being tested against termites in the field. Shock wave treated bamboo (new technique), Hot and cold process and CCA 4% Pressure treated bamboo were tested for their durability against termites.

Project 16: Clonal test trials on *Casuarina equisetifolia* L. in North coastal Andhra region (Old title: Species, provenance and clonal test trials on *Casuarina* spp. in North Andhra) **[IWST/WBD-Marine/X004/2003-2008]**

Status: Ten clones of *Casuarina equisetifolia* L. were collected from Regional Forest Research Centre, Rajahmundry. Survival percentage studied. Growth performance in terms of height, basal stem diameter and branching pattern at ground level were recorded.

Project 17: Ethnobotanical studies of Godavari valley in Andhra Pradesh [IWST/WBD Marine/X04/2002-2007)]

Status: Ethnobotanical data on 82 plant species was collected from the tribes of Godavari valley on various uses of plants. Herbarium was made and documented for the species collected.

Musa ornata Roxb. A rare wild banana -rhizome extract used as coolant by Godavari valley tribes

Project 18: Community involvement in coastal forestry through periodical returns by value added produce [IWST/WBD-Marine/X24/2003-2008]

Status: Herbage from the three plantation areas was collected and essential oil distilled. Essential oil yield from the three areas was estimated. Samples of essential oil are being tested for quality.

Project 19: Environmental impact of leachates from Copper-Chrome-Arsenic (CCA) wood preservative under marine condition [IWST/WBD-Marine/X23/ 2003-2007]

Status: Macro grain pattern of test panels was analyzed. "End penetration test", as per IS: 401-1981, was performed. Untreated mango panels were prepared to serve as controls. All treated panels were end sealed to arrest preservative leaching from free ends. All treated panels were sorted into four CCA retention groups besides controls and made into 200 test ladders, each having triplicates. Preliminary experiments on CCA leaching and effectiveness of end coating in preventing chemical leaching were carried out in the laboratory.

Project 20: Studies on recruitment and metamorphosis of marine wood borer larvae [IWST/WBD-Marine/X22/2003-2008]

Status: Generations of wood boring teredinids were maintained in the laboratory for use as stock for larval production. Two species of algae, namely, *Chaetoceros* sp. and *Isochrysis* sp. were procured and maintained in the laboratory. Experiments on the influence of algal species on the recruitment of teredinid wood borer larvae on wood surface and subsequent metamorphosis were carried out. Test panels immersed in the fishing harbour at Visakhapatnam to facilitate formation of primary film and were removed after 24 hrs. Colonies of microorganisms in the primary film separated and pure cultures of them maintained in the laboratory in appropriate culture media. Regular maintenance of running seawater system done.

Aristolochia bracteolate Lam. A medicinal plant found along the coast of north Andhra region

Arthrocnemum indicum (Willd). Moq. A halophyte extensively growing along with mangrove areas of northern coast of Andhra Pradesh

Project 21: Inventory of coastal plant communities of north Andhra region [IWST/WBD - Marine/X25/2003-2007]

Status: Several coastal areas in Visakhapatnam, East and West Godavari Districts were surveyed. Plant specimens collected, inventorized and herbarium prepared. A total of 554 plant specimens belonging to sand binders, mangroves, mangrove associates, halophytes, shelterbelt species and medicinal plants were collected and 242 of them identified.

Collected a rare and endemic plant species, namely, *Dimorphocalyx glabellus* Thw. from the coastal hilly area near Bangarammapalem, Visakhapatnam District. Ethnobotanical data were collected wherever available.

Project 22: Studies on Productivity and Management of Teak (*Tectona grandis*) in agroforestry practices in Karnataka and Andhra Pradesh [IWST/TIP/ X38/2004-2007]

Status: Survey was conducted among beneficiary farmers covered under a previous UNDP programme in Tirupati (Andhra Pradesh) and Devanahally (Karnataka) and some fields were identified for detailed studies. Farm teak trees (10 years) of block plantations in farm lots and field boundaries were sampled. The trees were felled for estimating productivity by recording data on above ground (stem, branch wood, leaves/twigs) and below ground parameters (taproots, lateral roots etc). Wood samples from felled teak trees (green and air-dry samples) collected and samples were prepared for tangential and radial directions for testing various wood properties as per standard procedure.

Project 23: Productivity and interaction studies in *Acacia* hybrid based agroforestry practices in Karnataka [IWST/TIP/X40/2004-2009]

Status: Ramets of *Acacia* hybrid were procured from Mysore Paper Mills. One site each in Kolar and Doddaballapur was identified and trials were raised with maize and red gram as inter- crops. Growth data is being periodically recorded.

Project 24: Screening clonal propagation, *ex-situ* conservation and genetic improvement of *Pongamia pinnata* [IWST/TIP/X36/2004-2007]

Status: Collected seeds of plus trees from 4 silvicultural zones namely, Central, Southern, Eastern and Northern zones

Northern Silvicultural Zone

Eastern Silvicultural Zone

Suthern Silvicultural Zone

Rooting of Cuttings (Larger)

Central Silvicultural Zone

of Karnataka. Conducted variability studies on fruits, seeds and its germination. Estimated oil content in seeds of *Pongamia pinnata* collected from 4 different silvicultural zones of Karnataka to screen the plus trees with higher oil content. Completed studies on the effect of various auxins and their concentration, and the size of cutting for the refinement of vegetative propagation of *P. pinnata.* Raised seedlings from the seeds of 25 plus trees source and established progeny trial at Nallal field research station in 0.6 ha. of land with 375 seedlings.

Project 25: Comprehensive tree improvement program for *Gmelina arborea* in Karnataka Phase I-Progeny trial [IWST/TIP/X41/2004-2009]

Status: Seeds of 49 families of *G. arborea* were procured twice from RFRI, Jorhat both the lots exhibited poor germination. Seventeen plus trees have been identified for collection of seeds.

Project 26: Seed studies of some of the economically important species of Western Ghats [IWST/TIP/2003-2007]

Status: The seeds of *Garcinia gummigutta* stored at various temperature level and room temperature was periodically tested for viability. Complete loss of viability was recorded for seeds stored at RT, -10 and 5 °C. Maximum viability was maintained by seeds stored at 25°C with 49.5 % moisture content and at 15 °C at both the moistures contents. The desiccation and storage studies reveal that the seeds of *G. gummigutta* are dormant recalcitrant in nature. In *Garcinia gummigutta* a unique pattern of germination of seed fractions (> 1cm) was recorded. The internal structure of seed reveled the presence of vascular bundle in the centre running along the length of the seed. The seeds of *Dipterocarpus indicus* were infested by weevils. Infestation was recorded in 98% of the seeds.

Independent seedlings arising from two
equal fractions of the same seed

Project 27: Carbonisation of selected fuelwood species [IWST-34/WE1/2004-2007]

Status: Variation in basic density of wood, bark and wood/bark ratio of 2 to 6 years of *Eucalyptus* hybrid and 1 to 6 years *Acacia auriculaeformis* with age and height of the tree was carried out. Variation in calorific value of *Eucalyptus* hybrid (2 to 6 years) and *A. auriculaeformis* (1, 3, 4, 5 and 6 years) with age and height (bottom to top) was studied. Ash content was higher at lower age and top of the tree. There was no significant variation in other parameters. Elemental analysis (ultimate carbon and hydrogen) of *A. auriculaeformis* and *E.* hybrid with age and height were carried out. No significant change in these parameters was observed.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006

Project 1: Standardization of anti-leaching treatment for *Pterocarpus marsupium, Pterocarpus soyaxii* and *Intsia* spp. [IWST/CFP/X51/2005-2007]

Status: Woods of *Pterocarpus marsupium, Pterocarpus soyaxii* and *Intia* spp. were procured. Design of experiment was made. Samples of the above wood prepared. FTIR studies to ascertain the degree of modification due to treatment is being carried out.

Project 2: Analysis of active principles in *Gymnema sylvestre* and *Phyllanthus amarus* from the forest of Southern India [IWST/CFP/X46/2005-2008]

Status: Eleven MPCA were selected in Karnataka state for this study. Plant materials are collected from selected place of Karnataka. Collected materials were processed for extraction of gymnemic acid.

Charmadi ghats (Karnataka state) - One of the rich source of *Gymnema sylvestre*

Project 3: Screening and evaluation of wild varieties of *Emblica officinalis* fruit in various agroclimatic zones of Western Ghats [IWST/CFP/X48/2005-2008]

Status: Methods for estimation of Ascorbic acid has been standardized. *Emblica officinalis* fruits were collected from BR hills of Karnataka state. Collected fruits were processed for extraction of Ascorbic acid.

Project 4: Extraction and separation of chemical constituents of *Dysoxylum malabaricum* Bedd. Wood [IWST/CFP/X52/2005-2007]

Status: Extraction of oil has been carried out from white cedar wood from Sirsi. Extracted white cedar wood oil was analyzed through GCMS at ITC lab, Bangalore. Results are showing 28 important chemical compounds such as Alpgha-Muurolene, T- Muurolol, Delta cadinene and others.

Project 5: Studies on age related durability of plantation timbers [IWST/WBD X50/2005-2009]

Status: *Acacia auriculiformis, A. mangium, Eucalyptus tereticornis, Grevillea robusta* and *Melia dubia* of different age group of timbers from Nallal experimental plot of KFD have been collected, converted and samples being prepared. Samples are being exposed to wood rot fungi under accelerated laboratory condition to study the natural durability of different age group timbers.

Project 6: Assessment of seed quality in unimproved populations, seed production areas and seed orchards of *Tectona grandis* [IWST/TIP/X48/2005-2007]

Status: Seeds have been collected from Seed Production Area at Virnoli, Barchi and Baghwati in Haliyal forest division and from Seedling Seed Orchard at Tirupati.

Project 7: Studies on seed source variation, determination of age of the trees and establishment of germplasm bank in Sandal [IWST/TIP/X47 2005-2008]

Status: Seed collections from different geographical areas such as Shimoga, Sirsi, Kadur, Bellary, Raichur, Mysore totaling to ten locations have been collected from Karnataka. Land preparation completed for the establishment of germplasm bank.

PROJECTS COMPLETED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Characterization and quantitative analysis of decayed wood by fluorescence and Fourier transform infrared (FTIR) spectroscopy. Funding Agency: International Foundation for Science, Sweden) [2003-2006]

Findings: FTIR spectroscopy was used to examine qualitative and quantitative changes in lignin and carbohydrate components relative to one another in wood decayed by brown-rot and white-rot fungii. *Pinus sylvestris* L. (Scots pine) and *Fagus sylvatica* L. (beech) were decayed by *Coniophora putenea* (a brown rot fungus) and two white rots (*Coriolus versicolor* and *Phanerochaete chrysosporium*) whereas *Pinus roxburghii* (Chir pine), *Hevea brasiliensis* (Rubberwood) and *Mangifera indica* (Mango wood) were decayed by *Polyporus meliae* (a brown rot) and two white rots (*Trametes hirsuta* and *Coriolus versicolor*). Results demonstrate usefulness of this technique for the rapid detection of wood decay

at early stages by brown rot fungi and identifying the type/nature of decaying fungi and determining quantitative changes in wood constituents with relative to each other. Brown rots removed structural carbohydrate components selectively leaving elevated levels of the syringyl moiety in hardwood and guiaicyl moiety in softwood. This results in an increase in the lignin:carbohydrate peak intensity ratio as decay proceeded. In wood decayed by white rot, the lignin content decreased as decay progressed, as did the xylan content. All the white-rots studied in this study showed preference for lignin reflected in a reduction in the lignin:carbohydrate peak intensity ratio as decay progressed. The ratios of reference peaks for lignin against polysaccharide FTIR peaks were compared with lignin content of the wood determined by the acetyl bromide method in beech and Scots pine decayed to different weight losses by the brown-rot fungus *C. puteana*. Project has been completed and Scientific Report of the project has been submitted to IFS Sweden.

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Investigations on lesser known aspects of mangrove biodiversity and ecology in the states of Goa, Karnataka and Andhra Pradesh. Funding Agency: Ministry of Environment and Forest (MoEF) [April 2004 to March 2008]

Status: Plant samples of mangrove species were collected. Bark and wood samples from *Rhizophora mucronata* and *Excoecaria agallocha* were processed separately for extraction of their chemical constituents. Extraction process with solvents of different polarity is under progress. Thin layer Chromatography for *Rhizophora mucronata* bark extract was carried out using different solvent system.

Collected 436 plant specimens of mangrove, their associates, halophytes and sea grasses and all the specimens were poisoned, preserved and made into herbarium. Data were collected for various parameters to study the vegetation ecology besides DBH of the trees in each quadrate. Water and soil samples were collected from all the sites and being analyzed. The calorific values of various mangrove species which are used as fire wood in coastal areas have been studied. Seed germination studies were done in *Sonneratia alba* and *Avicennia* species. Vegetative propagation studies were done in Rhizophora and *Sonneratia* sp. Permanent slides of TS, TLS and RLS were prepared using microtome for Sonneratia. Data on fibre and vessel morphology were collected for *Sonneratia alba*, *Avicennia officinalis, A. alba* and *A. marina.*

Extensive conservation of mangrove wetlands for aquaculture farms in East Godavari District

Project 2: Establishment of Advanced Wood Working Training Centre at IWST. Funding Agency: Italian Trade Commission/ACIMALL

Status: Total number of students trained upto March 2006 -1382 module wise. Percentage unemployed benefited for employment after the course 92%. Name of states from which the students attended the course Karnataka, Tamil Nadu, Andhra Pradesh, Kerala, Maharastra, Dehli, Meghalaya, Orissa, Assam, West Bengal, Madhya Pradesh, Tripura,

Rajasthan, Gujarat, Uttaranchal and Arunachal Pradesh. Different qualified students attended the course other than S.S.L.C. pass PUC, ITI, Diploma Holders, Degree Holders (BA, BSc., MA, MSc., LLB, MSW, BSc. (Ag) and BCom.), Engineering Holders, industrialists etc. The salary earned by the trainees after their employment in wood working companies in India From 3000 to 15000 per month depends upon their qualification, experience etc. No of companies benefited by the trained personnel of AWWTC more than 36 companies all over India.

Project 3: Refinement of protocols for rapid clonal propagation of Sandal and Red sanders; Demonstration of field performance and evaluation of genetic fidelity. Funding Agency: Department of Biotechnology, Govt. of India [2003- 2006]

Status: In sandal, studies on the effect of TDZ and polyamines on shoot multiplication and rooting and the effect of genotypes on shoot multiplication and rooting was carried out. Based on the protocol developed 5 genotype wise production of plants through axillary shoot proliferation was carried out. About 200 plants through axillary shoot proliferation were produced through axillary shoot proliferation. Conducted studies on media, growth hormones, sucrose, agar agar, pH on callus multiplication and high frequency synchronized somatic embryogenesis in sandal. About 400 plants were produced through somatic embryogenesis, somatic embryos are in germinations stage.

Project 4: Biocomposites From Engineered Natural Fibres. Funding Agency: Ministry of Environment and Forests (MoEF)

Status: A series of wood filled polypropylene composites having 10 to 50 weight percentage of wood content were prepared using the co-rotating twin screw extrusion system. Both wood fibres and wood flour were used as filler material. To understand the effect of coupling agents, all the formulations were prepared without any coupling agent. The compounded material was injection moulded into standard ASTM type test specimens and evaluated for their mechanical properties.

Project 5: Community ecology of a detritus systems. Insects and fungi associated with fallen trees in the Nilgiri Biosphere Reserve. Funding Agency: MoEF, Govt. of India [2004-2007]

Status: A weather recorder was installed in the field, for studying the effect of seasonal variation in insect and fungal biodiversity. The collected insects were identified upto family level. About 80 morpho species of beetles have been recorded from the fallen logs. The collected insects are compared across various physical and chemical characteristics of the logs.

Project 6: Studies on the Entomofaunal diversity and their interactions in selected provenances of sandal. Funding Agency: Ministry of Environment and Forests [(MoEF)2004-2007]

Status: The studies on entomofauna diversity in all six selected sandal provenances of south India is continued and listing of identified species of insects belonging to different orders of class Insecta. The study indicated the presence of

56 species of butterflies representing 4 families and 21 species of Odonata belonging to 16 genera, 4 families and 2 suborders from the six selected provenances of sandal during the study period. Insects representing 10 orders were found active and collected during the study period. The study to document the Entomofauna associated with flowers of sandal and their role as pollinator during the flowering seasons of sandal were completed.

Project 7: Revision of subfamily Ponerinae (Hymenoptera : Formicidae) in India with special emphasis to western ghats. Funding Agency: DST-Fast Track Scheme [2004-2007]

Status: Ponerinae are loaned from National Insect Collection Museum Forest Research Institute Dehradun for study, which includes collection from North - East India and Andaman Nicobar islands since 1921. The specimens are photographed and their identity is documented according to museum numbers. Survey is completed for the state of Goa and continuing in the States of Karnataka, Kerala and Tamil Nadu. Synoptic classification list for the Ponerinae and of the world and Oriental region prepared. The type species distribution list for the species of the genera represented from India and Oriental region is prepared. The genus Odontoponera is recorded for the first time from South India. Key to the species of rare and genus Platythyrea Roger and Harpegnathos is prepared. The Recognizable Taxonomic Units (RTUs) were isolated and drawings were made.

Project 8: Investigations on the mechanisms of success of *Mytilopsis sallei* (Recluz) in managing toxic load arising out of biodeterioration control measures. Funding Agency: Department of Science and Technology [2005-2008]

Status: Permissions for utilizing jetty facilities for trapping *Mytilopsis sallei* were obtained from State Institute of Fisheries Technology, Kakinada and Deputy Conservator, Visakhapatnam, Port Trust.

Project 9: Development of protocols for rapid and mass clonal propagation of *Bambusa pallida* Munro and *Phyllostachys bambusoides* Sieb. et Jucc. Funding Agency: Department of Bio technology (2004-2007)

Status: For genotype studies offset cuttings of four CPCs of *Bambusa pallida* were collected from RFRI, Jorhat and established at germplasm bank at Gottipura for micropropagation studies. Studies on effect of media and PGRs and TDZ on shoot multiplication was carried out on both the species. In *Phyllostachys bambusoides* studies were conducted for direct root and shoot development from the explants. In *Bambusa pallida* effect of explant type and auxins on callus induction for somatic embryogenesis was studied. Shoot multiplication rate was about 4 fold in *Bambusa pallida* in 4 weeks period.

Project 10: Field performance of micro and macropropagated planting stock of selected five commercially important bamboo species (Collaborative project with KFRI & IFGTB). Funding Agency: Department of Biotechnology [2004-2007]

Status: Established field trials of micro and macropropagated planting material of five bamboo species viz; *B. bambos, B. balcooa, D. asper, D, strictus* and *P. stocksii* in 13.0ha in Karnataka (Gottipura, Nallal and Yelwala) and 3.7 ha. in

Andhra Pradesh (FRC, Hyderabad). In Karnataka different trials established are; mode of regeneration, spacing and effect of fertilisers on growth. Whereas, in Andhra Pradesh trials are on effect of spacing and fertilizer treatment on growth.

Project 11: The properties of coffee wood as indicators of white stem borer resistance. Funding Agency: Central Coffee Research Institute [2005-2008]

Status: Training was imparted to the in-service officials of coffee board on histo-chemistry. Starch, lipid, protein contents based on staining technique for borer affected and controls for 8 cultivars were analysed.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Studies on the assessing growth performance and standardization of management practices for *Guadua angustifolia* Kunth in Karnataka Funding Agency: NMBA[2005-2008]

Status: Established field trials at two sites (each site of 1.3 ha). The trials were established in Randomized Block Design in two spacing schedules with seven treatments and three replications. Nine plants per replicate were established and 388 Guadua plants were planted in each site. Observations related to survival rate, height of the plant and number of culms were collected.

Project 2: Investigations on the fungi and insects associated with fruits and seeds of selected endemic trees of western ghats. Funding Agency: MoEF [20062009]

Status: The project work has been initiated in March, 2006.

Project 3: Bamboo Locational Trials (BLT). Funding Agency: NMBA [2005-2007]

Status: Under species trial eight bamboo species were selected and trials established at Nallal (Karnataka) and FRC, Hyderabad (AP). Nutrient management trial with 5 m x 5m spacing, bamboo based cropping system trial and clump management trial were established using *Pseudoxytenanthera stocksii* at Nallal in Karnataka.

Project 4: Multilocational introduction cum demonstration trials and field evaluation of six important bamboo species viz., *Bambusa balcooa, B. nutans, Dendrocalamus asper, D. hamiltonii, Guadua angustifolia* and *Pseuodoxytenanthera stocksii* in Andhra Pradesh, Karnataka and Goa. Funding Agency: DBT [2005-2009]

Status: Shoot multiplication and rooting in *D. asper* initiated. Initiated work on establishment of cultures of *B. nutans* and *B. balcooa* from selected CPC material.

Project 5: Insect-plant relationship with special reference to herbivory in the mangroves of South India. Funding Agency: MoEF [2005-2008]

Status: The purchase of the equipments (Leaf Area Meter, Digital Camera and Solar Light Traps) were processed. The Solar Light Traps (4 Nos.) have been received and installed in study sites at Upinkudru, Masoor and Dev bagh. Survey and collections are made on a routine basis (monthly) in three coastal districts of Karnataka (at mangroves of Karwar, Honnawar, Kundapur and Mangalore). Insects from the day and night collections are being sorted out and identified. 56 species are identified upto species level.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	13	27	7
External Projects	1	11	5
Total	14	38	12

TECHNOLOGY ASSESSED AND TRANSFERRED

1. A demonstration programme on "Forestry and Wood Science Technologies" was organized at Forest Technical and Administration Training Institute (FTATI) Kadugodi, Karnataka on 2nd September 2005.
2. A demonstration programme on "Forestry and Wood Science Technologies" was organized at Hassan on 16th September 2005.
3. Operation of portable distillation unit meant for extraction of essential oils was demonstrated to the officers and staff of the Andhra Pradesh Forest Department and members of VSS/NGO at Vizianagaram on 27th February 2006.
4. Evaluated the potential of *Simarouba glauca* and *Eucalyptus citriodora* for Development Commissioner Handicraft (Bangalore) for handicrafts as new raw material resource.

EDUCATION AND TRAINING

Education

1. A total of 307 students from different universities visited the Institute from April 2005 to March 2006.
2. Students of Wood Science and Technology, FRI (Deemed University) were given lectures on wood quality.

Training

1. Conducted training course on " Techniques of wood anatomy" to the officials of Central Coffee Research Institute, Chikkamagalur.

2. Conducted Training course on "Classification and grading of timbers" to the in-service officials of Ordinance Factory, Trichirapalli and M/s Moser Baer India Pvt. Ltd., Greater Noida, from 09th to 11th January 2006.
3. Dr. R. Sundararaj and Smt. H.C. Nagaveni imparted training and practicals for trainees of TNFD officials on Biofertiliser and Pest and Disease management in nurseries from 15th to 17th February 2006.
4. Conducted Training course on "Joinery" to the in-service officials of Andaman & Nicobar Forest Department, Port Blair from 9th to 13th January 2006.
5. Conducted Training course on "Field identification of important timbers" to the in-service officials of Tamil Nadu Forest Department from 20th to 24th February 2006.
6. Conducted training course for official of Andaman & Nicobar Island in Wood Seasoning and Preservation from 16th to 20th January 2006.
7. IWST supported a training programme organized by EMPRI from 7th to 11th November 2005.
8. Training on "Preservation of rubber wood and silver wood for Industrial packaging application" was organized from 31st August to 2nd September 2005 for 7 trainees from M/s Wheels India Limited, Chennai.
9. Compulsory Training Course for IFS officers on IPR on Forestry issues from 2nd to 6th January 2006 was organized in the Institute. A total of 30 officers participated. 2 days Training Workshop on "Advancements in Wood Production and Utilization" was organized on 30th and 31st January 2006.
10. Conducted one week training programme on "Modern Seed and Nursery Technology" for RFOs and Foresters of Tamil Nadu State Forest Department from 16th to 21st February 2006.

Attended

Dr. R. Vijendra Rao, Scientist- F, Mrs. M. Sujatha RA Gr. I and Mrs. S. Shashikala, RA Gr. I attended training on Histo-chemistry techniques given by Prof. K.V. Krishnamurthy of Bharatidasan University, Tiruchirapalli on 21st and 22nd July 2005.

LINKAGES AND COLLABORATION

1. Linkages with State Forest Department, Karnataka, Andhra Pradesh Forest department, Goa Forest Department, Bangalore University, University of Agricultural Sciences, Bangalore, University of Agricultural Sciences, Dharwad and Indian Institute of Science, Bangalore, PESIT, Bangalore, IFGTB, Coimbatore and KFRI, Peechi.
2. Two DBT projects being undertaken in collaboration one with KFRI, Peechi and IFGTB, Coimbatore on "Field performance of micro and macropropagated planting stock of selected five commercially important bamboo species" and another with KFD, Karnataka, APFD, Hyderabad, GFD, Goa on "Multilocational introduction cum demonstration trials and field evaluation of six important bamboo species viz; *Bambusa balcooa, B. nutans, Dendrocalamus asper, hamiltonii, Guadua angustifolia* and *Pseudoxytenanthera stocksii* in Andhra Pradesh, Karnataka and Goa".
3. Linkages developed with DCF Sirsi, DCF Sagara and DCF Mangalore for the collection of information on management practices followed by the department.
4. Had good linkages with A.P. Forest and Fisheries Departments, Toy making industries, Universities and Research Institutes in Andhra Pradesh.
5. MoU signed between Central Coffee Research Institute (CCRI), Coffee Research Station, Chikkamanglur district

and IWST, Bangalore for Rs. 5.35 lakhs. IWST will collaborate with CCRI in carrying out Research studies on the properties of coffee wood as indicators of white borer for resistance.

PUBLICATIONS

Project Completion Reports

1. Dhyan Singh, P. Kumar and Anthony Das (2005). Development and popularization of packing boxes of plantation grown timbers from South India for Horticulture produces. Project No. IWST/WPU/X18.
2. Hemavathi T.R, R. Vijendra Rao, S.R. Shukla, M. Sujatha, S. Shashikala and Maddurappa (2005). Assessment of wood quality (Anatomical) of 8-10 years old *Acacia auriculaeformis* and *Acacia mangium* hybrids. Project No. IWST/WPU/X04.
3. Nirmal Kumar Upreti, S.S. Chauhan and Anil Kumar Sethy (June 2004) Studies on forced air drying of plantation grown timbers. Project No. IWST/WSP/X01.
4. D. Venmalar and P. Ramlal (2005). Development of alternative preservatives of more economic value and schedules for their incorporation in wood. Project No. IWST/WSP-009.
5. P. Narayanappa, K.S. Rao and V. Kuppusamy (2005). Evaluation of ammonia based preservatives against Indian termites. Project No. IWST/WSP/X02.
6. Pankaj Kumar Aggarwal, D. Venmalar and C.N. Vani (2005). Effect of temperature, humidity and pH on CCB fixation in wood. Project No. IWST/WSP/X11.
7. Gairola S.C. and S.S. Chauhan (2005). Studies on the drying behaviour of timber used for handicrafts. Project No. IWST/WSP/X20.
8. Angadi, V.G. K.H. Shankaranarayana, G. Ravikumar and K.T. Chandrashekar (2005). Natural products evaluation of extractives of plant origin for biological and pharmacological activity *Nothapodytes nimmoniana* and *Garcinia indica*. Project No. IWST/CFP 003.
9. Nagaveni H.C. and G. Vijayalakshmi (2005). Role of biofertilizer in ecorestoration of problematic site like mine reject soil in Goa. Project No. IWST/WBD-003.
10. Remadevi O.K., Rajamuthukrishnan, (2005). Studies on entomofauna of mangroves of Karnataka, Goa and Andhra Pradesh Project No. IWST-24/WBD-7/2005.
11. Nagaveni H.C., K.H. Shankaranarayana, G. Vijayalakshmi (2005). Control of biodeterioration of wood with the help of eco-friendly preservatives and bioactive substances on staining and decay fungi under terrestrial conditions Project No. IWST/WBD-008.
12. Srinivasa Y.B. and O.K. Remadevi (2005) Biosystematic studies on parasitoid complex of sandal coccids and their utilization in biological control. Project No. IWST/WBD-16.
13. Rathore T.S., Ashutosh Srivastava, Geeta Pandey (September 2004). Development of modern nursery techniques for propagation of important species of Goa *Terminalia tomentosa, Xylia xylocarpa, Myristica fragrans, Bambusa arundinacea* and *Dendrocalamus strictus*. Project No. IWST/TIP 3.
14. Rathore T.S., Ashutosh Srivastava and P.V. Somashekar (2005). Studies on micropropagation field evaluation and conservation of *Pseudoxytenanthera stocksii* (*Oxytenanthera stocksii*)- Threatened species. Project No. IWST/TIP-002.

15. Arun Kumar A.N., Geeta Joshi and Nataraja Karaba (2005). Variation in photosynthesis in clones of Sandal and Eucalyptus. Project No. IWST/TIP-X28.

Publications

1. Institute Profile (2005-2006)
2. Research highlights (1988-2005) of the institute

CONFERENCE/ MEETINGS/ WORKSHOPS/ SEMINARS/ SYMPOSIA/ EXHIBITIONS

Organized

1. Organisation of 36th Annual conference of International Research Group on Wood Preservation (IRG), Sweden from 24th to 28th April 2005.
2. A one-day seminar on "Quality issues in forestry and forest products" was conducted on 20th September 2005.
3. A national workshop on "Advancements in Wood Production and Utilization" for IFS Officers was conducted at institute on 30th and 31st January 2006.
4. Two days Regional Workshop on "Forestry Extension: Experience sharing and perspectives" was organized on 8th and 9th November 2005.
5. National Workshop on "Lesser Known Non-Timber Forest Products: Status, Conservation, Management and Sustainable Utilization" was conducted on 28th and 29th March, 2006. Workshop was sponsored by CSIR.

Attended

1. A total of 11 Officers/Scientists from the institute attended 36th Annual Conference of International Research Group on "Wood Protection" held in Bangalore from 24th to 28th April 2005.
2. A total of 33 scientists participated in Indo-Italian Seminar on "Quality Issues in Forestry and Forest Products" held at IWST, Bangalore on 20th September 2005.
3. All the scientists of the institute attended Regional Workshop on "Forestry Extension: Experience Sharing and Perspective" held at IWST Bangalore on 8th and 9th November 2005 .
4. Scientists upto the level of Scientist D attended seminar on "Quality issues in Forestry and Forest Products" conducted by NABARD at Bangalore on 11th November 2005.
5. All the scientists of the division participated in Research Advisory Group Meeting on 29th and 30th November 2005 and presented new project proposals for ICFRE/external funding.
6. All the officers and scientists of the institute attended National Workshop on "Lesser Known Non-Timber Forest Products: Status, Conservation, Management and Sustainable Utilization" on 28th and 29th March 2006.
7. All the scientists attended a Lecture on Preparation of "Research proposal for funding" by Prof. M.G. Chandrakanth, Gandhi Krishi Vidya Kendra (GKVK), Bangalore.
8. Scientists and technical staff participated in 'Krishimela' and demonstrated the products/technologies of the institute at University of Agricultural Sciences, GKVK, Bangalore from 17th to 20th November 2005.

9. Scientist of the CFP division of the institute participated in programme on Cultivation and Processing of Medicinal and Arometic plants organized by " National Institute of Rural Development, Rajendranagar, Hyderabad from 12th to 18th May 2005.
10. Dr. O.K. Remadevi, Mr. Y.B. Srinivasa, Mr. Gaurav Sharma and Ms. P. Sarasija attended International Conference on "Biodiversity of Insects: Challenging issues in management and conservation" held at Department of Zoology, Bharathiyar University from 30th January to 3rd February 2006. Dr. O. K. Remadevi acted as judge for poster session.
11. Dr. N. Rama Rao, Scientist-E, Shri. M. V. Rao, Scientist-C and P. K. Swain, JRF of MoEF Mangrove project participated in the *National Symposium on trends in Plant Science Research* at Visakhapatnam from 8th to 10th December 2005.
12. Dr. K.S. Shashidhar and Dr. R. Vijendra Rao participated and presented a paper on "Need to introduce Wood Science in the educational curriculum" and " Certification in forest products- opportunities, challenges and future needs" in the National Symposium on Trends in Plant science Research organized at Andhra University, Visakhapatnam from 8th to 10th December 2005.
13. Dr. Balaji and M. V. Rao, Scientists-C participated in the Workshop on Coastal Zone Management at Visakhapatnam by the MSSRF on 25th February 2006.
14. Dr. S.K. Sharma and Mr. P. Kumar participated and presented a write-up on "Utilization of Bamboo culms" in State Level Consultative meet on Bamboo at NABARD Karnataka RO., Bangalore organized by NABARD, Bangalore on 25th November 2005.
15. Dr. R. Vijendra Rao, Scientist-F -
    - Attended the Eighth meeting of the Timber and Timber Stores Sectional Committee conducted by Bureau of Indian Standards, Bangalore on 16th November 2005
    - Attended Academic Council Meeting of FRI Deemed University at Dehradun on 11th November 2005.
    - Attended the Eleventh meeting of the wood and lignocellulosic products Sectional Committee CED 20 organised by Bureau of Indian Standards, Bangalore on 20th December 2005.
16. Dr. O.K. Remadevi, Scientist-E-
    - Attended the review meeting of the TIFAC (DST) Project in Delhi on 8th July 2005 and presented the findings.
    - Attended the Workshop on Promotion of Sericulture conducted by AHADS, Kerala on 4th and 5th August 2005.
    - Participated and presented a paper as an invitee in the National Symposium on Coastal resources and their Sustainable Management: Issues & Strategies held by Bidhan Chandra Krishi Viswavidyalaya, West Bengal from 23rd to 27th November 2005.
    - As an ICFRE nominated delegate, participated in the APFISN Workshop on Early Warning Systems for Forest Invasive Species at Kerala Forest Research Institute, Peechi from 21st to 24th February 2006.
17. Dr. T.S. Rathore, Scientist E
    - Participated in the workshop on "Integrating IPR culture with R & D and regional seminar on Intellectual property, protection, valuation and commercialization" on 5th and 6th December 2005 at Bangalore.
    - Participated in National Conference on Tree Biotechnology: Indian scenario held at TFRI, Jabalpur on 9th and 10th February 2006.
    - Participated in Regional workshop on recent advances in teak research and management in Central India organized by the EDMC, Maharashtra Ltd., Nagpur, during 17th and 18th March 2006.

18. Dr. N. Rama Rao Scientist-E-
    - Participated in the National Conference on Current Trends in Plant Sciences at Kakatiya University, Warangal during 16th and 17th April 2005.
    - Participated in the Workshop on Coastal Zone Management at Visakhapatnam by the MSSRF on 25th February 2006.
    - Attended as advisory committee member at the State level seminar on Biodiversity and conservation of flora and fauna of Andhra Pradesh at Kavali on 11th and 12th March 2006.
19. Dr. K. K. Pandey, Scientist-E
    - Participated in a Seminar on Fundamentals of Weathering (Part II) in Bangalore on 22nd July 2005 organized by Atlas Material Testing Solutions Chennai.
    - Visited Gottiningen University, Germany and delivered two seminars on "Photodegradation of unmodified and chemically Modified wood" and "FTIR methodology Applications in Wood Science as a Guest Speaker from 12th to 23rd December 2005.
20. Dr. R. Sundararaj, Scientist-E
    - Attended the National "Brainstorming workshop on Biodiversity" organized by NCSTC Network, New Delhi in collaboration with Karnataka Rajya Vijnana Parishat and Centre for Ecological Sciences, Indian Institute of Science at Bangalore on 16th June 2005.
    - Attended the regional Conference on "Science Technology Society" on 17th September 2005 held at Bangalore, organized by Karnataka Regional Branch, Indian Institute of Public Administration, New Delhi.
    - Attended the VI Discussion meeting on Emerging Technologies and Resistance Dynamics in Insects and Crop plants held at COSTED Auditorium, Chennai on 2nd December 2005.
    - Attended the "National Conference on Biodiversity" held at School of Entomology and Center for National Resources Management, Loyola College, Chennai on 30th and 31st January 2006.
21. Dr. S. Viswanath, Scientist D
    - Participated in the Workshop on "Promotion of Bio-pesticides and Biofertilizers in Agriculture from 20th to 22nd September 2005 at National Institute of Rural Development (NIRD), Hyderabad.
    - Attended National Workshop on Clean Development Mechanism (CDM) and Indian Rubber Sector, RRII, on 12th August 2005 at Rubber Research Institute of India, Kottayam.
    - Attended National Workshop cum training on Bamboo Locational trial, Bambusetum and propagation from 14th to 16th February 2006, conducted by NMBA at Bamboo co-ordinating centre, GB Pant University of Agriculture & Tech., Pantnagar, Uttaranchal. Presented progress of NMBA-BLT experiments being carried out at IWST in Hoskote, Bangalore and FRC, Hyderabad.
    - Participated in the Workshop on Improvement of Pronunciation and expression skills in Hindi language at Kendriya Hindi Training Institute, Kendriya Sadan, Bangalore on 24th and 25th November 2005.
22. Mr. P. Kumar, Scientist-B
    - Attended the meeting of Selection cum- Promotion Committee for selection of candidates for various posts at IPIRTI, Bangalore for conducting trade test on 15th and 16th July 2005.
    - Delivered a lecture during Training to Trainers and Master crafts persons programme on "Wood Based

Crafts" held at office of the Development Commissioner (Handicrafts), Bangalore from 20th February to 3rd March 2006.

23. Shri Gaurav Sharma, SRF
   - Attended the VII Asian Symposium on Odontology and recent trends in Zoology held at Hislop College, Nagpur from 9th to 11th January 2006 and presented a paper. He was awarded Gold Medal in the symposium for the best presentation.
   - Attended the "National Conference of Entomology" held at Department of Zoology, Punjab University, Patiala from 15th to 17th March 2006 and presented two papers.

24. Dr. S.P.S. Rawat, Scientist E participated in National Seminar on "Emerging Scenario of Patents' Protection, Valuation and Commercialization", organized by NRDC at Chennai on 27 April 2005.

25. Sri. Y.B. Srinivasa attended the workshop on *Opisina arenosella* on 27th November 2005 at GKVK and presented an invited talk on "Research on *Opisina arenosella*, What next?"

26. Mr. R. Nainamalai, Scientist B, attended and participated in the National Workshop on "Recent Advances in Forestry Sciences" held at Guru Ghasidas University at Bilaspur in Chhattisgarh on 30th and 31st January 2006.

Exhibition

1. IWST participated in "KRISHIMELA" organized by University of Agricultural Sciences from 17th to 20th November 2005 by putting up a stall of Institute activities.
2. India Wood 2006 exhibition was arranged from 16th to 20th February 2006 at Palace Grounds in which the Institute exhibited stall: Properties and uses of plantation timbers; Advantages of Seasoning and Preservation; Ammonia Fumigation Technique; Sap Displacement Technique; Portable distillation unit; Advantages of root trainers for sandal and teak seedlings; and Wood polymer composites.

Meeting

1. Institute organized 15th meeting of review committee on 12th and 13th December 2005 for the progress of ongoing projects and completed projects of Eastern and Western Ghats, MoEF on behalf of MoEF.
2. The Research Advisory Group Meeting of the institute was held on 30th November 2005 at the institute.

CONSULTANCY

1. Monitoring and evaluation of 40 NMPB funded projects was undertaken by the Institute.
2. Impact assessment of Wild Fauna with the diversion of forest land (154.96 ha) for mining at SCCL, Kothagudem, Andhra Pradesh.
3. Analytical service was rendered to Police Department, Forest Department and public in analysis of essential oils from sandalwood samples. A number of technical inquiries on utilization of various Non-Wood Forest Products from Government Departments and public were attended to and advice given.

4. Attended several enquiries from Forest department officials and NGOs with respect to entomological and pathological problems in nursery, plantations and timber in-service and suitable remedial measures were suggested.
5. Testing services were rendered to different users from Industry, Government departments, Police, Vigilance, CBI, Defence, Railways, Construction industry, NGOs and Private sectors on (a) Timber Identification, (b) Moisture content, (c) Strength property determination and (d) Bulk density and specific gravity.
6. Efficacies of commercial preservatives against wood rotters and termites are being tested for various agencies. The test report on the bioefficacy of TERMINATOR 'A' and 'E' against termite and borer was prepared and submitted to M/s Pidilite Industries, Mumbai.
7. Dr. O.K. Remadevi, Dr. R. Sundararaj and H.C. Nagaveni visited and inspected the teak plantation at Chordi Range, *Shorea talura* plantation at Chandragutti State Natural Forest from 11th to 15th April 2005 and the report on the mortality reasons was submitted to the Forest Department.
8. Dr. O.K. Remadevi, Dr. R. Sundararaj and H.C. Nagaveni visited the Yellapur range of Uttara Kannada Division of Karnataka Forest Department from 7th to 9th May 2005 and analysed the factors responsible for the mortality of *Terminalia tomentosa.*
9. As per the instruction of the Asst. Registrar cum Administrative Officer, Shimoga District, Shri Raja Muthukrishnan attended the court of Shimoga on 4th July 2005 with the permission of Director, IWST, Bangalore.
10. 20 wood samples and preservative solutions received from Government, and other user agencies were analyzed for their preservative content. Problems connected with wood preservation were discussed and suitable advices were given based on their enquiries.

DISTINGUISHED VISITORS

- Dr. Andrees Ropp, DFH (Federal Research Centre for Forestry and Forest Products of Germany) Head, Wood Protection, Leuschnerstrasse 91, 21031 Hamburg, Germany visited the institute on 29th April 2005.
- The IRG delegates Dr. Andrew H.H. Wong, Malaysia Philip D. Evans, Canada and Mark Mankowski, USA visited Entomology laboratory on 29th April 2005.
- Mr. David Venables, European Director, American Hardwood Export Council, London and Mr. Roderick Wiles, Broadleaf Consulting, Hampshire, UK visited the institute on 12th July 2005 regarding collaborative work in wood science.
- Ms. Alexis Chan and Ms. Adeline Goli, Executive Trade Promotion and marketing division, Malaysian Timber Council visited the Institute on 21st October 2005.
- Mr. Ashok Bhatia, Director, MoEF, New Delhi visited the institute on 12th and 13th December 2005.
- Sri Lankan and Nepalese officials visited the labs and had an interaction meeting with the officers of this division during December 2005.
- Dr. S.K. Pandey, Advisor, NMBA visited the Institute on 2nd February 2006.
- Representatives from M/s. Asian Paints, Mumbai visited the Institute on 17th February 2006.
- Italian delegates (ACIMALL, ICE) visited the Institute on 17th February 2006.
- American Softwood Council delegates visited the Institute on 17th February 2006.
- A meeting was arranged with Director, Group Co-ordinator Research and Division Head with Danny Day, President, EPRIDA- to discuss regarding carbon sequestration with the use of charcoal and biofertilizer.

CHAPTER 3.4

Tropical Forest Research Institute Jabalpur

Tropical Forest Research Institute (TFRI), an Institution of ICFRE caters to the forestry research needs of four central states of India, viz. Madhya Pradesh, Chhattisgarh, Maharashtra and Orissa. Thrust areas of research in the institute relate to non-wood forest products, rehabilitation of mined areas and other stress sites, development of and demonstration in agroforestry models, planting stock improvement, developing tissue culture protocols for difficult species of central Indian forests, and control of forest diseases and pests. TFRI has established constant liaison with state forest departments, NGOs working in the field of forestry and allied areas, universities imparting education in forestry, and forest based industries. A number of scientists, officers and staff of the institute participated in various scientific seminars and symposia both at state and national levels were also actively involved in extension activities. This has helped the institute in imbibing in its research programme ideas and concepts from various user groups.

PROJECTS COMPLETED DURING THE YEAR 2005-2006

Project 1: Development and standardization of management practices for most promising existing agroforestry system in Central Narmada Valley and Satpura Plateau agroclimatic region [043/TFRI-2002/Agro 1 (8)/2002-2006]

Findings: An agroforestry model with three tree species (age 34 months) namely *Tectona grandis, Gmelina arborea* and *Emblica officinalis* and wheat developed. Wheat (rabi crop) was grown in the inter spaces between the trees. Among the tree species *E. officinalis* showed best performance in terms of height growth (1.24.m) followed by *Gmelina arborea* (0.93 m) and *T. grandis* (0.63m). Data on yield, wheat showed highest yield under *T. grandis* (311.18/sq m) followed by *G. arborea* (320.14 g/sq m) and *E. officinalis* (287.77/ sq m) against sole crop of wheat 231.99 g/sq m.

On Station Trail at TFRI

Agri crop-sole

Farmers of Jabalpur and Narsinghpur were also surveyed through questionnaire for identification of most suitable agroforestry system practiced by them. Farmers of Narsinghpur preferred planting teak, khamer and bamboo in their field bunds intercropped with wheat, arhar, gram and mustard. Farmers of Jabalpur preferred babul, bamboo, teak and eucalyptus in their field bunds with wheat, gram, arhar, masur, til and urad.

Project 2: Management of insect pests of forest nurseries in central India [045/TFRI-2002/Ento 1(2)/2002-2006]

Findings: Surveys carried out at 7 major nurseries in M.P., Chhattisgarh, Maharashtra and Orissa, revealed white grubs to be the major species causing maximum economic losses in terms of seedling mortality in teak in forest nurseries of Maharashtra, M.P. and Chhattisgarh. Termites caused 23 to 60 % losses to teak and khamer (*Gmelina arborea*) seedlings in nurseries of Orissa. Considering the intensity of white grub attack detailed study was carried out at Ramdongari Nursery, FDCM Ltd., Nagpur (MS). Three species of white grubs, viz., *Holotrichia mucida* Gyll., *H. rustica* Burm. and *Schizonycha ruficollis* Fab were recorded for the first time, as a major pest on teak. Chafer beetle of these species fed on *Ziziphus jujuba, Z. mauritiana, Z. xylocarpa, Acacia catechu* and *A. leucophloea*. The beetle emergence initiated after the pre-monsoon showers and continued to be actively feeding and laying eggs till 18 19 days after emergence. Grubs of a predatory beetle species feeding on the white grubs in teak nurseries were recorded for the first time with predatory potential of matured grub in laboratory being 8-10 white grubs/day. Endosulfan @ 0.04% proved most effective against eggs of white grubs when treated through soil drenching. Field experiments proved that *Beauveria bassiana* and *Metarhizium anisopliae* in combination with phorate 10% G and methyl parathion 2% D, (in ratio of 100g microbial product + 250g phorate 10 % G/methyl parathion, proved effective in reducing infestation of grubs.

Project 3: Integrated management of diseases of seeds, nursery and plantation [035/TFRI-2001/Path-4(5)/2001-2006]

Findings: One month after soil solarization population of Aspergillus, Penicillium, Fusarium, Rhizopus and Nematodes were completely eliminated from upper 10 cm soil depth, while population of AM fungi, *Trichoderma* and bacteria was significantly reduced. Population of weeds in the control beds were 229/m^2, were completely eradicated after solarization. A new cotyledon rot of *Pongamia pinnata* caused by *Fusarium dimerum* was recorded from nursery. Disease was successfully controlled by application of Anucop 0.2%. An unrecorded foliar blight of *Ailanthus excelsa* due to *Colletotrichum dematium* was noticed in TFRI nursery. Disease was managed by keeping seedlings in well drained sites with full sunlight and fortnightly spray of Thirum 0.2%. Incidence of *Botryodiplodia* the obromae and *Funalia leonina* was first time recorded in 12 years old plantations of *Bursera panicilata*. Proper sanitation at the site of plantation and spray of bordeaux mixture (copper sulphate 1 kg + calcium carbonate 1kg in 100 lit. water) was recommended for disease management.

Seeds of 13 provenances of *Acacia nilotica* were evaluated for seed associated mycoflora. *Trichurus spiralis* was found in 6 provenances. Six fungi and one bacteria from *Albizia procera* seeds and ten fungi from neem seeds were isolated and identified.

Biocontrol experiments were conducted by using *Trichoderma* spp., PSB, VAM fungi against Fusarium wilt of *Gmelina arborea*. Combination of Rhizobium, Trichoderma AM fungi against Fusarium wilt of *Dalbergia sissoo* was tried in nursery. AM fungi Rhizobium and *T. polysporum* in combination was found best in controlling the disease. *Streptomyces* sp. controlled wilt of *A. procera, D. sissoo* and *A. lebbek* in nursery. Soil solarization completely eliminated population of pathogens. Nematode and weed population is also drastically reduced. Germination and survival of *D. sissoo* and *A. nilotica* seedlings in solarized plots increased as compared to non-solarized plots.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Eco-rehabilitation of limestone mined area in Madhya Pradesh [065/TFRI/2004/Ecol-1 (6)/2004-2007]

Status: Vegetation survey was carried out in Kuteshwar limestone mined area by quadrate method in the overburden dump and adjoining sites (natural). In the overburden sites, *L. leucocephala, Casia siamea, A. procera,* Eucalyptus etc. were found as the dominating tree species; *Lantana camara, Zizyphus* spp., *Casia tora* and *Calotropis procera* as common shrub species and *Hyptis suaveolens,* Binata, *Parthenium* and *Atylosia* spp. as common herbs. In the adjoining (natural) sites *A. auriculiformis, A. nilotica, A. indica, A. procera, D. sissoo,* and Gulmohar etc. were commonly found. Soil samples were collected from both the sites and physiochemical and nutritional characteristics including pH, EC, organic carbon, N, P, K, Cation exchange capacity and exchangeable cations were quantified. Pot experiments on biofertilizer, chemical fertilizer and mulching were set up in nursery and in progress.

Project 2: Studies on the role of Actinomycetes in controlling root diseases of *Tectona grandis* and *Albizia procera* [072/TFRI-2004/Patho 2(9)/2004-2007]

Status: Surveys were conducted in Sagar, Mandla, Badwani, Raipur and Jabalpur forest areas and collected different soil samples. Isolated one effective strain of actinomycetes. Its efficacy was tested against various soil borne plant pathogens. The culture filtrates of streptomyces species were prepared and purified for identification of active antibiotic principles.

Project 3: Studies on bacterial and viral diseases of teak, Gmelina and Albizia and their management [066/TFRI/2004/Patho-1(8)/2004-2007]

Status: Six isolates of bacteria were identified as a cause of collar rot and seedling wilt of *Tectona grandis* and *Gmelina arborea* from various forest nurseries of Madhya Pradesh and Chhattisgarh. Out of 6 isolates, 3 are gram positive and 3 are gram negative. Their morphological characteristic and field symptoms recorded. Further work on field management with application of broad-spectrum antibiotic and modification in cultural practices is in progress.

Incidence of bacterial collar rot was recorded from Katra teak nursery, Mandla and root trainers seedlings from social forestry nurseries, Jabalpur, Belkund and Kanchangaon. 15% seedlings were found to have leaf curl and stunting, caused by virus, in *Gmelina arborea* in TFRI nursery.

Project 4: Standardization of the cultivation technique and utilization of laccate, stipitate species Ganodermataceae (*G. lucidum*) [056/CFRHRD-2003/2(6)/2003-2006]

Status: Surveys were conducted in different parts of Maharashtra state viz. Wardha, Arve, Yawatmal, Pushad, Ishapur, Gondia, Aamgaon, Salekasa, Darekasa, Jamkantri for collection of *Ganoderma* sp. Twenty two samples of fruit bodies of Ganoderma were collected. The culture prepared and isolates were purified. Further work on screening of Ganoderma isolates through CAI technique is continuing. The detail morphological and microscopic parameters were studied for taxonomic characterization of the strains.

Project 5: Germplasm conservation and investigation on inheritance pattern of *Gmelina arborea* [040/TFRI2002/Gen1(5)/2002-2007]

Status: Germplasm bank with 49 diverse genotypes and clonal seed orchard with 36 clones of *Gmelina arborea* were established in the premises of the institute. Similarly to derive information on inheritance of growth traits during the project period data on growth from earlier established progeny trials was collected. In addition to this, a new SSO-cum-progeny trial comprising 9 families was established in randomized complete block design.

A study was undertaken to understand the pattern of variation and inheritance of seed morphology, germination and seed mycoflora using open pollinated seeds from 12 different phenotypically selected trees of different origin. Data on stone length, stone width, stone weight, germination (%), Germination Value (GV), Germination Velocity Index (GVI), Vigour Index (VI), number of fungi infested and fungal infection percent was generated. Data was subjected to analysis of variance followed by estimation of genetic parameters. Analysis of variance revealed significant differences for all the traits studied. Differences between phenotypic and genotypic coefficient of variation for stone traits, infection percent and GVI were found to be very small. Stone weight showed the highest heritability value of 84 %. Other traits also exhibited high heritability values ranging from 32 to 83 %. The study concluded that stone weight, stone width, GVI, fugnal infection percent and germination percent are under the influence of additive gene action and amenable to selection of more productive parents for improvement in seed and germination traits through inclusion of these parents in breeding and production populations. It was also observed that trees, ORBLG-1, ORBLG-4 and Kasai-701 were less prone to seed infection. It is, therefore, suggested that phenotypically selected trees should also be screened for associated seed mycoflora.

Seedlings of different populations of D. sissoo raised in earthen pots to record changes in growth and endogenous biochemical under NaCl-induced salinity stress regimes

Project 6: Screening populations of *Dalbergia sissoo* for tolerance to salt and water stress using physiomorphological and biochemical criteria [067/TFRI-2004/Gen-2 (8)/2004-2007]

Status: Seedlings of four populations (FRI, TFRI-I, TFRI-II and SFRI) of *Dalbergia sissoo* were raised to evaluate their tolerance to salinity stress. Seedlings of different populations were transferred to earthen pots containing

sterilized sand and provided nutrient solution supplemented with different concentrations of NaCl as T_1 - 0 mM, T_2 -40 mM, T_3 -80 mM and T_4 -160 mM on alternate day. Changes in morphology and growth (height, collar diameter, leaf fresh and dry weight) and endogenous biochemicals (soluble sugars, starch, phenol, o-phenol, chlorophyll, proline, peroxidase, nitrate reductase) were recorded during different intervals of seedling growth, i.e. 0 h, week 1, week 3, week 5 and week 8. Analysis of the data is in progress.

Project 7: Studies on inheritance pattern of selected wood traits in teak (*Tectona grandis* L.f.) [068/TFRI-2004/Gen-3 (9)/2004-2007]

Status: Wood core samples were collected from a 28 years old progeny trial consisting of nine families of teak at Chandrapur, Maharashtra. Data on height, girth and bark thickness were also collected from different teak progenies. Wood core samples were used to generate data on wood specific gravity and sapwood ratio among progenies of half-sib families. There was significant variation in height (range 5.00 - 18.5 m), girth (24 - 106 cm), heartwood percentage (20 - 77%) and wood specific gravity (0.53 - 0.73). Studies on inheritance pattern of wood traits revealed very high heritability values (77 %) for heartwood and sapwood. Specific gravity with 29 percent heritability, showed significant correlation with growth and other wood traits. Wood core samples collected from different progenies have been further processed for microscopic examination of length/diameter variations of vessels and fibres in progenies of half-sib families, which is in progress.

Project 8: Chemical investigations on biologically active chemicals of forest species and their utility for pest control [069/TFRI/2004/NWFP-1(19)/2004-2007]

Status: Isolated and estimated oil and anti-nutritional constituent, phytate in different provenances of Jatropha (*Jatropha curcas)*. Separated toxic fraction of Jatropha oil assessed for anti fungal and anti-bacterial activities against *Fusarium oxysporum, Alternaria alternata* and *Pseudomonas tectonae. J. curcas* seed oil was also derivatised and assessed for their physico-chemical properties.

Project 9: Evaluation of wild edible plants of central region for polysaccharides and other food value [070/TFRI/2004/NWFP-2(10)/2004-2007]

Status: Surveyed different parts of central region and collected wild edible fruits of Manhar (*Randia dumatorum*) and edible fungus Putpura (*Asterus hygromatricus*). Estimated different nutritional and anti-nutritional biochemicals.

Project 10: Evaluation of Management systems and level of community participation under Joint Forest Management (JFM) [071/TFRI-2004/Silvi-1(6)/2004-2007]

Status: Vegetation-cum-soil survey in Peoples Protected Area (PPA), (compartment No. 561) / Rehabilitation of Degraded Forests (RDF), (compartment No. 562)/Unprotected Forest (compartment No. 563) has been completed for study of ground flora, regeneration status etc. The data are being analysed for vegetation co-ordinates, Importance Value Index and Diversity Index and status of pH, organic matter, NPK in soils. Preliminary observations indicate that there is very good regeneration of ground flora, coppice growth and middle storey plants in PPAs followed by RDF areas. In unprotected areas heavy growth of *Lantana* sp., *Casia tora* and *Achyranthus* spp. was observed, which are not browseable by cattle. Only 10-12 old trees per ha of species of Salai, Dhawa and Gunja are found in unprotected area.

Project 11: Seed physiology of the tropical forest species with special reference to their maturity and storage [076/TFRI-2004/Silvi-2(7)/2004-2009]

Status: Protocol for better germination had been developed for three medicinal plants- *Rauvolfia serpentina, Emblica officinalis* and *Abelomoschus moschatus*. Preliminary studies on desiccation sensitivity tests on *Bassia latifolia* suggests its recalcitrant nature. Desiccation tolerance tests and storage experiments on *Emblica officinalis* and *Rauvolfia serpentina* proved their orthodox nature. Seeds of these two species were stored at different conditions for further studies. Studies on seed development is continued on *Mimusops elengi, Buchanania lanzan* and *Sapindus* spp.

Project 12: Development of decision support system for predicting suitability of tree species in various climatic conditions in central India [059/TFRI-2003/Misc-IT-1(1)/2003-2006]

Status: Information for 15 identified tree species have been collected as per designed data structure. Different forms viz. main form, query shell form, data display forms have been designed and codes have been written to generate these forms. Designed algorithm for retrieval of information. Codes are being written to execute these algorithm for the retrieval of information and function of system as a whole.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006

Project 1: Study on plant diversity in Sal -Teak ecotone zone as influenced by ecological and climatic changes [085/TFRI/2005/BD-2(5)]

Status: Preliminary survey was conducted to observe the general features of the ecotone zones. Collected compartment history and maps of the area. Quadrates were laid down in the ecotone zone area and the total number and girth of individual species of herbs, shrubs and trees were recorded. Soil samples from appropriate areas were collected from 0-5 cm and 5-15 cm depth. Chemical analysis for pH, EC, organic matter and available nutrients and microbial analysis is in progress.

Project 2: Documentation of traditional knowledge on ethnomedicinal information from traditional herbal healers (vaidyas, ojhas, guniyas) in central Madhya Pradesh [084/TFRI/2005/BD1(4)]

Status: Documentation of traditional knowledge on ethnomedicinal uses have been initiated from traditional herbal healers in districts of Bhopal, Sehore, Hoshangabad, Seoni and Jabalpur in central Madhya Pradesh. The traditional herbal healers have been enlisted from the tribal pockets. The medicinal plants used in cure of diseases such as fever, pain, diarrhea, dysentery, arthritic, paralysis, obesity, piles were recorded alongwith formulation prepared from medicinal plants.

Project 3: Studies on forest dwelling Braconids (Hymenoptera : Braconidae) from central India and their role in biological control of important forest insect pests [081/TFRI/2005/Ento-2(10)]

Status: Surveyed Jabalpur, Seoni, Chhindwara, Parasia, Mandla, Tikamgarh and Chhattarpur districts of Madhya Pradesh and 150 samples of insect fauna were collected by sweeping method. 106 Braconids were isolated and

preserved. 112 samples of leaf miners of *Pongamia pinnata*, *Dalbergia sissoo* and *Lagerstroemia parviflora*; teak skeletonizer, and bamboo leaf roller were collected from different localities. *Apanteles machaeralis* Wilkinson and *Apanteles tachardiae* Cameron were emerged from the larvae of teak skeletonizer; *Parahormius deiphobus* Nixon and *Hormius* sp. were emerged out from the larvae of *Corcyra cephalonica* and *Meteorus dichomeridis* Wilkinson was emerged out from the larvae of *Crypsiptya coclesalis*.

Project 4: Effect of microbial inoculants on Safed Musli (*Chlorophytum borivillianum*) [082/TFRI-2005/Path-1(11)]

Status: Survey was conducted for germplasm collection of safed musli from Chhindwara and Saunser. Collected healthy propagules of Safed Musli and raised in nursery of forest pathology division. *Fusarium* and one fluorescent bacteria were isolated and purified from rhizopsphere of safed musli plants. Further work on application of different biofertilizers and soil conditions is under progress.

Project 5: Evaluation, modification and value addition of starches of forest origin [083/TFRI/2005/NWFP-2(13)]

Status: Fruits of *Careya arborea* were collected from 4 localities namely Bargi, Barela, Kundam and Mandla, M.P in the month of July-August. The fruits were peeled and seeds extracted, which were used directly for extraction of starch. In another case seeds were used after removal of testa. Seeds of *C. arborea* were found to have 7.2% testa and 92.8% endosperm. Ammonium oxalate resulted in maximum yield of starch, 34.09% in seeds with testa and 47.38% in seeds without testa.

Fruits of Careya *arborea*

Seeds of *C. arborea* imbedded in the fruits
(left) seeds of *C. arborea* (right)

Project 6: Sustainable management of medicinal plants in JFM areas in different agroclimatic zones of Madhya Pradesh [079/TFRI/2005/Silvi-1(8)]

Status: Study sites in JFM areas having richness of medicinal plants species namely, Kalmegh, Satawar, Surpgandha and Safed musli were selected for laying out sample plots for sustainable harvesting/management. JFM sites having

richness of Kalamegh at Satnur Forest under Sawni Forest Range was selected. The selected area measures about is 1.5 ha having 27 fruits bearing trees and 145 trees without fruits.

Project 7: Standardization of nursery techniques of *Strychnos nux-vomica* and *Strychnos potatorum* [080/TFRI/2005/Silvi-2(9)]

Status: Two sites i.e. Sahanikhar, Saankara Forest Range, Dhamtari Forest Division were identified and selected for *S. nux-vomica* and Khutama Forest Range, South Forest Division, Chhindwara was identified and selected for *S. potatorum*. Seeds of *S. nux-vomica* were collected in the month of December 2005. Seeds of both the species were dried under room temperature and stored in airtight tin container. After viability test in laboratory seeds were sown in the nursery beds under different physical, chemical and hormonal treatment in the last week of March 2006. Proper watering and insecticidal spray are maintaining during experiment.

PROJECTS COMPLETED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Screening and identification of teak of Madhya Pradesh for resistance against major insect pests [034/TFRI-2001/Ento-1 (MPCST) (4)/2001-2005]

Findings: Out of 150 teak clones of MP origin, planted in teak seed orchards located at Behrai and Nanditola (Seoni), State Forest Research Institute and Tropical Forest Research Institute campus and Barha (Jabalpur) of Madhya Pradesh, 24 clones, viz, C 2, 3, 4, 8, 9, 11, 54, F-1, G-1, K-1, PT-1, 26, 41, 45, 46, 47, BLC-4, 11, CSC-9, SKC-2, 3, 4 and 11 were found to be highly resistant against teak defoliator, *Hyblaea puera* and skeletonizer, *Eutectona machaeralis*. The early, early-mid leaf flushing teak clones showed less damage intensity of teak defoliator and skeletonizer compared to mid, mid-late and late leaf flushing clones. Early leaf flushing clones with good growth and resistance to pests may be used for large-scale plantation.

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Taxonomy and documentation of fungi occurring in forest of Madhya Pradesh and Chhattisgarh [061/TFRI-2003/Path-1(CSIR)(7)/2003-2006]

Status: Surveys were conducted in the forests of Betul, Harda, Shadol, Dindori, Jagatpur, Umariya, Rewa, Raipur, Sidhi, Jahbua, Mandau, Sardarpur, Raisen, Katthiwara and 243 plants and 58 soil samples were collected. 50 genera belonging to different groups have been recorded from the collected plant samples. 7 genera and many unidentified forms were also recorded from soil samples. 10 different species of AM fungi were identified from soil samples. Description of 91 fungi was written and camera lucida drawings of 65 fungi were also prepared. Photographs of 216 specimens and microphotographs of 108 fungi were taken. Herbarium of 511 plant samples and culture of 149 fungal isolates are maintained. An ascomycete genus on *Dendrocalamus strictus* is found new. In addition to this, 11 species belonging to different genera were found new to science, 5 species were new fungal record for India and 19 species were new host record.

Project 2: Studies on refinement and scaling up of existing micropropagation and macropropagation technologies for *Bambusa nutans* and *B. tulda* [063/TFRI-2004/Gen 1 DBT (7)/2004-2007]

Status: *Micropropagation*:

***Bambusa nutans*:** Three liquid basal nutrient media, viz., Murashige and Skoog, Gamborg's B_5 and Llyod and McCown's Woody Plant Medium enriched with BA (7 mg l^{-1}) and IAA (0.5 mg l^{-1}) were tried over four consecutive subculture cycles each of 15 days. The subculture cycle had a significant effect on the rate of shoot multiplication whereas basal media and their interaction with subculture cycle was non-significant for shoot multiplication. The carbon sources (3% werose) significantly affected shoot length.

In a two-way factorial experiment among four carbon sources (sucrose, lactose, fructose and glucose at 3 %), 5 levels of cytokinin BA (0, 1.0, 3.0, 5.0 and 7.0 mg l^{-1}) and 4 levels of auxin IAA (0, 0.1, 0.5 and 1.0 mg l^{-1}), MS medium supplemented with 7.0 mg l^{-1} BA and 0.5 mg l^{-1} IAA optimally produced 3.18 fold shoots. Another factorial experiment comprising 5 levels of BA (0, 5.0, 7.0, 9.0 and 11.0 mg l^{-1}) and 4 levels of adenine sulphate (0, 5.0, 10.0 and 15.0 mg l^{-1}) at uniform 0.5 mg l^{-1} IAA, maximum shoot multiplication was obtained on medium supplemented with 9.0 mg l^{-1} BA. Addition of adenine sulphate in the medium did not have any significant effect on shoot multiplication, but significantly enhanced the shoot length.

Bambusa tulda: For *in vitro* shoot multiplication, a propagule (bunch of three axillary shoots) was inoculated on MS liquid medium supplemented with 100µM glutamine, 1µM IBA and different concentrations of BA (0.0, 9.0, 12.0 and 15.0µM) alone or in combinations with adenine (0.0, 50.0 and 100.0 µM). A maximum of 2 fold shoot multiplication rate at 15 days sub-culture cycle was obtained on medium enriched with BA 12µM and 15µM alone or BA (9 µM) adenine (100 µM). The presence of cytokinins significantly inhibited the extension growth of shoots.

In vitro rooting

B. nutans: Two sets of experiments on *in vitro* rooting were carried out with propagules of 3-4 shoots. In the first experiment, MS liquid medium containing different auxin sources (IAA, IBA, NAA or IPA at 15 M) or a commercial formulation (VIB-333 at 3 ppm) were tested for their effect on rooting percentage, number of roots per propagule and root length. The rooting medium was changed after an interval of one month and observations were noted after two months. Various auxins did not show significant variation in rooting response but IBA and NAA maximally produced 60 % rooting and roots per propagule (2.22). However, the root initiation took 10-20 days in control, IBA, IPA and VIB 333 but 23- 29 days in IAA and NAA supplemented medium. In the second experiment, different doses of IBA (0, 5, 10, 15, 20 and 25 M) were tested for induction of rooting. MS liquid medium supplemented with 25 M IBA produced 78 % rooting and was on par with 20 M IBA.

***B. tulda*:** Two sets of experiments were conducted for *in vitro* adventitious rooting. MS medium was supplemented with 0.0, 10.0, 15.0 and 20.0 µM IBA in the first experiment and 0.0, 10.0, 20.0, 30.0 and 40.0 µM coumarin in the second experiment, taking 2-3 shoots (>2.0 cm length) from 10th subculture onwards. The higher rooting was obtained on 20 µM IBA (60 %) in the first experiment and 40 µM cumarin (98 %) in the second experiment.

Hardening and acclimatization: The plantlets of both bamboos (*B. nutans* and *B. tulda*) were transferred to root trainers containing sterile soilrite and compost mixture soaked with half strength MS nutrient medium (organic free) and kept in culture room for one week, followed by shifting to polybags containing soil, sand, and FYM in 1:1:1 proportion in shade house. This process of hardening resulted in around 90 % survival in *B. nutans* and 95 % survival in *B. tulda*.

Macropropagation: Material for propagation was collected from identified superior clumps of both species, i.e. *B. nutans* (Kalimati, Sambalpur, Orissa) and *B. tulda* (Ghatikia, Bhubaneshwar, Orissa).

Three types of single culm nodes i.e. full, split and strip cuttings were prepared and administered for 24 h with 0, 1, 2 and 3 mM of five growth regulators (IAA, IBA, coumarin, boric acid and thiamine). Root induction did not take place in *B. tulda*. However adventitious rhizogenesis and flowering was simultaneously recorded in *B. nutans*.

Micropropagation of *Bambusa nutans* and *Bambusa tulda*. (a) Shoot multiplication, (b) *In vitro* rooting, (c) Hardening of plantlets in root trainers and (d) Plantlets in polybags

Full and Strip cuttings exhibited better rooting than split cuttings. Full node cuttings also produced maximum number of roots. The influence of the growth regulators and their molar doses was not significant. Significant interaction of growth regulators and nature of cuttings was recorded for rooting. The best rooting occurred in full node cuttings treated with thiamine or coumarin. Strip cutting treated with coumarin, boric acid and IAA also enduced rooting. Interaction of treatment doses and nature of cuttings was significant for rooting and root number. Strip and full cuttings in control exhibited the best root induction while treatment of full node cuttings with 0 or 1 mM growth regulators resulted in superior root numbers. Three-way interactions of growth regulators, molar doses and nature of cuttings were non significant for adventitious rhizogenesis. The maximum rooting (40.6%) was recorded in strip cuttings treated with 3 mM IAA followed by split cuttings treated with 1 mM thiamine (40.3%). Flowering was not significantly influenced by nature of cuttings, growth regulators, molar doses and 2 and 3 way interactions except full node control exhibiting the 17.5% flowering. Overall, 3 mM boric acid treatment of split cuttings provided maximum flowering. Flowering and rooting in culm cuttings appeared to be independent phenomenon as rooting did not correlate with flowering.

Adventitious rhizogenesis and flowering in B. nutans
(a) Preparation of cuttings, (b) Treatment with growth regulators,
(c) Planting in sand beds, (d) Sprout emergence in beds,
(e) Flowering induction, (f) Closer view of flowering, (g) Rooted full node cuttings, (h) Rooted split cuttings and (i) Rooted Strip cuttings

Project 3: National network on integrated development of Jatropha and Karanj [073/TFRI-2004/NWFP-3(NOVOD)(11)/2004-2007]

Status: Twenty five CPTs of *Jatropha curcas* were selected from 3 agroclimatic regions of Madhya Pradesh. Twelve Thousand seedlings/plantlets were raised from the collected superior material. National trial of Jatropha comprising of 19 accessions from 8 participating institutes and zonal trial of 14 accessions received from 6 participating institutes has been established at the institute campus. A progeny trial comprising of 20 families has been established at Chhindwara. Study has been initiated to standardize cultivation practices of Jatropha for central India at the institute campus to optimize spacing, fertilizer/manure doses, time of plantation, method of plantation sowing, age of seedlings, etc. Jatropha seedlings have been planted at 4x3 m spacing and lentil was grown as inter crop to establish agroforestry model. Fatty oil was extracted and its yield was estimated to identify the elite trees of Jatropha. The oil percentage varied from 18.20% to 42.50% from the seeds collected from various agroclimatic regions of the study area.

Forty three CPTs of *Pongamia pinnata* (Karanj) were selected from 5 agroclimatic regions of Madhya Pradesh. Four thousand Seedling were raised in nursery from the selected superior planting material. The collected

seeds were tested for its germination. Maximum germination percentage was recorded in Kusmeli, Chhindwara while minimum was in Satna town. A national trial comprising of 5 accessions received from two institutions and zonal trial comprising of 12 accessions from six participating institutions has been established at the institute campus. A progeny trial comprising of 20 progenies has been established at Bhandamuri, Balaghat. Karanj seedlings have been planted at 6 x 5 m spacing to develop a agroforestry model. Lentil was planted as agriculture crop. All the seed samples were analyzed for fatty oil content. 16 seed samples were sent to NBPGR, New Delhi for cryo-preservation.

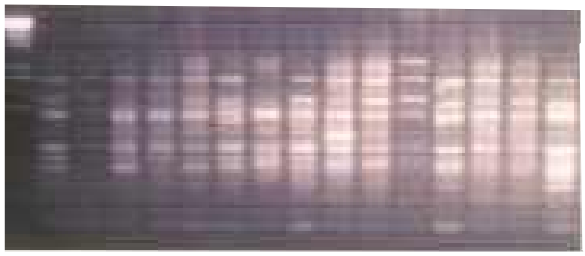
Project 4: Study of sal mortality in forest divisions of Chhattisgarh [074/TFRI-2004/Patho-3(CGFD)(10)/2004-2005]

Status: Mortality occurring in East Raipur and Udanti Van Mandal was studied. The status of mortality has been recorded in different ranges under these divisions. The sal in these areas is maintained on coppice system basis and most of the crop is in second and third rotation. There is 60% heart-rot in the affected trees. The swollen bole and punk knots are the indicators of heart rots, which have been observed in the affected trees.

The soil and leaf samples were collected from the affected and healthy trees for analysis of NPK and heavy metals. The analysis work is in progress. The ecto-mycorrizhal development was also recorded in the healthy trees as well as one year old seedlings. Mycorrzhizae were characterised by monopodial light brown is smooth, to whitish corolloids roots attached with the main root of the seedlings.

Project 5: Studies on cataloguing the genetic variability in teak species using molecular markers [052/TFRI-2003/Gen-1(DBT) (6)/2003-2006]

Status: Inter Simple Sequence Repeat (ISSR) markers were used to study the DNA polymorphism for development of DNA fingerprint profiles in genotypes of *Tectona grandis* and *T. hamiltoniana*. Amplification of genomic DNA of 49 genotypes yielded 53 bands using five ISSR primers. Number of amplified fragments ranged from 8 to 13 and varied in fragment size from 70 bp to 8900 bp. All the five ISSR primers generated hundred percent polymorphic bands in 49 teak genotypes. Numerous plus tree specific bands/markers were generated in ISSR study, which could distinguish *T. grandis* and *T. hamiltoniana* genotypes. ISSR profiling generated specific marker for MHALP4 (6191bp) and WB (3255bp and 881bp). For *T. hamiltoniana* genotype, four specific markers were generated. With reference to AFLP assay, use of 4 primer combinations produced 276 clearly scorable bands which could clearly



ISSR fingerprints of plus tree of T. hamiltoniana

DNA fingerprint of teak (*Tectona grandis*) plus trees and *T. hamiltoniana* generated through AFLP technique.

distinguish all candidate plus trees. The results of ISSR and AFLP assays indicate high levels of genetic variation among selected genotypes of teak. Dendrograms generated using UPGMA clustering method of ISSR and AFLP data clustered the teak genotypes into different groups. Studies have also been initiated on assessment of genetic variation within and among populations of teak collected from various natural forests and old plantations using RAPD, ISSR and AFLP markers.

Project 6: Developing coalition approach to non-timber forest produce for better livelihoods of tribal communities of M.P. [053/TFRI-2003/Agro (1) DFID (10)/2003-2005]

Status: Harvested baisakhi lac crop from its host trees i.e. *Butea monosperma*. Arranged disposal of lac produce through bye-back policy, which was initiated by TFRI for the members of SHGs of four pre-selected villages of Kundam block (Jabalpur). Besides, the above described lac host, another host (agri species- *Cajanus cajan*) also used for lac cultivation. On the basis of this study, an Agri-lac culture model was developed.

Further inoculation of lac on the host trees - Palash, Ber and Ficus species were carried out for obtaining IInd crop of lac. The work on lac production is on progress.

Mahua was stored in traditional bins in each member's house. These bins were lined with plastic sheets so that Mahua is protected from moisture. The quality of this stored Mahua was tested by Sadashiv and Manicam method, and it was found that sugar percentages was higher than the sugar percent stored in traditional bins. For value addition of Mahua, the dust free collection of Mahua was carried out to prepare Mahua kishmish.

Project 7: Standardization of production technology of some important medicinal plants under

Women busy with scraping of lac

Dust free collection of Mahua

Rangini lac on Palash

tropical climate of Madhya Pradesh [055/CFRHRD/2003-2006]

Findings: Germplasm of Sarpagandha (*Rauvolfia serpentina*), Giloe (*Tinospora cordifolia*), Gurmar (*Gymnema sylvestre*) and Kalmegh (*Andrographis paniculata*) were collected from different parts of Madhya Pradesh and conserved in NWFP nursery of the institute. Non-destructive harvesting technique of Sarpagandha was standardized. Harvesting time for Aonla fruits was standardized for tropical climate of central India. Major active ingredients viz. ascorbic acid, tannins and other phenolic acids in Aonla fruits; total alkaloids and reserpine in sarpagandha roots;

andrographolide in Kalmegh (*Andrographis paniculata*); gymnemic acid in Gurmar were estimated. Aonla fruits harvested during January are of superior quality in respect of ascorbic acid whereas gallic acid content was found to be highest in the fruits harvested in mid November. Green chip cutting (grating) and drying in shade was found to be the best method for the processing of Aonla. Roots harvested in the month of December were found to contain maximum amount of total alkaloids. For Kalmegh best harvesting period was found between 100-120 days after planting as it contains maximum andrographolide (1.67%). Standardized manural doses and irrigation schedule for the cultivation of Sarpagandha, Gurmar, Kalmegh and Giloe. Quality planting materials of Kalmegh, Sarpagandha, Aonla, Giloe and Gurmar were distributed to farmers and forest departments.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Identification of species and ethnobotanical survey [088/TFRI/2005/BD3(CGMFD)6]

Status: Survey in the People's Protect Area (PPA) earmarked in forests of Chhattisgarh at Bilaspur (Lamni), Dhamtari (Jabarra and Shankra), Pendra Road (Marwahi, Kevanchi), Kondagaon (Makdi), Jagdalpur (Karpavan, Machkot, Guriya) and Bhanupratappur (Antagarh) was conducted. The preliminary observations on vegetation status were recorded. Quadrate study has been initiated for documenting floral wealth and increasing or decreasing trend of important forestry species in the area. Vegetational records of PPA for tree species with girth class, regeneration status of major tree species and medicinal plants available in the area were recorded from previous survey records. Tabulation and calculation of these data for trees in different girth classes, number of species with total basal area, regeneration figures of major tree species in different years; identification of medicinal plants and other species were conducted.

Project 2: Identification of suitable tree species and other vegetation for biodrainage in Bargi command area (Jabalpur, M.P.) [087/TFRI/2005/Ecol-1 (MOWR)7]

Status: Suitable sites having 10 ha area has been selected along the left bank canal of Bargi command area for experimentation and plantation of forest tree species. Existing vegetation of the selected sites was surveyed. Soil and water samples from the sites were collected and analysed for their quality. Meteorological data of the area including maximum and minimum temperature, relative humidity, rainfall, atmosphere pressure, solar radiation, wind speed and wind direction were collected for the last 10 years. Design and technical specifications of the instruments including lysimeters, piezometers, infiltrometer and pan evaporimeter were collected for the construction and installation at plantation sites and in the institute. Existing cropping pattern of the area was studied.

Project 3: Introduction of egg parasitoid *Trichogamma raoi* to protect teak seed orchards from the loss caused by teak leaf defoliator and skeletonizer [086/TFRI/2005/Ento-3(MPFD)11]

Status: Teak seed orchards at Jabalpur, Behrai, Betul and Hassanpura near Nepanagar were selected. 1.25 lakh wasps of egg parasitoid, *Trichogramma raoi* per hectare were liberated in 4 installments between July to October to parasitize the eggs of teak defoliator and skeletonizer. The intensity of insect attacked in parasitoid liberated sites were compared with non-liberated nearby sites in the month of December.

Project 4: Standardization of sustainable harvesting practices of arjuna (*Terminalia arjuna)* bark [078/TFRI/2005/NWFP-1(MPFED)12]

Status: Surveys were conducted in Balaghat district of Madhya Pradesh to select Arjuna growing areas. Arjuna trees of different age group and girth size were selected for laying out the experiments. The experiments were laid out in the forest areas of Balaghat as well as in the farmer's field for the extraction of bark. The girth of selected trees at breast height ranged between 77-228 cm. Bark thickness at breast height ranged from 8.12 to 20.96 cm. Mean bark thickness at breast height in Arjuna trees was 15 mm. Mean bark yield per square centimeter ranged between 0.27 gm to 1.14 gm and found varying from tree to tree. The tannin content ranged from 6.76 to 14.29 gm per 100 gms. The amount of oxalic acid in the bark ranged between 11.54 gm to 20.05 gms per 100 gms. Regular field observations were taken on the recovery of bark. The stage of bark recovery (regrowth) varied from tree to tree. Extraction of bark can be done after two years from the opposite size of the blaze which will not damage the tree.

Project 5: Standardization of non-destructive harvesting practices of Arjuna (*Terminalia arjuna)*, Maida (*Litsea chinensis*) and Ashoka (*Saraca indica*) bark [096/TFRI/2005/NWFP-8(CGMFD)19]

Status: Surveys conducted in Dhamtari, Kanker, Raipur districts of Chhattishgarh to select the Arjuna, Maida and Ashoka growing areas in the state. Experiments were laid out in the forest area of Dhamtari and Kanker for non-destructive harvest of Arjuna and Maida bark. Bark samples were analyzed for tannin and oxalic acid content.

Project 6: Standardization of non-destructive harvesting practices of Aonla (*Emblica officinalis*), Baheda (*Terminalia belerica*) and Baividang (*Embelia ribes*) fruits [097/TFRI/2005/NWFP-8(CGMFD)20]

Status: Baividang, Aonla and Baheda growing areas were selected in the Dhamtari and Kanker forest division of Chhattishgarh state. Experiments were laid out in field for the non-destructive harvest of Baividang, Aonla and Baheda fruits. Aonla and Baheda fruits were analysed for their major active ingredients.

Project 7: Non-destructive harvesting practices for selective MFP- Nagarmotha [094/TFRI/2005/NWFP-6(CGMFP)17]

Status: Surveyed and field experiment was laid out at Hagaria nala and Hafnadi Bisasara ghat, Pandaria Kawardha range, Kharragarh. From the experimental plot 60%,70%, 80% and 90% Nagarmotha plants was uprooted and evaluated. Nagarmotha rhizomes were removed, cut into small peaces and essential oil was extracted by steam distillation using Clevenger apparatus.

Project 8: Processing techniques of NWFP- *Aegle marmelos* (Bael) [095/TFRI/2005/ NWFP-7(CGMFP)18]

Status: Surveyed and collected both unripe and matured fruits of *Aegle marmelos* from Baroda, Pandaria, Khairagarh forest division, Kawardha Chhattisgarh. The fruits were processed using 5 different methods. The pulp from the kernel were separated and dried. The powder of the pulp was prepared and chemically analysed.

Project 9: Processing techniques of NWFPs of Chhattisgarh *Madhuca latifolia, Shorea robusta, Schleichera oleosa, Pongamia pinnata* and *Buchanania lanzan* Spreng (Chironjee) [091/TFRI/2005/NWFP-3(CGMFP)14]

Status: Surveyed different regions of Chhattisgarh for the collection of experimental materials of the selected species.

Project 10: Non-destructive harvesting practices for selective MFP- *Buchanania lanzan* Spreng (Chironjee) [092/TFRI/2005/NWFP-4(CGMFP)15]

Status: Surveyed different areas of Chhattisgarh and selected sites to conduct experiments from April 2006 onwards when the fruits starts ripening.

Project 11: Quality assessment of NWFPs from different regions of Chhattisgarh Species- *Asparagus racemosus, Buchanania lanzan, Emblica officinalis, Embelia ribes* and *Andrographis paniculatus* [093/TFRI/2005/NWFP-5(CGMFP)16]

Status: Surveyed different regions of Chhattisgarh. **C**ollected Satawar and Kalmegh, and also soil samples where the above species are growing. Collected samples were processed and analysed physical parameters.

Project 12: Training of societies in collection and grading of NWFPs in Chhattisgarh [090/TFRI/2005/Agro-2(CGMFD)13]

Status: Training imparted to the forest officials and VFC members of following districts namely, Bilaspur, Kathghora, Korba, Pendra, Dharamjaigarh, Janjgir, Raigarh, Durg, Rajnandgaon, Khairagarh, Kawardha, Raipur, Mahasamund, Dhamtari, East Raipur (Gariyaband) and Udanti Van Mandal (Mainpur) of Chhattisgarh on "Cultivation and processing of Lac and Medicinal Plants".

Training on collection and processing of medicinal plants for VFC members and forest officials of Korba, Raipur, Bilaspur divisions (Chhattisgarh)

Project 13: Documentation of best practices in collection and processing of NWFPs in Chhattisgarh [089/TFRI/2005/Agro-2 (CGMFD)13]

Status: Documented best practices in collection and processing of NWFPs in following districts namely, Bilaspur,

Kathghora, Korba, Pendra, Dharamjaigarh, Janjgir, Raigarh, Durg, Rajnandgaon, Khairagarh, Kawardha, Raipur, Mahasamund, Dhamtari, East Raipur (Gariyaband) and Udanti Van Mandal (Mainpur) of Chhattisgarh.

Project 14: Sustainable yield assessment/harvesting of Non Wood Forest Produce (NWFP) in People's Protected Areas (PPAs) of Chhattisgarh [098/TFRI/2005/ Silvi-3 (CGMFD)10]

Status: Sample plots were laid out for Satawar and Kalmegh at Matchkot Forest Range, Jagadalpur Forest Division for Malkagani at Sankra Range Dhamtari Forest Division and Bael at Gandai Range, Khairagarh Forest Division. As per experimental design Satawar and Kalmegh were harvested and their fresh and dry weights were taken.

Project 15: Nursery techniques for mass multiplication of superior seedlings of Baivadang, Sarpgandha, Chironjee, Arjun, Aonla and Bael in Chhattisgarh [099/ TFRI/2005/Silvi-4 (CGMFD)11]

Status: Literature has been collected from different sources i.e. universities, institutes, and internet. Seeds of Aonla and Sarpgandha have been collected from reliable sources for conducting experiments in order to establish standardized nursery techniques of test species

Project 16: **Screening of indigenous species of Trichogramma Westwood and Trichogrammatoidea Girault (Hymenoptera: Trichogrammatidae) from central India and their utilization against important forest insect pests [077/ TFRI / 2005/ Ento-(1)(DST)9]**

Status: Surveyed Jabalpur, Chhindwara, Parasia, Mandla, Tikamgarh and Chhattarpur districts of Madhya Pradesh and 245 specimens belonging to the genera: Trichogramma and Trichogrammatoidea were collected.

Five species of Trichogramma viz., *T. plasseyensis* Nagaraja, *T. agriae* Nagararaja, *T. raoi* Nagaraja, *T. semblidis* (Aurivillius) and *T. pallidiventris* Nagaraja and one species of *Trichogrammatoidea* viz., *T. armigera* Nagaraja identified. *Trichogramma plasseyensis* Nagaraja and *T. raoi* Nagaraja were also collected from the fields by keeping the *Corcyra cephalonica* eggs as fictitious eggs. Culture of *Corcyra cephalonica* was maintained for the use of their eggs as laboratory host / fictitious eggs.

Project 17: Monitoring of compensatory afforestation done under NVDA and monitoring of FDA work in north and south Betul of M.P.

Status: To evaluate the work done under NVDA and FDA scheme in various districts of Madhya Pradesh, visited and collected data from Khandwa, Khargone Badwani and Burhanpur under NVDA scheme and also visited north and south Betul for monitoring of FDA work.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	3	12	7
External Projects	1	7	17
Total	4	19	24

EDUCATION AND TRAINING

Training organized

1. Training imparted to the forest officials and VFC members of following districts namely, Bilaspur, Kathghora, Korba, Pendra, Dharamjaigarh, Janjgir, Raigarh, Durg, Rajnandgaon, Khairagarh, Kawardha, Raipur, Mahasamund, Dhamtari, East Raipur (Gariyaband) and Udanti Van Mandal (Mainpur) of Chhattisgarh on Cultivation and processing of lac and medicinal plants.
2. Training imparted to the forest officials on Agroforestry systems and its benefits at Tala, Badhavgarh on 11th December 2005, 5th February 2006, 5th March 2006 and 25th March 2006.
3. Training imparted to forest officials and VFC members of Mandla districts on Lac Cultivation at Tropical Forest Research Institute, Jabalpur from 29th to 31st March 2006.
4. Training imparted to the farmers and forest officials of Jabalpur, Narsinghpur and Dindori districts of Madhya Pradesh on agroforestry models for central India at Tropical Forest Research Institute, Jabalpur from 15th to 17th February 2006.
5. Organized an exhibition on Promoting technology development, utilization and transfer in Mahakoshal region at this institute on 6th January 2006.
6. Training provided on Lac Cultivation to the forest officials and villagers of Singpur (Satna) on 16th June 2005.
7. Training organized for M.Sc students in the month of July to December 2005 on biotechnology, biochemistry and tissue culture.
8. Training organized for VFC members in Chhattisgarh State at Bilaspur, Dharamjaigarh, Raigarh, Khatgoda, Korba, Champa, Janjgir, Durg, Pendra, Rajnandgaon, Khairagarh, Raipur, Dhamtari and Gariyaband on MFP collection and processing.
9. Training programme organized on improvement, biofertilizer insect pest management, cultivation, processing and value addition of medicinal plants for field executives of Maharashtra Forest Department at CFRC, Chandrapur.
10. Three days training programme was organized on improving forest productivity through technological interventions from 15th to 17th February 2006 for the field executives of M.P. Forest Department.

LINKAGES AND COLLABORATION

· Developed linkages and collaboration with state forest departments, forest development corporations and minor forest produce federations of central Indian states; local universities and institutes, TERI etc. for conducting field surveys, field experiments and utilization of specialized laboratory facilities.

Pamphlet

· Pamphlets containing information about MFP collection, processing, value addition and marketing etc were published for the following species: (i) *Emblica officinalis,* (ii) *Termarindus indica,* (iii) *Buchnania lanzan* and (iv) *Madhuca indica* (Flowers and seeds).

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Attended

1. A.K. Mandal attended the XII Silvicultural Conference held at FRI, Dehradun from 1st to 3rd February 2006 and presented the outcome of meeting of the group of researchers of central Indian states.
2. Jamaluddin attended the XII Silvicultural Conference held at FRI, Dehradun from 1st to 3rd February 2006 and presented a paper entitled Effect of fire on microbial status and physicochemical properties of soil in teak plantations.
3. R.K. Verma attended the National Conference on Tree Biotechnology : Indian Scenario held at TFRI, Jabalpur on 9th and 10th February 2006 and presented a paper entitled Interaction of AM fungi and Azospirillum enhances growth, survival and nutrient uptake in teak seedlings.
4. Jamaluddin attended the Global Conference of Society of Mycology and Plant Pathology at Udaipur from 25th to 29th November 2005 and presented a paper entitled Problem of diseases in multipurpose tree species and medicinal plants in central India.
5. Nanita Berry attended jkT; Lrjh; lxk"Bh e/; izn'ke esa vk"k/kh; Qlyksa dh 0;olkf;d df"k] izlLdj.k ,oa foi.ku dh {kerk ,oa lHkkouk;sa held at JNKVV, Jabalpur on 25th and 26th October 2005.
6. N. Kulkarni attended National Conference *Biopesticides:* Emerging trends BET 2005 organized at Palampur (H.P.) from 11th to 13th November 2005 and presented a paper entitled Efficacy of *Beauveria bassiana* and *Metarrhizium anisopliae* against white grubs of *Holotrichia rustica* Brim (Coleoptera: Scarabaeidae).
7. N. Kulkarni attended International Conference on Biodiversity of Insects: Challenging issues in management and conservation (BIMC, 2006), at Bharathiar University, Coimbatore from 30th January to 3rd February 2006 and presented a paper entitled Incidence of white grubs, *Schizonycha ruficollis* (Fab.) (Coleoptera: Scarabaeidae) on teak seedlings at Nagpur, Maharashtra and its management.
8. Fatima Shirin attended National Conference on "Tree Biotechnology: Indian Scenario" held at TFRI, Jabalpur on 9th and 10th February 2006 and presented a paper entitled “Efficient *in vitro* plantlet production of *Bambusa nutans* Wall. and *Bambusa tulda* Roxb.”
9. C. Narayanan attended National Conference on Tree Biotechnology: Indian Scenario” held on 9th and 10th February 2006 at Tropical Forest Research Institute, Jabalpur and presented a paper entitled “Molecular profiling of teak plus trees using RAPD marker system and its application for maintenance of germplasm collection and evaluation of genetic diversity”.

10. S.A. Ansari attended National Conference on Tree Biotechnology: Indian Scenario" held on 9th and 10th February 2006 at Tropical Forest Research Institute, Jabalpur and presented a paper entitled "Molecular profiling and genetic relationship of teak (*Tectona grandis*) plus tree accessions and *T.hamiltoniana* using amplified fragment length polymorphism markers".
11. A.K. Mandal attended Regional workshop on Recent advances in teak research and management in central India held on 17th and 18th March 2006 at FDCM, Nagpur and chair a technical session on tree improvement.
12. Nanita Berry attended a workshop on Management and extension activities in the forestry sector on 14th and 15th September 2005 at TFRI, Jabalpur and presented a paper entitled Agri-lac culture: an innovative agri model.
13. Sharad Tiwari attended National Workshop on Forestry Extension held at TFRI, Jabalpur on 14th and 15th September 2005 and presented a paper entitled "Role and potential of decision support system in forestry extension services".
14. N. Kulkarni attended Regional workshop on Recent advances in teak research and management in central India organized by Forest Development Corporation of Maharashtra, Nagpur on 17th and 18th March 2006 and presented a paper entitled "New species of white grub, their menace on the seedlings of teak (*Tectona grandis* L. f.) and their management: an experimental study" at Ramdongari Forest Nursery, Nagpur.
15. Jamaluddin attended workshop on recent advances in teak research and management in central India held at FDCM, Nagpur on 17th and 18th March 2006 and presented a paper Diseases of teak in central part of India.
16. P. H. Chawhaan attended Regional workshop on management of extension activities in the forestry sector held on 14th and 15th September 2005 at TFRI, Jabalpur and presented a paper entitled "Do tree improvement activities pays? Evidence based research and implications for extension".
17. P.H. Chawhaan attended Regional workshop on Recent advances in teak research and management in central India held on 17th and 18th March 2006 at FDCM, Nagpur and presented a paper entitled "Half-sib genetic analysis of growth parameters in teak (*Tectona grandis* L.f.) of Maharashtra and Madhya Pradesh origin".
18. Sanjay Singh attended Regional workshop on Recent advances in teak research and management in central India held on 17th and 18th March 2006 at Nagpur and presented a paper entitled "Cloning of *Tectona grandis* : Procedures and economics".
19. N. Roychoudhury attended National Symposium on Environment and Development held on 16th and 17th January 2006 at EPCO, Bhopal and presented a paper entitled "Insect epidemic and its threat in deterioration of forest cover: A cause of environmental degradation".
20. N. Roychoudhury attended National Symposium on Biotechnology and insect pest management held on 2nd and 3rd February 2006 at Entomology Research Institute, Loyola College, Chennai and presented a paper entitled "Tree resistance to insects: A biotechnological method of forest insect management".
21. Jamaluddin attended National Symposium on Conservation and management of threatened medicinal plants held from 23rd to 25th February 2005 at SFRI, Jabalpur and presented a paper entitled "Effect of VAM and bacterial Biofertilizers on growth and development of *Chlorophytum borivillianum"*.
22. V.S. Dadwal attended National Symposium on Conservation and Management of Threatened Medicinal Plants held at SFRI, Jabalpur from 23rd to 25th February 2005 and presented a paper entitled "An improved technique for germination of *Strychnos potatorum* seeds".
23. S.A. Wali attended National symposium on plant Biotechnology: New Frontiers held from 18th to 20th November 2005 at Central Institute for Medicinal and Aromatic Plants, Lucknow and presented a paper entitled "Influence of plant material and methods on yield, quality and suitability for ISSR-PCR analysis of extracted DNA in teak (*Tectona grandis* L.f.)".
24. Fatima Shirin attended National Symposium on Plant Biotechnology: New Frontiers at CIMAP, Lucknow

from 18th to 20th November 2005 and presented a paper entitled "*In vitro* propagation of *Bambusa nutans* Wall. using nodal explants from mature culms".

25. C. Narayanan attended National symposium on plant Biotechnology: New Frontiers held from 18th to 20th November 2005 at Central Institute for Medicinal and Aromatic Plants, Lucknow and presented a paper entitled "ISSR profiles as molecular genetic markers for plus tree identification and diversity analysis and phylogenetic relationship in teak (*Tectona* spp.)".
26. A.K. Pandey attended Seminar on Prospects and potential of commercial cultivation, processing and marketing of medicinal and aromatic plants on 25th and 26th October 2005 at JNKVV, Jabalpur and presented a paper entitled "Commercial cultivation of Sarpagandha (*Rauvolfia serpentina*)".
27. Jamaluddin attended Seminar on Recent advances in forest sciences on 30th and 31st January 2006 held at G.G. University, Bilaspur and presented a paper entitled "Disease management in forest trees in central India".
28. Rajiv Rai attended National Seminar on Environment and Development organized by EPCO Bhopal on 16th and 17th January 2006 and presented a paper entitled "Ethnomedicinal studies in Pachmarhi Biosphere".
29. Sanjay Singh attended National Seminar on Plant physiology, crop productivity and quality improvement through physiological interventions held from 23rd to 25th November 2005 at Navsari, Gujarat and presented a paper entitled "Clonal multiplication of *Bambusa nutans* and *Bambusa tulda* by adventitious rhizogenesis : Influence of season, IBA and nature of cuttings".

Mela

The institute participated in National Swarozgar and Vyapar Mela at Jabalpur from 23rd to 26th December 2005 and demonstrated different technologies developed by the institute.

AWARDS

1. Dr. Jamaluddin, Scientist-G, Group Coordinator (Research) and Head, Forest Pathology Division, has been awarded *Vishist Vaigyanik Puraskar* (2001-2002) by Govt. of India, Ministry of Environment and Forests in September 2005.
2. Dr. Jamaluddin and Dr. V.S. Dadwal, Scientist-B have been awarded *BRANDIS PRIZE* for the paper entitled Biocontrol of important pathogens of forestry species by Streptomyces formulation published in Indian Forester in 2003.

DISTINGUISHED VISITORS

Dr. S.N. Paul Khurana, Vice Chancellor, R.D. University, Jabalpur visited this institute on 12th December 2005, inaugurated the 58th Zonal Meeting of Indian Phyto Pathological Society and addressed the officers and scientists of TFRI, Jabalpur.

MISCELLANEOUS

Meetings, RAG, CTA's etc.

1. 15th RAG meeting was held at Tropical Forest Research Institute on 23rd August 2005.

2. Two days regional workshop on Management of extension activities in the forestry sector was organized on 14th and 15th September 2005.
3. A workshop on Promoting technology development, utilization and transfer in Mahakoshal region was held on 6th January 2006.
4. Organized National conference on Tree biotechnology: Indian scenario on 9th and 10th February 2006.

Important activities during the year

1. Celebrated World Environmental day on 5th June 2005.
2. Van Mahotsava was celebrated on 20th July 2005.
3. Wild Life Week was celebrated from 1st to 7th October 2005.

CHAPTER 3.5

Rain Forest Research Institute Jorhat

The Rain Forest Research Institute (RFRI) is a national Institute established at Jorhat, Assam in the year 1988, a constituent unit of the Indian Council of Forestry Research and Education (ICFRE), an autonomous body under the Ministry of Environment and Forests, Govt. of India. The mandate of the Institute is conservation of forest ecosystem with emphasis on natural regeneration, control of shifting cultivation, management of community forests, planting practices for eco-restoration and research on bamboo and rattan.

PROJECTS COMPLETED DURING THE YEAR 2005- 2006

Project 1: Genetic Improvement of Khasi pine (*Pinus kesiya*) [RFRI/TI/08/2002-2005]

Findings: Established 5 ha and 10 ha Seed Production Areas (SPA) of *Pinus kesiya* at Khonghampat in the central forest division, Imphal and Riet Khwan in Shillong forest division in the state of Manipur and Meghalaya, respectively.

A total 33 plus trees have been selected in east and west khasi hills of Meghalaya. Seedling Seed Orchard cum Progeny Trial was established at Umiam, Barapani over 2 ha area in Randomized Block Design with 16 progenies along with control in the state of Meghalaya.

The seed maturity indices for *Pinus kesiya* are determined using specific gravity of mature cones as parameter. The occurrence of cones in four, five and even six clusters in some of the plus trees was observed in the pine forests of Meghalaya. This is an unusual feature and can be exploited for the production of seeds in the orchards in future improvement programmes.

The presence of red pine besides the Khasi pine *(Pinus kesiya)* in the pine zone of Khasi hills in the state of Meghalaya was resolved scientifically by analyzing samples of wood, needle and cones collected from red pine and white pine (Khasi pine) trees. It was revealed that there is no red pine in Khasi pine areas in the state of Meghalaya.

Project 2: Studies on distribution dynamics of bamboo and canes and their *ex-situ* conservation [RFRI/EE/03/2004-2007]

Findings: Distribution map of bamboos of north-eastern region of India and *ex-situ* conservation of 32 species and 4 varieties of bamboo has been completed and identification of some bamboo species based on morphology is under progress.

Project 3: Germplasm collection, conservation and mass multiplication of selected Medicinal plants of north-east India [RFRI/EE/05/2003-2006]

Findings: Collection and *ex-situ* conservation of 5 selected medicinal plant species (*Bacopa monnieri*, *Andrographis panniculata*, *Plumbago zeylanica*, *Plumbago indica* and *Asparagus racemosa)* have been made at RFRI campus. Developed protocol for propagation of *Andrographis panniculata*, *Plumbago zeylanica* and *Plumbago indica.*

Project 4: Ecological studies on Dipterocarp forest of Gibbon Wildlife Sanctuary of Assam [RFRI/EE/04/2003-2006]

Findings: An ecological studies have been carried out in the Gibbon Wildlife Sanctuary, Assam to highlighted the present ecological status of the ecosystem with a view to suggest suitable measures for sustainability.

Natural Forest site

Dipterocarpus plantation site

Enumeration of vegetation in three different sites has indicated the presence of 298, 458 and 348 trees/ha (>10cm dbh) in the plantation, natural and disturbed sites respectively. Tree height stratification has indicated value, which is indicative of the fact that the bigger trees might have been felled.

Considering the regeneration status, Mesua seedling were the most dominant followed by Vatica and *Dipterocarpus retusus*. In the natural area similar trend was observed with Mesua, Vatica and *Dipterocarpus retusus*. In the disturbed site too, this trend was reflected with Mesua accounting for followed by Vatica and *Dipterocarpus retusus*. The dominance of Mesua seedling in all the three sites indicate that the Gibbon Wild life Sanctuary is in a disturbed stage as canopy openings are favouring the establishment and growth of Mesua which is a light demander.

Project 5: Growth, biomass and energy production potential of selected energy plantation species [RFRI/SC/07/2003-2006]

Findings: Growth and biomass studies conducted showed maximum height growth was observed in *Mallotus albus* followed by *Anthocephalus chinensis, Alstonia scholaris* and *Melia azedarach* etc. Lowest progressive height growth was observed in *Artocarpus chaplasha* among non legumes. In legumes *Samanea saman* and *Dalbergia sissoo* showed lowest growth rate.

Maximum diameter growth was recorded in *Mallotus albus* followed by *Anthocephalus chinensis*, *Alstonia scholaris* and *Melia azedarach* etc and lowest collar diameter was recorded in *Dalbergia sissoo* and *Samanea saman*. Diameter at basal hight was recorded highest in *Alstonia scholaris*. It was followed by *Anthocephalus chinensis* and in *Mallotus albus*. Minimum basal diameter was recorded in *Dalbergia sissoo.*

Minimum biomass was observed in *Samanea saman, Dalbergia sissoo* and *Artocarpus chaplasha*. Energy content was determined component wise. *Anthocephalus chinensis* leaf recorded highest energy content followed by *Melia azaderach* and *Lagerstromia speciosa*. Lowest leaf calorific value was recorded in *Ficus hispida*. Among leguminous species branch of *Dalbergia sissoo* measured highest energy content and in non legumes, it was highest in *Anthocephalus chinensis* followed by *Melia azaderach* and *Alstonia scholaris*.

Project 6: Indigenous knowledge of Angami tribe in sustainable management of biodiversity in Dimapur and Kohima districts of Nagaland, India [**RFRI/ EP/03 2003-2006**]

Findings: The Angami people of Nagaland bring the necessary resources such as fuel, food, fodder, dye, medicine etc. from forest.

About 28 species of medicinal plants, 14 species of dye yielding and 20 species of wild edible plants are reported, which are good sources of income and survival for the rural folk. Some promising indigenous medicinal plants used by Angamis have been reported for multiple biological effects such as anti-inflammatory, anti-allergic and anti-cancer properties etc. Angamis integrate indigenous technique for protection of crops, conservation of forest, water harvesting system, filtration of drinking water etc.

Filtration unit

Rice bundle

Project 7: Contribution of N_2 fixing plants on improvement of abandoned fallow in shifting cultivation [RFRI/ EP/04/ 2003-2006]

Findings: Nutrient status of soil was significantly improved by the application of legume green manure. Enhancement of chemical properties of soil was recorded due to addition of *Crotalaria pallida* followed by *Sesbania bispinosa.* Maintenance of fertility status might be due to easy decomposition of organic matter that converts organically bound nutrient to inorganic form. Maximum increase of rice and maize yield was recorded in *C. pallida* applied plot. In case of rice the productivity was increased 36.2% over control. During the year of experimentation the total nutrient uptake value was found maximum in *C. pallida* applied plot.

Project 8: Assessment of biological diversity of various ecosystems and to establish methods for conservation in the Kaziranga National Park of Assam [RFRI/EP/06/2003-2006]

Findings: Quantitative structure, population dynamics of forest communities and grassland productivity has been analyzed in the Kaziranga National Park. Four communities were identified on the basis of dominance of species in different ecosystem.

Grassland enumeration and biomass study has indicated the distinct characters of tall and short grass community. Four grassland communities have been identified.

Lagerstroemia Streblus Community
Reparian Forest Kaziranga National Park

Data collected reveals the presence of endangered species, rare Orchids and also cane species reported in the Kaziranga National Park, Assam.

Project 9: Financial assistance for improvement of infrastructural facilities in Botanical Garden/Centres of *ex-situ* conservation at Rain Forest Research Institute Jorhat, Assam [RFRI/ EP/ 09/2003-2006]

Findings: Construction of shade cum poly house, orchidarium and installation of irrigation facilities has been

completed. 20 species of rare orchids of north-east region collected. Other development activities of botanical garden are in progress.

Flowering of *Calanthe masuqa* a terrestrial Orchid in Botanical garden

Orchidarium in Botanical garden

Project 10: Capacity building of village level committee for efficient forest resource management through JFM [RFRI/CFE/01/2002-2006]

Findings: Assessment of natural resources has been done through participatory approach. Microplan has been prepared. Various Training programmes at Institute level and at Field level has been imparted to the villagers, farmers, SHGs, NGOs and GOs for awareness generation and capacity building of farmers and various user communities. A number of exhibitions have been organized and demonstrations of useful technologies have been done at village level. Use of Biofertilizers was explained to various farming and forestry groups to enhance productivity. Audio visual aids, Extension based movies were shown to the user groups. Technical brochures and booklets were distributed. Indigenous techniques and knowledge were collected and documented.

Use of treated bamboo in housing

Project 11: Studies on yield and quality traits of fragrant products from selected humid-tropical aromatic plants [RFRI/CFE/02/2002-2005]

Findings: Correct harvesting time of patchouli leaves in terms of optimum oil yield has been determined and

organoleptic traits were ascertained in terms of optimum oil yield. Effect of drying different methods on the essential oil content of patchouli leaves, appropriate drying method has been determined. Different distillation methods were attempted with certain modification and procedural refinement has been done for enhanced production of essential oil from patchouli leaves. Thin layer chromatographic chemical profiles for patchouli oil have been standardized. Significant decline has been recorded in oil content of infested leaves. The products so obtained need further chromatographic and spectral analysis for characterization.

Project 12: Germplasm evaluation of selected bamboo species for various end uses [RFRI/SM/03 /2001-2005]

Findings: A base population of about 2067 ramets belong to the four different bamboo species namely *Bambusa nutans, Bambusa balcooa, Bambusa tulda* and *Dendrocalamus hamiltonii* have been produced in the RFRI, nursery.

The overall genotype/clone of four different bamboo species showed the best performance in the Naharoni (Assam) in comparisons to the Khasiamangal of Tripura. The genotype /clone No. S_4C_{10} of *D. hamiltonii* had best performance at Khasiamangal, Tripura in respect of height followed by S_3C_4 of *B. nutans*, S_3C_8 of *B. balcooa* and S_3C_8 of *B. nutans*. Where as collar diameter is concern the best progeny/clone is S_4C_9 of *D. hamiltonii* followed by S_3C_3 and S_3C_8 of *B. nutans*. The progeny / clones of S_3C_4 of *B. nutans* showed best performance in respect of height at Naharoni, Assam followed by S_3C_9 of *B. nutans* and S_2C_6 of *B. balcooa*. Where as collar diameter is concern the best progeny/clone is S_3C_{10} of *B. balcooa* followed by S_2C_5 and S_2C_6 of *B. balcooa*.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Development of an ecofriendly strategy for the Management of *Calopepla leayana* Latr., a serious pest of *Gmelina arborea* (Roxb.) [RFRI/FE/ 11/2004-2007]

Status: Pathogenic evaluation of entomopathogenic fungi *Beauveria bassiana* and *Metarhyzium anisopliae* against *Calopepla leayana* were carried out. Both the fungi were found to be pathogenic to all stages of *C. leayana*. After that mass production of entomopathogenic fungi *B. bassiana* and *M. anisopliae* using different substrates was standardized. Bio safety test of *B. bassiana* and *M. anisopliae* with muga silkworm was carried out. Both the fungi were found to be harmless to muga silkworm and all silkworms attained pupal stage (Cocoon) without any deformities and malformations. Spores of *B. bassiana* were isolated and kept in refrigerator at 4ºC in different vials to test their self-life expectancy, which are viable for about 8 months of storage period.

Project 2: Evaluation of different existing land use systems for development of viable economic models in north-east India [RFRI/SC/06/2003-2008]

Status: Survey, selection and collection of productivity data of different land use system in Silonijan, Karbi Anglog Assam, Nagaland and Meghalaya have been completed. During this period survey of different land use system of Meghalaya was carried out.

Benefit cost ratio and productivity of *Ananas comosus* and *Zingiber officinale* are higher than jhum cultivation in this region. Soil nutrient status of these cropping system shows that PH, organic carbon and nitrogen plays an active role to enhance productivity of crop.

Plantation of *Ananas comosus*

Project 3: Stability test of various clones and progenies for different characters in *Gmelina arborea* [RFRI/TI/10/2003-2006]

Status: Evaluation and monitoring of established progeny trials at different locations of north-east India is in progress. Data collected from the three sites of progeny trial located at Teliamura (Agartala), Imphal and Naharoni. Seeds are also collected and distributed as per requirement to other ICFRE institutes where Multilocational trial is under progress.

Project 4: Genetic improvement and clonal propagation of *Dipterocarpus retusus* [RFRI/TI/11/2004-2007]

Status: Clonal propagation trials to develop an efficient clonal propagation protocol of *Dipterocarpus retusus* are in progress. Data on different growth related parameters have also been recorded for evaluation of progeny trials and significant variation was observed among all the progenies for different traits. Observation were also made on flowering and fruiting behaviour in 11 out of 18 progenies raised from half-sib seeds collected from plus trees, selected from upper Assam and Arunachal Pradesh and raised at Jorhat (Assam) in 1999.

Project 5: Reclamation of highly eroded site of Cherrapunjee, Meghalaya [RFRI/SM/04/2003-2006]

Status: Growth datas of *Alnus nepalensis* and *Exbucklendia populenia* were collected during the month of July and it was observed that the growth performance of *A. nepalensis* shows better than *E. populenia* in that climatic zone.

Survival percentage for *Alnus nepalensis* was 92.19% and for *Exbucklendia populenia* 83.69 % after a period of 15 months plantation. And the maximum height growth was observed 180cm and 60 cm for *Alnus nepalensis* and

Exbucklendia populenia respectively. Quarterly growth and survival data of *Alnus nepalensis* and *Exbucklendia populenia* were collected during the month of November. Survival percentage for *Alnus nepalensis* was 90.8% and for *Exbucklendia populenia* was 75.18 %.

Project 6: Development of Patchouli based viable agroforestry models for north-east region of India [RFRI/CFE/04/2004-2007]

Status: Patchouli plants were raised through vegetative multiplication in root trainers under mist chamber condition for laying out agroforestry trails. Laid out Agar-patchouli based agroforestry trail on farmer's field at Salbari, Betel Nut-Patchouli based agroforestry trail at Numaligarh, Bharali gaon and Bogori gaon and Bamboo-Patchouli agroforestry trail on at Teak Tea Estate, Teok. Patchouli experimental trial plot were managed by providing technical guidance to the farmer concerned. Tours were undertaken to the on farm trial sites for collection of data on various crop parameters

Patchouli under Areca nut

NEW PROJECTS INITIATED DURING THE YEAR 2005- 2006

Project 1: Development of Nursery practices for production of quality planting stock of Bamboo in N.E. [RFRI/SM/06/2005-2008]

Status: *Dendrocalamus hamiltonii* bamboo culms aged 2 years were collected from Germplasm bank of bamboo. Two nodded cuttings were prepared, treatment were given and planted in beds to standardize propagation technique. Data is being recorded.

Off shoots are being separated from those two nodded cutting and are being planted in different potting media.

Different potting media were prepared to carryout experiment.

Culm cuttings

Project 2: Bioecological studies of seed insect pests of *Dipterocarpus retusus* [RFRI/FE/12/2005-2008]

Status: *Alcidodes crassus* (Coleoptera) a weevil and *Dioryctria abicutella* and *Enarmonia pulverula* (Lepidopera) moths were found infesting seeds of *Dipterocarpus retusus* collected from forest floor. 8-10% fallen mature seeds

were infested with these insects. Insect infestation on mature seeds collected using nylon nets, before falling to forest floor, was recorded which was 12-14% only.

Project 3: The potential role of bamboo species with reference to carbon sequestration in Assam and Mizoram [RFRI/EE/07/2005-2008]

Status: Surveyed the areas of Assam and Mizorum and Sites have been selected for biomass estimation of bamboo. Fresh biomass of *Bambusa tulda* of three age groups of 1st year, 2nd year and 3rd year estimated from selected sites at Jorhat, Assam. Oven dry weight has also been taken. Further studies are in progress.

Project 4: Comparative studies on natural resistance of bamboos to biodegradation in Assam [RFRI/FP/08/2005-2008]

Status: Ten bamboo species were selected for graveyard test, out of which seven species have been locally collected from Bambusetum at RFRI and local market. One new species *Bambusa bambos* has also been collected and included in the comparative tests on natural resistance of bamboo to biodegradation.

Bamboo samples at one experimental site at Jorhat has been set up and samples for another experimental site at Burnihat has been completed.

Project 5: Management of *Bambusa nutans* for enhancing the productivity of marketable culm through silvicultural practices [RFRI/TI/13/2005-2008]

Status: Plantation of *Bambusa nutans* in the year 2002-2003 covering an area of 0.5184 ha in 36 blocks, planted in 4x4 m, spacing in RBD design, at Dakshinpat Satra. Literature was surveyed and collected. Recording of initial observations as well as field works is in under progress.

Project 6: Studies on structural formation of vegetation for the conservation of Biodiversity in Gibbon Wildlife Sanctuary Assam [RFRI/SC/08/ 2005-2008]

Status: Study site was surveyed for reconnaissance pertaining to site, terrain, physical features and vegetation composition. Under floristic component investigations were initiated on location, identification and inventorization of specific species of flowering plants, area, which are the indicators of the Hoolock Gibbon's natural habitat and are indispensable to life style of Hoolock Gibbon. Phenological behavior of such species was also observed. Appropriate spots were selected for conducting ecological studies, such as structural formation of vegetation, community studies, vegetation types, etc. with reference to the habit and habitat of Hoolock Gibbon.

Project 7: Diversity and dynamics of Arbuscular Mycorrhizal fungi and their influence on biomass production of some medicinal and aromatic plants of Assam [RFRI/FP/10/2005-2008]

Status: Survey and collection of soil and rhizosphere root samples of 94 indigenous Medicinal and Aromatic Plants (MAPs) from five districts of Assam namely, Jorhat, Golaghat, Sonitpur, North Lakhimpur and Dhemaji have been completed. 52 indigenous Medicinal and Aromatic Plants (MAPs) are conserved in the shade house. Analysis of root and soil of collected samples are in progress. The root sample of various plants collected has shown varying degree of Mycorrhizal infection. The number of arbuscular mycorrhizal spores associated with rhizosphere also varies with the species.

Dracaena

Nephaphu

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Augmentation of Entomopathogenic fungi for the management of *Calopepla leayana* on *Gmelina arborea*: An ecofriendly approach [RFRI/EP/ 10/2005-2007]

Status: Entomopathogenic fungi viz., *Beauveria bassiana*, *Metarhyzium anisopliae*, *Aspergillus* spp. and *Fusarium* spp. were isolated from dead and diseased larvae and adults of different insect groups. All fungi were effective against both larval and adult stages of *Calopepla leayana*.

Project 2: Conservation of productive land and promising flora of Majuli Island in Brahmaputra River [RFRI/EP/05/2003-2006]

Status : Assessment of natural resources has been carried out by selecting different user groups. Indigenous knowledge of local inhabitants about medicinal and other plant resources was collected and documented. A number of trainings have been organized for villagers, farmers, SHGs, on correct harvesting and storage practices of some

Plantation of *Sesbania sesban* (fibre and fuel spp.)
for soil fertility improvement

important Medicinal Plants for economic upliftment and biodiversity conservation. Soil fertility enhancement through green manuring were also informed. Technology related to bamboo preservation and agroforestry has been demonstrated to villagers, farmers, SHGs etc. Agroforestry models like Moringa on field bunds, Moringa with Areca nut, Sissoopaddy have been established. Management of water for paddy and Trapa cultivation in water logged area for higher production was demonstrated. Shelterbelt of *Ipomoea carnea* grasses and banana on the bank of Tuni river has been established to check sand deposit in the field. Cultivation of *Sesbania sesban* to improve soil fertility and use of dry stem for fibre and fuel is under progress.

Project 3: Control of soil and riverbank erosion in Majuli through bamboo based vegetative embankment [RFRI/EP/07/2004-2007]

Status: Participatory rural appraisal was under taken. Microplan was prepared. Kissan nurseries were established in 12 groups in near by areas of the project site to meet the requirement of seedlings. Technical guidance was provided time to time. Similarly compost units were established to meet the requirement of compost. A bamboo treatment unit

Fencing of site with treated bamboo

has been established in Potia village near the project site to meet the requirement of treated bamboo. Materials for embankment work have been purchased. Fencing of the plantation area is under progress. Plantation work in all the four different zones is under progress. On site training programmes were organized to empower the local inhabitants.

Project 4: Validation, testing and locational trial of micro/macropropagated planting stock of selected bamboo species in north-east India [RFRI/EP/08/2005-2008]

Status: Liaison with Nodal Officers and Supporting Agencies has been established. Matter related to supply of required TC planting stock was persued with NMBA and Growmore Biotech Ltd. Periodically monitored the hardening status of TC planting Stock at HPC. Funds were released to various Field Implementing Agencies. Supply of planting stocks of *B. balcooa* from HPCL to Nodal Officers of Mizoram and Nagaland were expedited for demo plantations. Out of 20 ha area selected for locational trail by all the 8 FIAs, demo plantation of *B. balcooa* has been raised in Mizoram and Nagaland covering 7 ha area in each of the two states.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in2005-2006	No. of projects initiated in 2005-2006
Plan Projects	12	6	7
External Projects	-	4	-
Total	12	10	7

LINKAGES AND COLLABORATION

The linkage and collaboration were established with State Forest Departments of N.E. States, University, other research organizations, G.B. Pant, NMBA, MoEF, DBT, NEC and NGOs working in the field of forestry and forestry research.

CONSULTANCY

1. RFRI is currently undertaking the consultancy on evaluation of afforestation and tree planting activities in Kamrup District of Assam, Mara Autonomous District Council of Mizoram, Tennoupal district of Manipur and Mokakchung, Kohima and Phek District of Nagaland.
2. RFRI is also undertaking the consultancy on monitoring and evaluation of plantations raised under National Medicinal Plants Board (NMPB) of the Ministry of Health and Family Welfare in all the north-eastern states including Sikkim.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. A training programme was organized on "Development of Bamboo Germplasm bank and multiplication strategies for conservation and plantation activities" and held at RFRI on 6th September 2005. Forest officials of Eastern Assam Circle participated.
2. Training on "Mass Multiplication and plantation of Fuelwood and Fodder species" was held on 6th January 2006 at Sokhoramukh Village, Majuli (Assam) under TIFAC-DST Sponsored Project.
3. Training on "Selection and Plantation Practices for bamboo in Flood Affected Areas" was held on 23rd February 2006 at Nimonichumoimari Village, Majuli (Assam) under TIFAC-DST sponsored Project.
4. Training on "Exploitation of Endemic Bioresources for Employment and Income Generation" was held on 27th February 2006 at Potia Village, Majuli (Assam) under ICFRE Project.
5. Trainees of State Forest Service College, Burnihat (Assam) and Assam Forest Guard School, Makum (Assam) were imparted training on propagation and multiplication of Bamboo species and nursery management on 30th December 2005.
6. A two days training on "Advanced Nursery Technology" was organized at RFRI on 8th and 9th November 2005 which was attended by Forest officials of State Forest Department, Manipur.
7. Seventh Research Advisory Group Meeting was held in the premises of RFRI on 26th October 2005.
8. Training on "Correct Harvesting and Storage Practices of Some Important Medicinal Plant for Economic Upliftment and Biodiversity Conservation" on 3rd and 4th May 2005, Potia Village, Majuli (Assam) under GBPIHED sponsored project.
9. Training on "Selection of Suitable Plant Species for Afforestation in Flood Affected Areas" on 10th May 2005, Potia Village, Majuli (Assam) under GBPIHED sponsored project.
10. Training on "Composting and Its Application for Productivity Enhancement" on 14th May 2005, Chumoimari Village, Majuli (Assam) under ICFRE Plan Project.
11. Training on "Advanced Nursery Technology" (for Forest Officers of SFD, Manipur) on 8th and 9th November 2005, Rain Forest Research Institute, Jorhat.
12. Training on "Agroforestry Models for Riverine Sand Dunes (Char Areas)" on 17th November 2005, Kaniajan Village, Majuli (Assam) under ICFRE Plan Project.
13. Training on "Soil Fertility Enhancement through Green Manuring" on 19th November 2005, Sokhonamukh Village, Majuli (Assam) under GBPIHED sponsored project.

Attended

1. Dr. Ombir Singh, Scientist C attended an International Conference on "Faciliting Forestry Mitigation Projects in India: Promoting stake-holder Dialogue and capacity Building" from 15th to 17th June 2005 at ICFRE Headquarter, Dehradun.

2. Shri S.S. Jain, Scientist C participated in the workshop on "Early warming systems for Forest Invasive species" at Kerala Forest Research Institute, Peechi, Kerala, India from 21st to 24th February 2006.
3. Scientific Exhibition cum Technology Demonstration during the Platinum Jubilee Celebration of J.B. College, Jorhat (Assam) from 5th to 7th February 2006.
4. Shri Pawan K. Kaushik, Scientist B, Community Forestry and Extension Division attended the National Seminar on "Growing, Processing, Value addition and Marketing of Medicinal and aromatic Plants" held at SFRI, Jabalpur from 6th to 8th February 2006.
5. Dr. Y.C. Tripathi, Scientist E and Head of Community Forestry and Extension Division attended the Meeting on Production and Supply of Quality TC Planting Stock of Bamboo, on 21st May 2005 at Hindustan Paper Corporation Limited (HPCL), Jagi Road (Assam).
6. Dr. Y.C. Tripathi, Scientist-E and Head of Community Forestry and Extension Division attended the Training on Bamboo Tissue Culture, from 18th to 22nd July 2005 at Growmore Biotech Ltd., Hosur (Karnataka).
7. Dr. Y.C. Tripathi, Scientist E and Head of Community Forestry and Extension Division attended the Meeting on "Operational Guidelines for Large Scale Production and Demonstration of Quality Planting Material of Bamboo" on 9th September 2005 at DBT, New Delhi.

AWARDS

Dr. J. Singh, Scientist E and Head, Shifting Cultivation Division, and his team (Dr. I. P. Bora, R.O., Dr. A. Baruah, RA-I, and Sri M. Hussain, RA II) have been awarded the prestigious Schlich prize for the year 2003 for the best research paper entitled "Effect of shifting cultivation on nutrient status of soil in Silonijan (Karbi-Anglong) Assam" (Indian Forester November 2003) on 26th May 2005 in the field of Forestry other than Silviculture.

DISTINGUISHED VISITORS

1. Mr. D. S. Tomar, IFS, M.D., Uttaranchal Forest Development Corporation visited RFRI on 4th May 2005.
2. Shri Pradyut Bordoloi, Hon'ble Forest Minister of Assam visited RFRI on 13th July 2005.
3. Shri P.P. Srivastava, Hon'ble Member of north-east Council, Shillong visited RFRI on 21st November 2005 and held discussion with the Director and Scientists regarding Bamboo and Cane research.
4. Dr. Tapan Dutta, Advisor to Chief Minister of Assam, Shri S. Rao, Deputy Commissioner, Jorhat; Dr. P. Gogoi, Head of Botany, D.R. College, Golaghat visited RFRI on 12th January 2006 and held a meeting on commercial cultivation of bamboos in Jorhat District.

MISCELLANEOUS

1. Shri Mridul Saikia, Khalasi Motor Mechanics of this Institute who represented ICFRE in the XIVth All India Forests Sports Meet held at Jamshedpur, Jharkhand from 4th to 8th January 2006 bagged the SILVER Medal in Power lifting and BRONZE Medal in Weight lifting.
2. Dr. M. George, Director of this Institute who represented ICFRE in the XIVth All India Forests Sports Meet held at Jamshedpur, Jharkhand from 4th to 8th January 2006 bagged the BRONZE Medal in Tennis (Senior Veteran Doubles).

CHAPTER 3.6

Arid Forest Research Institute Jodhpur

Arid Forest Research Institute (AFRI), Jodhpur (Rajasthan), is one of the eight Institutes under the Indian Council of Forestry Research and Education (ICFRE), an autonomous body of the Ministry of Environment and Forests, Government of India. The objectives of the Institute are to carry out scientific research in forestry and allied fields to enhance the productivity and vegetative cover and to conserve the biodiversity in Rajasthan, Gujarat and Dadra & Nagar Havelli with special emphasis on the hot arid and semi-arid region and also to develop the technologies for the end users in the mandated area. The main thrust areas of the institute are soil, water and nutrient management, technologies for afforestation of stress sites, management of plantations, growth and yield modelling, planting stock improvement, biofertilizers and biopesticides, agroforestry, JFM and extension, photochemistry and non-timber forest products, integrated pest and disease management and forestry education.

PROJECTS COMPLETED DURING THE YEAR 2005-2006

Project 1: Provenance trial on *Acacia nilotica* and *Ailanthus excelsa* [AFRI-40/FGTB/1994-2006]

Findings: *Acacia nilotica:* Seeds of 28 provenances from different agro - climatic zones of the country were collected for the trial. Seed morphology and germination studies were carried out and observations were recorded daily for the calculation of germination percentage, germination energy and energy period for the each provenance. The parameters for tree growth characters of different provenances were recorded initially at six months interval and later on yearly basis. Tree height varies from 44.59 cm to 72.53 cm in the first year and from 386.00 cm to 270.00 cm in the eight years. The ranking of height also varies from one year to another; Gurgaon is the only provenance which has come under first three since the beginning of the trial followed by Agra, Etawah, Hastinapur, Aligarh, Haldwani and Jhabua. The mineral values of different provenances to be used as fodder were also estimated. The phosphorous varies from 4522.30 ppm to 1849.30 ppm; nitrogen varies from 3233.2 ppm to 5656.50 ppm; manganese varies from 308.40 ppm to 65.60 ppm and copper varies from 71.90 ppm to 21.20 ppm.

Ailanthus excelsa: The morphological characters of the seeds of the different provenance were recorded in terms of seed length, seed width and test weight. The highest test weight recorded in Jodhpur provenance was 120 g followed by Jodhpur and Kajipet of 105.8 g and 105.1 g, respectively. The lowest test weight 55.5 g was recorded from a provenance of Bilaspur. The seed length was highest (6.6 ± 0.5 cm) in the provenance from Kajipet. The seed length of other provenance varied from 5.60 to 2.52 cm. The maximum seed width was claimed by Bikaner provenance, which was 1.46 ± 1.7 cm and minimum was 0.78 ± 0.1 cm of Bilaspur provenance. The germination percentage was especially in the hot arid and semi arid region of Balaghat provenance, which was 50.7%. The next in order was Jodhpur provenance, which had 40.1% germination percentages. The poorest germination performance was displayed by Jaipur provenance (0.41%).

Project 2: Studies on post harvest technologies on non-traditional, under-exploited locally available timber species for suitability to handicraft and other small scale industries [AFRI-51/NWFP/2002-2006]

Findings: Preservative treatment and seasoning schedule has been developed for three species. *Prosopis juliflora* wood exhibits good turning, finishing and polishing properties. *Acacia tortilis* wood is moderatly hard and heavy, with fairly good grain pattern having very good turning, carving, finishing and polishing properties. This wood is highly susceptible to wood deteriorating agents. After treatment this wood resisted to insect borer and fungus attack. *P. cineraria* species having moderate to poor finishing and polishing properties as comapared to *A. tortilis* and *P. juliflora*. *P. juliflora* can be grown as clear bole tree by proper management. Quality of this wood is equal to that of *Dalbergia sissoo.*

Project 3: Survey of sandal population in Rajasthan and Gujarat states and evaluation of heartwood content and oil content [AFRI-52/NWFP/2002-2006]

Findings: Data of sandal population, heartwood and oil content collected during the survey in Rajasthan state has been compiled and analysed. The oil content in trees of Rajasthan varies between 0.9 to 3.0 %. The heartwood content is found better in naturally grown trees than trees grown on agricultural/ farmlands.

Project 4: Identification of mortality factors of *Prosopis cineraria* and development of their suitable management strategies in north-western Rajasthan [AFRI-46/FP/2001-2005]

Findings: Maximum percentage of Khejri mortality in the four north-western districts of Rajasthan has been recorded as being 36.30, 42.78, 41.00 and 37.69, respectively. Maximum mortality was observed in 71-100 cm girth class in which 2122 trees were killed followed by 1570 in 31-70 cm girth class, 850 in 101-130 cm, 700 in 21- 29 cm, 165 in 131-160 cm and only 47 in 161 cm and above girth class.

Continuous depletion of water table in Rajasthan, increasing number of tube wells or over exploitation of ground water, effect of low rainfall, change in soil properties and agricultural practices and over maturity of trees are some of the suspected causes which also play their role in mortality of Khejri in north-western zone of Rajasthan.

Project 5: Identification of key indicators and suitable strategies for sustainable Joint Forest Management in Rajasthan and Gujarat [AFRI-53/AFE/ 2002-2007]

Findings: Homogeneity of population: Homogeneous caste composition of the villages ensures greater success owing to an almost similar socio-economic status.
Dependency on nearby forest*:* JFM plantation is successful where the major proportion of villagers or JFMCs are solely or partly dependent on nearby common forest for their daily requirement of fuel wood and fodder

Availability and free collection of MFP: Non-Wood Forest Products (NWFPs) have a key role in the success of JFM. It supplements income by collection of medicinal herbs, tendu leaves, forest seeds, Mahua flowers, Aonla fruits and Acacia gum up to Rs.10,000 to 15,000 per season.

Literacy rate has positive effect on JFM: With low literacy rate.

Micro-planning and site condition: The degree of success was found to be positively linked with micro-planning and site condition.

Economic status: Lower income people were more interested in doing the activities related to JFM.

Awareness and extension: With the increase in peoples' awareness, more areas were put under plantation and previous plantation was protected.

Liaison of forest officials with villagers: The attitude of forest official plays positive role in influencing and involving people in Joint Forest Management.

Adequate and timely flow of funds: With increasing JFMC's, funding has resource crunch. Most of the new JFMC's do not have adequate funds. Timely release of fund is also a problem.

Self help Groups (SHGs) with emphasis on women: SHGs created with revolving funds for micro-credits and micro-enterprises, particularly focusing on women, brought effective change.

Motivation, recognition and capacity building of forest officials: The government officers' and field functionaries' attitudinal change through training and persuasion is necessary as it changes their ideas to adopt the participatory approach of forest management rather than policing approach.

Project 6: Studies on improving tree productivity of *Prosopis cineraria* through VAM/Biofertilizers [AFRI-47/FP/2002-2006]

Findings: The maximum number of AM fungal species was identified from Jodhpur whereas only 13 species were recorded from Jaisalmer. Maximum spore population was recorded after rain and minimum in summers. Maximum spore population was recorded from Jodhpur and minimum at Jalore. Seedlings of *P. cineraria* inoculated with VAM + rhizobium performed better as compared to other treatments in all parameters including nutrients.

The genera of AM fungi were identified as Acaulospora, Glomus, Scerocystis and Scutellospora.

Project 7: Ethanomedical property of phyto pathogenic fungi: screening and isolation of therapeutic products [AFRI-48/FP/2002-2006]

Findings: Screening of *Ailanthus excelsa* leaf and stem for wound healing property against the wound caused by Fusarium in *Prosopis cineraria* has been worked out, using crude extract leaves. The partially purified fractions showed positive effect though inhibition spore germination of *Fusarium* sp.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Multilocational trials of Eucalyptus and Dalbergia clones [AFRI-41/FGTB/2002-2006]

Status: Multilocational clonal trials of *Eucalyptus camaldulensis* and *Dalbergia sissoo* were established at four different locations namely Deesa, Kheralu, Gandhinagar, Rajpipala in Gujarat state. These clones are superior germplasm. Data was recorded in subsequent years. Initial data were recorded on growth parameters (height and girth in cm). Best clones for *Dalbergia sissoo* are G5, 20, 66, G1 and 32 and in Eucalyptus are 83,128, 99, 32 and 93.

Project 2: Micropropagation of an important medicinal plant of the arid and semi arid regions - Commiphora [AFRI-42/FGTB/2002-2006]

Status: Somatic embryogenesis has been successfully achieved in the endangered *Commiphora wightii*. It has been also observed that activated charcoal at 5% concentration gives a good response. Hardening experiments have been carried out both *in vitro* and *ex vitro* in mist chamber with 90 misting at 10 minutes interval. Twenty plants have been hardened. These plants have been produced by both somatic embryogenesis pathways as well as from cotyledonary node.

Project 3: Genetic Improvement of *Tecomella undulata* [AFRI-44/FGTB/2002-2006]

Status: Plus trees have been marked both in the canal-irrigated area and the non-irrigated farmers field. Seeds have been collected from 48 plus trees of Rohida. For the allotment of land to raise plantation in Govindpura Experimental Station, Jaipur was chosen.

Project 4: Screening of high oil and Azadirachtin in Neem [AFRI-45/FGTB/2002-2006]

Status: Two trials have been laid out from the CPTs selected for high oil and high Azadirachtin at Govindpura Experimental Station, Jaipur and maintained.

Project 5: Market survey on selected species in selected markets [AFRI-58/Silvi/1994-Continue]

Status: The data regarding prices of various forest produces viz., timber, fuelwood, bamboo were collected from the markets of Jaipur and Ahmedabad on quarterly basis. After compilation, the same were sent to the ADG (Stat.), ICFRE, Dehradun on prescribed format for publication of Timber and Bamboo Trade Bulletin.

Project 6: Stand dynamics of some important tree species of Gujarat [AFRI-57/Silvi/2001-2007]

Status: Annual measurements carried out in 30 sample plots of *E.* hybrid and 17 of *A. nilotica*. Data compilation and plot computations have been completed Basal area. Statistical distribution functions applied to define size class distribution in the stands. Johnson distribution performed better compared to Normal and Weibul distribution based on statistical tests like absolute residual, Chi-square and Kolmogorov-Smirnov test. Developed height growth and site index equations for *A. nilotica* and *E.* hybrid. Five algebraic difference equations were used to develop site index equations. Generalized non-linear least square method was used to take into account the error structure. Bias, root mean square error and Akaike's information criterion were calculated and cross validation residuals were used to evaluate the performance of the equations. Difference among the site index equations of the two species was examined using the non-linear sum of squares method. Based on the analysis, best approximating model has been recommended for both the species for site index modelling.

Project 7: Studies on seed quality improvement in respect of various tree species of arid and semi-arid areas [AFRI 59/Silvi/2002-07]

Status: Seeds of *Acacia nilotica, Prosopis cineraria* and *Azadirachta indica* were collected during the year and were graded, stored for testing. Seeds of *Dalbergia sissoo* and *Ailanthus excelsa* were stored at various moisture and temperature levels and were tested for moisture and germinability. In *Ailanthus excelsa* seeds stored at 5% moisture content gave significantly higher percent germination than seeds stored at 10% moisture level. Seeds can be stored safely up to three years without significant loss of germination. Low temperature storage is not suitable for this species. Seeds can be stored in gunny bags. Stored seeds of *Dalbergia sissoo* lost germination capacity after three years of storage at room temperature. However, when seeds were stored at low temperature, 46% germination was obtained. Three years old stored seeds of *Caparis decidua* showed lesser percent germination in all the treatments. Stored moisture content does not affect percent germination. Seeds of *Commiphora wightii* collected from six seed sources and germinated. Seeds were separated into two categories and were kept for seed germination studies. Black seeds are heavier than white and a kilogram of seed contains 35,000-40,000 seeds at moisture content of 7.5%. Black seeds collected from Kailana area showed higher germination followed by Nakoda.

Project 8: Development of suitable nursery technologies for arid and semiarid areas [AFRI-64/Silvi/DRDA/2002-2006]

Status: In AFRI model nursery improved planting stock for other stakeholders is being raised as per requirement. Medicinal Plants Germplasm Bank has been established. Experiment has been laid out to study effect of different potting mixtures on growth of seedlings of Mopane, Khejdi, Ardu and Ratanjot.

Project 9: Screening of exotic and indigenous plant species for their performance on salt affected soil with different management project [AFRI-49/NWFP/1997-2003]

Status: Performance of *A. amnicola* with or without gypsum on different modes of planting an experimental trial of *A. amnicola* was laid out. Survival percentage assessed for various treatments was ranging from 75 to 88.8% after 60

months of planting. Performance of exotic and indigenous tree species on different types of mounds and a trial with two tree species. *Acacia colei* and *Azadirachta indica* was laid with three treatments of planting growth, pattern recorded. Performance of *Z. mauritiana* and *C. morpane* with management practices. An experimental trial was laid with two fodder species namely *Zizyphus mauritiana* (ber) and *Colophospermum mopane*. Over all mopane recorded 64% and 8% more crown and control than ber. Nitrogen application increased both height and crown dia for both the species.

Project 10: Quantitative estimation of biologically active secondary metabolites in some of the arid zone medicinal plants to ascertain correct harvesting time [AFRI-50/NWFP/ 2002-2007]

Status: Bioactive compound viz. sterols, alkaloids and flavonoids were present in the extractives. Yield of alkaloids was highest in summer and sterols are higher in winter season in the MeOH extract. Calotropis flowers collected for the second years for study of active secondary metabolites.

Project 11: Litter dynamics and soil changes during stand development in plantation forest [AFRI-35/FED/2002-2006]

Status: Seventy six litter plots of 10 x 10 m^2 area were laid in plantations of *Eucalyptus camaldulensis, Acacia nilotica, Acacia tortilis, Tecomella undulata, Prosopis cineraria* and *Dalbergia sissoo* at Nachna, Sada and Ramgarh area along Indira Gandhi Nahar Pariyojna (IGNP). Tree height and GBH were recorded for trees inside the plot. Monthly litter collection is being made. Litters are separated into different components and dry weight is recorded. Annual litter production (kg/ha) from different trees in IGNP area indicated highest litter accumulation under *E. camaldulensis* followed by *D. sissoo*. Soil samples were collected from the plots and were analysed for organic carbon content. Soil organic carbon storage was found highest in *D. sissoo* followed by *E. camaldulensis*, *A. nilotica*, *P. cineraria*, *A. tortilis* and *T. undulata*. Analysis of soil and plant samples is in progress.

Project 12: Identification and screening of some suitable nitrogen fixing species of dry region for their utilization in improvement of soil fertility and biomass [AFRI -36/FED /2002-2006]

Status: Thirty beds of the size 5 x 5 m were prepared for seed sowing. Seeds of *Rhynchosia minima*, *Clitoria ternatea*, *Mucuna pruriense*, *Crotalaria burhia* and *Mimosa hamata* have been sown in the prepared beds. Soil samples were collected from the beds and analysed. Soil nitrogen content estimated before sowing of seeds in the beds. Standardization of buffers and substrate has been completed for *Mimosa hamata*. Highest Nitrate Reductase (HNR) activity was recorded at 0.2 m buffer (pH 7.7) and 0.2 m substrate concentration. Standardization of buffers and substrate for *Clitoria ternatea* is in progress.

Project 13: Screening different phenotypes of *Dalbergia sissoo* and *Acacia nilotica* for their tolerance to salinity and sodicity [AFRI-37/FED/2002-2006]

Status: Seeds collected from 14 selected phenotypes of *Acacia nilotica* and *Dalbergia sissoo*. Plantations were raised as per experimental design at Tharad range, Palanpur (Gujarat) with the help of State Forest Department. Growth and

survival data was recorded six months after planting. Highest survival and growth *A. nilotica* was recorded in phenotype collected from Harethar and Lakhani. The survival and growth of *Dalbergia sissoo* phenotypes was very poor because of high salinity level. Salinity of the experimental site was in the range of 8.80 to 10.88 dSm^{-1}. Soil pH and organic carbon was 7.6-8.8 and 0.23-0.28% respectively.

Project 14: Transfer of forestry technology through demonstration and training for increasing productivity and sustainable management of natural resources (Establishment of interpretation centre) [AFRI-54/AFE/2002-2006]

Status: The extension and interpretation centre is open to the visitors for technology dissemination.

Project 15: Development of suitable multi-tier farm forestry models in IGNP Command area [AFRI-55/AFE (A)/2003-2008]

Status: The survey in IGNP Command area has been conducted to select suitable site for initiating trial. But no suitable sites could be finalised. Hence, the project activities have been deferred for the next financial year.

Project 16: Development of economically viable and integrated agroforestry models for arid region [AFRI-55/AFE (B)/2003-2008]

Status: Field visit was conducted at village Harsh, Bilara, Jodhpur to find out the modalities for implementation of the project on the site selected earlier. Choices of horticulture and silviculture species with interaction of agricultural crops had been finalized with the farmer. The activities for raising seedlings of silviculture and horticultural species have been initiated in AFRI nursery. All the actives are under progress.

PROJECTS COMPLETED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Survey and silvicultural management practices for commercially exploitable medicinal plants of arid and semi-arid areas of Rajasthan [AFRI 35/Silvi 8/MPB/2002-2005]

Status: Surveyed 435 units/ traders involved in the trading of medicinal plants in 26 districts of Rajasthan. The total requirement of surveyed districts revealed that 9,36,110 kg of various medicinal plants is traded annually. Jaipur tops among the surveyed districts with 27.24% trading of medicinal plants followed by Jodhpur, Ajmer, Bhilwara, Udaipur and Sri Ganga Nagar. The trade share of Banaswara is only 0.002% of the total trade.

Cultivation practices for *Aloe vera* (L.) Webb. & Berth. (Gauwar patha), *Asparagus racemosus* Willd. (Satavari), *Catharanthus roseus* (L) G. Don. (Sadabahar, *Ocimum sanctum* Linn. Tulsi) and *Withania somnifera* (Linn.) Dunal (Ashwagandha) and senna in arid areas under rainfed and irrigated conditions have been developed.

Our observation indicated that *Ocimum sanctum*, *Catharanthus roseus* and *Asparagus racemosus* have 96-98% survival and *Withania somnifera* and *Aloe vera* suffered maximum causality. The initial percent survival of *Aloe vera* was 70% and for *Withania somnifera*, it was 74 percent. All species responded to irrigation and fertilizer application. Cultivation trial of guggal indicated that plants raised either through seed or cuttings performed better at Kayalana (good soil) site than at Karwad (saline soil) site. The growth was higher at Kayalana (mean height 48.37cm) against mean height of 28.89cm at Karwad site. A germplasm bank with 150 medicinal plants has been established at Jodhpur.

Project 2: Development of silvipasture model for rehabilitation of Oran/Gauchers [AFRI-275/Silvi-3/UNICEF/2001-2003]

Status: The rehabilitation model was developed at Tulesar and Ostran villages of Jodhpur district. The indigenous and fodder species like *P. cineraria, Tecomella undulata, Zizyphus* spp., *Colophospermum morpane, Hardwickia binnata* and *Alilanthus excelsa* were planted along with seed sowing of local grasses.

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems [AFRI/56/ AFE/2002-2007]

Status: Field training programmes were successfully conducted in phase II with financial collaboration of the Rajasthan Forest Department at three different places of Forest Divisions' Range Headquarters which comprised all the Panchayat Samitis in each of the remaining nine Desert Districts of Rajasthan i.e. Sikar, Jhunjhunu, Jaisalmer, Bikaner, Barmer, Churu, Jalore, Nagaur and Pali Districts to educate and uplift the socio-economic status of

Director, A.F.R.I. addressing the participants

Practical Demonstration at nursery

stakeholders, especially, the farmers, Forest field staff, Gram Sevaks, Panchayat Functionaries, NGOs, SHGs, women and children on the latest forestry technology and other allied ecofriendly value addition activities. A total number of 1963 participants including 185 women participated in these 27 practical-cum-demonstrative training programmes.

Project 2: Study of characteristic features pertaining to bio-drainage potential of some selected tree species [AFRI-38/FED/2004-2008]

Status: Three sites have been selected for the experiment. One is near Masitawali head of IGNP. This site is having extremely high salinity ranging from 37 dSm^{-1} to 42 dSm^{-1}. The other sites are located at 1357 RD and Anupgarh branch of IGNP having low salinity regime.

Sample plots have been laid out at Anupgarh branch of Indira Gandhi Nahar Pariyojna (IGNP) and 1357 RD, IGNP main canal. Plantation of *E. camaldulensis* was raised by the State Forest Department, Rajasthan. Arid Forest Research Institute, Jodhpur, raised experimental plantation of *Eucalyptus* sp. in 2003 (seed source CSIRO, Australia) at 1357 RD, IGNP. Growth and Physiological parameters recorded for three quarters. At 1357 RD experimental site height of the plats was highest in *E. camaldulensis*. However, crown spread and collar girth was high in *E. rudis*.

Plantation of four species viz. *Eucalyptus camaldulensis*, *Acacia nilotica*, *Tamarix aphylla* and *Casuarina junghuhniana* has been done. Average height of the seedlings at the time of plantation was 75 cm, 65 cm, 50 cm and 75 cm in *Acacia nilotica*, *Eucalyptus camaldulensis*, *Tamarix aphylla* and *Casuarina junghuhniana* respectively. Soil samples have been collected for analysis. Ground water level was recorded from the observation pits.

Soil and water samples have been collected and analysed. Fencing of the site has been completed. The mean soil pH was found to be 8.8, 8.6 and 8.5 at 0-25 cm, 25-50 cm and 50-75 cm soil depth. Electrical conductivity was very high in the topsoil layer. Organic carbon was also found to be high in the 0-25 cm soil layer. Soil ammonical nitrogen (NH_4 - N) and phosphorous was 12.2 and 22.73 ppm respectively.

Project 3: Development of suitable models for urban aesthetic forestry suitable for arid and semi arid region of Rajasthan [AFRI-63/Silvi/UIT/2001-2006]

Status: Growth and survival data in respect of the plants raised under the experimental roadside plantations at seven different locations have been recorded. Average height and diameter growth of various ornamental tree species raised under the experimental plantations have been observed in the order of *Dalbergia sissoo* > *Azadirachta indica* > *Cassia siamia* > *Tecomella undulata* >*Pongamia pinnata* > *Alistonia scholaris* > *Casia fistula* > *Delonix regia.*

Project 4: Raising of Arboretum-cum-botanical garden for native flora of Rajasthan [AFRI-61/Silvi/2002-2006]

Status: Plants belonging to 84 native tree species of Rajasthan and Gujarat have been maintained. Complete boundary wall construction has been accomplished to provide protection to the Arboretum-cum-botanical garden.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Integrated management for qualitative improvement and increased production of Rohida (*Tecomella undulata*) in Rajasthan [AFRI-65/FP/SFD/2005-2007]

Status: Three species of wood boring insects and two species of wood decaying fungi have encountered so far. Further study on the identification of these factors is in progress. It was observed that no hollowness problem was seen in the Rohida plantations raised in the IGNP area except in a few trees.

The preliminary observations revealed that the tree deformity pertaining to hollowness might initiate with the formation of cankers in the main trunks of the trees. The percentage of canker formation was found in trees having girth range from 80 cm onwards irrespective of age and girth class. The maximum percentage of cankers has been noticed in the trees with girth range above 121 cm.

Stem cuttings collected from three differently managed trees were raised in mist polyhouse under intermittent misting. Observations collected on sprouting at two weeks interval. After two months final observations were recorded on sprouting, relative growth of callus at basal cut ends and root primordia formations. Root primordia were also recorded in cutting showing callus formation.

Stem cuttings were also raised in mist polyhouse after giving 1000 ppm IBA treatment along with a control (with out IBA treatment). No significance difference was recorded in sprouting and root primordia formation between treated cutting and control. Stem cuttings were raised in sand and vermiculite for each class. Percentages of cuttings producing callus were just double when raised in sand as compared to cuttings raised in vermiculite.

The summary results indicated that depending upon age, site and density, average height in the stands varied from 3.35 to 6.47 m, mean quadratic diameter from 6.12 to 12.24 cm, dominant height from 4.24 to 9.30 m, basal area from 1.84 to 13.88 m^2/ha, volume yield from 3.90 to 47.78 m^3/ha, height increment from 0.20 to 0.36 m/yr, dbh increment 0.36 to 0.65 cm/yr and MAI from 0.22 to 2.65 m^3/ha/yr. Total wood volume equations constructed and validated. A total of 8 equations were compared and best model selected based on the bias, relative error of prediction, coefficient of determination and Akaike's information criteria differences.

Rainwater harvesting devices (top), run-off measuring devices (lower four left) and plantation activity at the site (lower four right)

Project 2: Studies on prediction of NTFP availability and potential for extraction in Aravalli region of Rajasthan [AFRI-67/Silvi/SFD/2006-2008]

Status: Preliminary survey for selection of villages has been undertaken.

Project 3: Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges [AFRI-39/FED/SFD/2005-2008]

Status: A hilly site was selected in Banswara forest division covering slopes of 0-10%, 10-20% and >20%. Rainwater harvesting devices are Contour Trench (CT), Gradonie (G), Box Trench (BT), V-ditches (V) along with a control plot. Seventy five plots (three slopes x five treatments x five replicates) of 700-m^2 area in completely randomised block design were laid. Seventy five number of run-off measuring devices along with flow control wall fitted with pipes were constructed to control water flow and collect run-off.

Observations in the first year indicated that slope gradient had significant effect on soil nutrients, vegetation status and their biomass, soil water content and surface run-off losses. Treatment effect was not significant on water loss and Soil Water Content (SWC) except in 0-20 cm soil layer of lower reach sampling points in a plot, in which SWC was significantly ($P<0.05$) greater in contour trench plots as compared to Gradonie and V-ditch plots. Steep slopes resulted in higher water and PO_4-P loss.

Project 4: Implementation of Bamboo Locational Trials (BLT) project [AFRI-43/ FGTB/NMBA//2005-2007]

Status: Three trials namely species, Water Management and Spacing Trails are established at Bhapore Nursery at Gaupara in Banswara District. Casualty is lesser in the species in which the plants have grown well at the time of planting viz. *B. balcooa, D. hamiltonii, D. strictus* and *B. tulda.* Whereas, casuality is more (50% and above) in plants which are smaller at the time of planting viz. *D. asper* and *B. bambos* (they are tissue culture raised also). Probably the absence of well-grown rhizome may be the reason for their poor survivability. In case of *B. nutans*, in which the plants are medium sized, the survival is better than *D. asper* and *B. bambos* (Mortality is 11%). In case of *B. giganteus*, the rhizomes could not produce new shoots.

Project 5: Multiplication and field trial of Bamboos through tissue culture in Rajasthan and Gujarat [AFRI-68/FGTB/DBT/2005-2007]

Status: Site identified in both states viz. Rajasthan and Gujarat. The identified sites in Rajasthan are Kushalgarh, Banswara and Saira, Udaipur. Only one site i.e. Chakhalia, Dahod is identified in Gujarat. Planting material (8000 TC Plants) of *Bambusa bambos* procured from TERI and *Dendrocalamus strictus* are being raised at AFRI, Jodhpur. Advance work of pitting as per field design is in progress.

Project 6: Coordinated Project: Genetic improvement of *Jatropha curcas* for adaptability and oil yield (Component: Performance of *Jatropha curcas* accessions under arid environment) [AFRI-69/Silvi/CSIR/2005-2010].

Status: Twenty two accessions have been collected/received against target of 27 accessions. Two new accessions from Haryana have been identified and seed has been collected from them. Twenty accessions from Tamil Nadu (10) and Kerala (10) have been collected and are under the process of propagation. Seeds of Udaipur and Banswara area have also been collected and sent to FRI for provenance trial. Seeds were also collected from one-year-old irrigated trial. Total fruit yield/tree, seed/fruit ratio, seed/kernel ratio and optimum solvent extraction time for oil estimation and type of solvent has been worked out for Jatropha. Performance trial has been laid out with 17 accessions. Design for all new trials to be laid out under this project has been finalized.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	7	16	-
External Projects	2	4	6
Total	9	20	6

EDUCATION AND TRAINING

Education

Mr. Ranjeet Singh Yadav under the supervision of Dr. G. Singh, Head, Division of Forest Ecology was awarded Ph. D. degree from FRI Deemed University.

Trainings

Attended

International

1. Dr. Tarun Kant, Scientist C successfully completed one year Post Doctoral Fellowship from 16th August 2004 to 15th August, 2005 under Biotechnology Overseas associateship 2003-2004, Govt. of India, Dept. of Biotechnology at the Department of Plant Sciences, University of Cambridge, U.K.
2. Dr. V.P. Tewari, Scientist-E successfully completed two months study-cum-research visit from 15th December 2005 to 15th February 2006 at the Institut für Waldinventur und Waldwachstum, Georg-August Universität, Göttingen (Germany) under the German Academic Exchange Programme (DAAD) and worked on the project "Modelling Growth and Yield in Forestry Tree Species".

National

1. Shri Balbir Singh, IFS attended the five days compulsory training programme for IFS officers on "Management of Tropical forests- Issues and challenges" held at Kerala Forest Research Institute, Peechi.
2. Dr. G. Singh, Scientist-E attended six days training programme on 'Participatory management of natural resources for sustainable livelihood' at National Institute of Rural Development, Hyderabad from 11th to 16th April 2005.
3. Km. Sarita Mutha, R.A. I of Forest Ecology Division attended two days training/workshop on 'Essentials of achieving forest certification: the process and the requirement' on 4th and 5th April 2005 organised by SGS, India Private, Ltd. at New Delhi.

Organized

1. Organized ten nos. of three days training programmes on "Capacity building and eco-sensitization of farmers and rural poor for development and sustainable management of life supporting systems" in desert districts of Rajasthan.
2. As a multidisciplinary approach of watershed management, inputs on nursery and plantation techniques, biofertilizers, agroforestry models, soil and water conservation techniques, horticulture, pasture

management, disease and pest management etc. were given by the resource persons from both within and outside the institute in above training programmes.

3. Technical staff of the institute delivered lectures/talks on various forestry topics at Nehru Yuva Kendra, Maru Van Prashikshan Kendra, Jodhpur for the benefits of students, NGOs and foresters from time to time during the year.
4. Training on VAM technology was imparted to 25 participants, which include ACFs, RFOs JRF and Field Supervisors, at TRC, Gandhinagar (Gujarat). Training on Isolation of VAM and identification techniques were given to JRF time to time at AFRI, Jodhpur.

LINKAGES AND COLLABORATION

National

1. Tata Energy Research Institute, New Delhi
2. Central Arid Zone Research Institute, Jodhpur
3. Jai Narayan Vyas University, Jodhpur
4. Council of Scientific and Industrial Research, New Delhi
5. National Bureau of Plant Genetic Resources, New Delhi
6. National Mission on Bamboo, New Delhi
7. Department of Biotechnology, Govt. of India, New Delhi
8. Ministry of Water Resources, New Delhi
9. Rajasthan Forest Department
10. Gujarat Forest Department

International

1. Institute of Forest Inventory and Forest Growth, George-August University, Goettingen, Germany.
2. Department of Plant Sciences, University of Cambridge, U. K.

PUBLICATIONS

Brochure/Pamphlets

1 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Giloe, *Tinospora cordifolia* (Willd.) Miers: The Climber of Longevity. Extension brochure.

2 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Sarpgandha, *Rauvolfia serpentina* Benth. Ex. Kurz: Bitter root to better high blood pressure. Extension brochure.

3 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Isabgol, *Plantago ovata* (Forsk.) Natural defence to digestive disorders. Extension brochure.

4 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Bhui Amla, *Phyllanthus amarus* Schum & Thonn.: The wonder herb. Extension brochure.

5 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Tulsi, *Ocimum santum* Linn: The sacred plant. Extension brochure.

6 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Ratanjot, *Jatropha curcas* L: The bio-diesel plant. Extension brochure.

7 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Mulhatti, *Glycyrrhiza glabra* Linn: Sweet Root sweeter than sugar. Extension brochure.

8 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Shatavari, *Asparagus racemosus* Willd. Extension brochure.

9 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Kalmegh, *Andrographis paniculata* (Wall.) Nees. The king of bitters. Extension brochure.

10 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Guar Patha, *Aloe vera* (Linn.) Burm.f., Lily of the Desert. Extension brochure.

11 K.K. Chaudhuri, D.K. Mishra and J.K. Shukla (2005). Ratanjot, *Jatropha curcas* L. Biodiesel Plant. Extension brochure.

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20 ekjokM+tk Vhd ¼jkstMkf½Vdkeyk vUMyVk lhe-

21 vjkssd xkeaadk ,d ek= L=ksr ¼ dq/ vdf'k;k luxy foYM-

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CONSULTANCY

Consultancy was taken up for "Landscaping and arboriculture job" at two housing construction sites of Air force station, Jodhpur, for M/s National Building Construction Corporation Ltd. (NBCCL), a Govt. of India Enterprise, under Ministry of Urban Development and Poverty Alleviation, New Delhi, who has been appointed executing agency for Defence Housing Project for armed forces at different locations in Rajasthan.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. One day Workshop on "Combating Desertification Programme" was held on 6th September 2005.
2. Research Advisory Group Meeting was organized on 20th September 2005.
3. A two days Regional workshop on "Challenges in Forestry Research Extension" was organised on 18th and 19th October 2005.
4. A three day workshop on "okfudh 'kCnkoyh" was held at AFRI, Jodhpur from 28th to 30th September 2005, which was sponsored by Commission for Scientific and Technical Terminology, Ministry of Human Resource Development, Govt. of India, New Delhi.
5. A one day workshop on "Strategies for meaningful implementation of Desert Development Programme

Inaugural session

Excursion to Eco park at Tinwari

(DDP), Drought Prone Area Programme (DPAP) and Integrated Watershed Development Programme (IWDP) in desert areas" on 7th December 2005.

Attended

1. Dr. R.L. Srivastava, Director attended 4th meeting of the Reconstituted Programme Steering Committee on Bioengineering for Biofuels and Bioenergy at New Delhi organized by Dept. of Biotechnology, New Delhi on 7th and 8th April 2005.
2. Dr. R.L. Srivastava, Director attended IRG-36 Annual Conference on "Protection and efficient utilization of plantation grown lesser-known timbers of arid region in India- *Acacia tortilis*, *Prosopis juliflora* and *Prosopis cineraria*" at IWST Bangalore from 24th to 28th April 2005.
3. Dr. G. Singh, Shri N. Bala and Dr. P.K. Aggarwal attended two days workshop on 'Dry Land Organic Farming in Rajasthan' organized by the Jodhpur chapter of the Indian Society of Soil Science at CAZRI, Jodhpur on 10th and 11th May 2005**.**
4. Dr. G. Singh attended one day meeting at UNDP office New Delhi on 12th May 2005 for presentation of project 'Integrated ecosystem approach to mitigate land degradation, enhance productivity and reduce poverty in arid and semi- arid lands of western India.
5. Dr. Ranjana Arya participated in two days workshop on Organic Agriculture in arid zone on 10th and 11th May 2005 in CAZRI, Jodhpur.
6. Shri R.L. Srivastava, Director AFRI, visited BITS, Pilani for delivering lecture on Desert Development Technologies from 8th to 10th May 2005.
7. Shri R.L. Srivastava, Director AFRI, attended a meeting at UNDP Office, New Delhi in connection with GEF Project from 11th to 13th May 2005.
8. Dr. R.L. Srivastava attended two days workshop on Agri Conclave 2005 at Jaipur on 11th and 12th August 2005 organized by CII, Rajasthan and delivered a talk on "Wasteland and their management with special emphasis on problem soils of Rajasthan".
9. Dr. R.L. Srivastava, Director and Dr. G. Singh, Scientist E participated in the workshop on 'Grassland Ecology and Gene Pool Conservation' organized by State Forest Department, Rajasthan from 26th to 28th September 2005 at Jaipur.
10. Dr. R.L. Srivastava, Director, AFRI attended the workshop on "Challenging Poverty by Enhancing Rural Livelihoods" organized by IFFDC & MKD, IFFCO from 27th to 29th September 2005 at Udaipur and chaired one session.
11. Dr. R.L. Srivastava, Director, AFRI attended "Immersion programme on institution building and livelihood promotion - Learning from the experiences of Andhra Pradesh" held at CRIDLA, Hydrabad and visited collaborative institutes/partners at CRIDA, Hyderabad and PAP Ltd. Bangalore under CSIR, Jatropha Project from 4th to 10th December 2005.
12. Dr. R.L. Srivastava, Director, AFRI attended International Workshop on Biofuels at New Delhi on 18th and 19th January 2006.

13. Dr. G. Singh and Dr. Sunil Kumar, Scientist-D participated in Regional level Workshop on the theme "Desert and Desertification for the Western Region" held at GCERT, Gandhi Nagar (Gujarat) on 19th and 20th January 2006 organized by the Gujarat Forest Department.
14. Dr. R.L. Srivastava, Director and Dr. U.K. Tomar Scientist-E, AFRI participated in National Conference on "Tree Biotechnology: Indian Scenario" held at TFRI, Jabalpur on 9th and 10th February 2006.
15. Shri C.J.S.K. Emmanuel attended workshop on "Medicinal and aromatic plants development" at Mandore Agriculture Station, Jodhpur organized by the State Agricultural Department.
16. Shri Arvind Apte, DCF attended National workshop on 'Conservation and cultivation of medicinal plants' at Pinjore, Haryana on 15th and 16th February 2006 and presented a paper on ' Market Potential of medicinal plants in Rajasthan'.
17. Dr. G. Singh, Head, Division of Forest Ecology, participated in national seminar on 'Recent Advances in Forestry Sciences' held at Guru Ghasi Das University, Bilaspur on 30th and 31st December 2005.
18. Dr. R.L. Srivastava, Director, AFRI participated and addressed a Technical Workshop in Hindi on National resource conservation as chief guest organized by Oil India Ltd. at Hotel Chandra Inn, Jodhpur on 22nd February 2006.

Exhibition

AFRI participated in the Paschimi Rajasthan Hast Shilp Utsav-2006 at Jodhpur to disseminate the research highlights and achievements of AFRI to the masses from 2nd to 11th January 2006.

DISTINGUISHED VISITORS

1. Dr. J.S.P. Yadav, Former Chairman, Agriculture Scientist Recruitment Board, visited the Institute on 15th April 2005.
2. Hon'ble Minister of Environment and Forests, Rajasthan visited the institute on 16th July 2005 on the occasion of Van Mahotsava and inaugurated *Aloe vera* Demonstration trial in AFRI campus.
3. Shri B.L. Arya, IAS, Commissioner, Jodhpur Division visited the institute and inaugurated the Regional Workshop on "Challenges in Forestry Research Extension" on 18th October 2005.
4. Smt. Veena Upadhyay, IAS, Joint Secretary, Ministry of Environment and Forests visited institute on 25th February 2006 and interacted with the Scientists/Officers on different aspects of research, computerization, administration etc.

MISCELLANEOUS

56th Van mahotsava was celebrated on 16th July 2005 in collaboration with Rajasthan Forest Department Jodhpur.

CHAPTER 3.7

Himalayan Forest Research Institute Shimla

Himalayan Forest Research Institute (HFRI), Shimla, Himachal Pradesh was established as Conifer Research Centre during May 1977 for carrying out Research on problem associated with natural regeneration of Silver fir and Spruce. The Centre developed the technology for the same and transferred it to the State Forest Departments. During reorganization of forestry research and coming up of Indian Council of Forestry Research and Education (ICFRE), Dehradun in 1987, the mandate of this Centre was enhanced from Regeneration of Silver fir and Spruce to Eco-Rehabilitation of Cold Deserts, Mined Areas Rehabilitation besides studies on Regeneration of Coniferous and Broadleaved Forests with the responsibility of addressing the problems of forestry Research in the Western Himalayan States of Himachal Pradesh and Jammu & Kashmir. This Centre was re-designated as Himalayan Forest Research Institute, Shimla in 1998.

PORJECTS COMPLETED DURING THE YEAR 2005 - 2006

Project 1: Development of Suitable Models for Afforestation of Mined Areas [HFRI-018/ 01(EBC-07)/ PLAN/ 2002-2006]

Findings: This research project was initiated with a view to develop suitable models for afforestation of mined out areas. To accomplish the objectives, floristic and ecological survey was undertaken to assess the vegetational and other related status of the mined out areas in the very beginning.

Nursery experiments were conducted to assess the effect of different combinations of Lime Mine Spoil and Forest Soils on the performance of five tree species viz. *Bauhinia variegata, Robinia pseudocacia, Eucalyptus* hybrid, *Grewia optiva* and *Toona ciliata* revealed that the combination of Lime Mine Spoil: Forest Soil in the ratio of 1:5 or 1:2 (v/ v) was found to be the most effective combination with regard to survival, growth and biomass parameters for all these five tree species. As far as species performance in the nursery conditions was concerned, *Eucalyptus* hybrid showed maximum value for height, collar diameter, shoot, root dry weight and total biomass whereas, survival was recorded maximum in *Grewia optiva*.

Field trial comprising of 600 ETPs of the species like, *Robinia pseudocacia, Leucaena leucocephala, Bauhinia variegata* and *Grewia optiva* as established during 2003 in JST Limestone Mine, Baldlwa (Paonta Sahib) was maintained. Another trial of about 1500 plants in the same location was established during 2004 where species like, *Alnus nitida, Quercus leucotrichophora, Robinia pseudocacia, Leucaena leucocephala, Bauhinia variegata* and *Grewia optiva* were used during planting.

It was concluded from the present study that plantations of *Robinia pseudoacacia, Bauhinia variegata, Leucaena leucocephala, Grewia optiva, Alnus nitida* and *Quercus leucotrichophora* can be taken up successfully for rehabilitation of lime stone mined out areas.

Project 2: Studies on Plant Diversity of Renuka and Simbalwara Wildlife Sanctuaries of Himachal Pradesh [HFRI-024/ 02(EBC-10)/ PLAN/ 2003 2006]

Findings: Floristic assessment around Renuka lake falling in Renuka Wildlife Sanctuary revealed that a total of 109 herbaceous plant species, 43 tree species and 24 shrub species including regeneration of 15 trees and shrub species

were recorded in this particular zone. Out of the total species, 73 species of medicinal value were also recorded from the area and 7 of them fall under the category of threatened plants.

Analysis of data as registered from the altitudinal gradient of 600-900 m above msl in the Renuka Wildlife Sanctuary, it was observed that the forest is composed of 61 species of trees, 64 species of shrubs and 157 species of herbs. The plant communities as identified at 500-750 m and 750-900 m elevation range were *Bauhinia variegata - Mallotus philippensis* and *Terminalia alata Bauhinia variegata* respectively. On the basis of importance value index (IVI), *Bauhinia variegata* and *Terminalia alata* were the dominant tree species at 600-750 m and 750-900 m elevation range respectively. The distribution pattern of plant species was random and contiguous in both the altitudes. The concentration of dominance was slightly lower and index of diversity was slightly higher for the plant species in 750-900 m elevations than 600-750 m elevation range. The population structure of tree species was found to be represented mainly by two patterns: one patterns represented by greater proportion of individuals in seedling stage indicating frequent reproduction whereas, another pattern showed more individuals in intermediate girth classes with absence of seedlings. It can therefore, be assessed that if such a trend continues for a longer period, these species may disappear from the area in the near future.

Becopa monnieri

Floristic assessment were also conducted in Simbalwara Wildlife Sanctuary area having altitudinal gradient 400-650 m above msl. On analysis of data, it was observed that the forest in the sanctuary area is composed of 53 species of trees, 32 species of shrubs and 175 species of herbs.

The plant communities identified at 400-525 m and 525-650 m elevation range were *Shorea robusta Mallotus philippensis* and *Shorea robusta- Terminalia alata* respectively. On the basis of Importance Value Index (IVI), *Shorea robusta* was the dominant tree species at both the elevational ranges. The distribution pattern of plant species was random and contiguous in both the altitudes.

Project 3: Screening and Selection of Insect pest and Disease Resistant Phenotypes/ Genotypes of Important Tree Species of *Pinus roxburghii, Dalbergia sissoo* and *Cedrus deodara* [HFRI-013/06(FPT-02)PLAN/2000-2006]

Findings: Provenances and clones of selected tree species were assessed for insect-pest and disease incidences. Seedlings of Deodar from 19 different seed sources as raised at Field Research Station, Shilly, Solan were examined regularly and systematically for Deodar defoliator attack, which revealed that the seeds collected from Sareen, Solan, Kalpa and Himgiri showed more resistance against *Ectropis deodarae* while compared to others.

Clonal Seed Orchard (CSO) of Shisham at Gondpur, Paonta Valley having 35 clones was screened against *Odontotermis parvidens.* 29 clones and 25 provenance of *Dalbergia sissoo* were also screened against *Plecoptera reflexa* and it was observed that clones with code numbers 90, 203, 36, 260, 107, 66, 59 and 42 were susceptible with infestation level ranging from 97 to 100 per cent and least susceptible clones were 28, 101 and 103 having infestation varying from 21.91 to 25.98 per cent in field conditions. Among different provenances, provenances with code

number 53, 35, 61 and 2 were found susceptible thereby, showing infestation level ranging from 89.13 to 93.75 per cent and the provenance with code no. 46 and 94 had shown 21.02 to 24.11 per cent infestation.

Data collected for 7 provenances was analyzed for their pest resistance. Infestation level by the insect stem borers varied from 7.7 to 58.8 %. Collected data also revealed that the Seer Kunar Khud provenance under Hamirpur Forest Division comprising forest of P-38 AM Platu C-3b, P-38 AM Platu C-1d, P-38 AM Platu C-1c, Chalsai Forest C-4c were moderately resistance to the incidence of different insect borers complex (*Sphaenoptera aterrima*, *Cryptorhynchus rufescens*, *Platypus biformis* and *Polygraphus longifolia*). The Giri-Gambhar provenance under Solan and Rajgarh Forest Division comprising forest of RF Sakor C-I, RF Sakor C-III, R-136 E. Banethi C-4 were susceptible to attack of these insect borers complex.

Drying of Chir pine tree due to insect stem borer attack

Project 4: Development of model for integrated pest management with special reference to *Cedrus deodara* [HFRI-017/06(FPT-03)PLAN/2000-2006]

Findings: Bioecology of *Ectropis deodarae* in Deodar forests was studied and it was observed that the pest was able to complete only one generation in a year. Females were found to deposit eggs on the tender needles of deodar during the spring and the total incubation period ranged from 8.5 to 15.0 days. Light green colour larvae of *E. deodarae* were found to be hatching from the eggs during April and May. The larvae showed quite resemblance to the smaller twigs and arrested shoots of the infested trees.

Adult emergence began in mid February from over wintering pupae of previous year. Under field conditions, maximum emergence of moths took place when around 15 eggs were deposited in April. With the onset of spring, adults emerged to start the new generation. Thus, the pupal stage is the longest period in the life-cycle of this univoltine species.

All the instar stages of this defoliator move on the branches and also to other trees by means of silken threads secreted by the larvae themselves. During epidemic, the infested trees had a network of silken threads on the stem, branches and undergrowth.

A large number of natural enemies of this pest comprising of 11 parasitoids, 8 predators and 9 entomopathogens were identified. Three species of parasitoids viz. *Apanteles flavipes*, *Apanteles glomeratus* and *Apanteles ruficrus* emerged from the larvae of *E. deodarae*. The extent of parasitization by these species was 6.7, 12.2 and 16.0 per cent in April, May and June, respectively. Among the predators *Calosoma beesoni* was the most important and a single beetle of the same was found capable of consuming 5.6 ± 1.6 larvae of *Ectropis deodarae* daily.

Among entomopathogens, NPV, *Bacillus cereus* and *Beauvaria bassiana* are important causing infection to the extent of 12.6, 16.5 and 12.9 percent, respectively. In case of pupae, 22.4-36.5 per cent infection of *Beauvaria bassiana* was observed.

Campoplegidae deodarae - Pupal
Parasitoide of *E. deodarae*

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Introduction and Performance of *Paulownia* sp. for agroforestry in different agroclimatic zones of Himachal Pradesh [HFRI-026/08 (AGF-02) PLAN/2003-2008]

Status: Field trials of *Paulownia* sp. as established earlier in different agro climatic zones of Himachal Pradesh were maintained.

During the year, seedlings were raised mainly through root cuttings for laying out the new field trials. In the process, a trial in the forest land was established in Jammu region of J&K and a pure agroforestry trial was raised on the private land in Tea garden at Rakh Palampur, Himachal Pradesh. Besides this, beating up operations were also carried out. Data on different growth parameters in all the field and nursery trials were also recorded.

Field trial of Paulownia sp. at Dharamsala

Project 2: Diagnostic survey and appraisal of existing agroforestry systems in mid and high hills of Himachal Pradesh [HFRI-028/08 (AGF-03) PLAN/2003-2008]

Status: Villages have been identified for detailed survey and there after, stratification of selected areas and villages was done. Pilot survey conducted with questionnaires and village level meetings were also conducted. Data collected for various existing agroforestry systems in the identified zones is being analyzed.

A general landscape of mid hill region in Kullu Valley

Project 3: Standardization of nursery techniques of five dominant indigenous species (*Capparis spinosa, Colutea* spp., *Caragana* spp., *Ribes* spp. and *Cratagus* spp.) besides *Eleaegnus angustifolia* and *Rosa webbiana* of cold deserts [HFRI-019/03 (EBC-08)PLAN/ 2002-2007]

Status: Trials to understand the (i) Effect of different concentration of Indole-3 Butyric Acid on rooting in shoot cuttings of *Ribes* sp., *Colutea* sp., *Eleaegnus* sp., and *Hippophae rhamnoides* and in root suckers of *Rosa webbiana* and *Capparis spinosa,* (ii) Effect of pre-sowing (hot-water and Gibbrellic Acid) treatment on germination behaviour in the seeds of *Ribes* sp., *Collutea* sp., *Hippophae rhamnoides, Capparis spinosa* and *Rosa webbiana* and (iii) Effect of medium (various ratios of sand and soil) on germination behaviour in the seeds of *Ribes* sp., *Collutea* sp., *Hippophae rhamnoides, Capparis spinosa* and *Rosa webbiana* were repeated both in poly house and in nursery conditions. Besides this, experiments on the effect of mulching treatments on *Ribes* spp., *Hippophae rhamnoides, Rosa webbiana* and *Capparis spinosa* were also undertaken.

Rosa webbiana

Colutea nepalensis

Detailed ecological studies for the identified species were carried out in the already selected sites at Mane, Ladang, Kurith, Hurling, Tabo and at Samdoh falling in Spiti Valley of Himachal Pradesh.

The data pertaining to different growth parameters in various experiments were recorded. Sites for carrying out ecological studies in case of *Cratagus songarica* were also selected in Trilokinath area of Lahaul Valley. All the ecological parameters of the species studied and the data is being analyzed. Field trials as raised earlier were also maintained during the period.

Facilities at Field Research Station, Tabo (Lahaul and Spiti) were further strengthened by erecting poly-tunnels, shade houses, digging out trenches and establishment of irrigation system for carrying out trials in the nursery conditions. Ecological details of the different species were scanned and new nursery experiments as laid were maintained.

A field trail of the different cold desert species

Project 4: Studies on plant diversity in cold deserts of district Kinnaur, Himachal Pradesh [HFRI-029/ 02(EBC-11)PLAN/2004-2007]

Status: Due to flash floods in river Satluj because of breeching of Parchhu lake in Tibet, the field studies could not be taken up during the year, however, data as collected during the earlier survey was analyzed. Major tree species - *Cedrus deodara, Pinus gerardiana, Juglens regia, Betula utilis* and *Salix alba,* whereas the shrubs of importance were *Capparis spinosa, Collutea nepalensis, Ribes* spp., *Rubus* spp. and *Lonicera* spp. etc. in the area. Herbs were also recorded and some of them are, *Thalictrum foliolosum, Hercacleum candicans, Epilobium* spp., *Persicaria* spp. and *Potentila* spp., etc. *Hyssopus officinalis, Bergenia strachyei, Viola biflora* and *Geranium wallichiana,* were the species of medicinal importance. *Orobache* sp. (parasitic plant) as collected during the survey may be one of the new record for the flora of Himachal Pradesh. The number of herb species analyzed were 83, 82, 38 and 25 at 3000-3500m, 3500-4000m, 4000-4500m and 4500-500 m elevational range respectively.

A view of Cold Desert (Pooh sub-division)

Project 5: Natural enemy complex of key and potential pests of five *Quercus* spp. of Himachal Pradesh [HFRI-027/06(FPT-05) PLAN-2003-2008]

Status: All the five species of oaks viz. *Quercus glauca, Q. leucotrichophora, Q. dilatata, Q. semicarpifolia* and *Q. ilex* were screened with major emphasis on ban oak. During this period Darer Forest, Jhungi (near Sudernagar Distt. Mandi), Narag and Rajgarh (near Nahan, Distt. Sirmour) areas were surveyed and impact of oak defoliators was also recorded. *Lymantria obfuscata*- the Indian Gypsy Moth was found to be the major defoliator and outbreak of the moth was observed in Sirmour district of Himachal Pradesh causing heavy defoliation to Ban oak. Evaluation of the damage by Indian Gypsy Moth in the term of leaf consumption was done using Leaf-Area Measurements. Life-cycle of *Lymantria obfuscata* feeding on ban oak was completed and a repeat study is in progress in the laboratory.

So far, three Hymenopteran parasitoids were discovered as a parasitoids of cynipid pests that cause leaf galls. These species are *Torymus himachalicus*, *T. stom*, and *T. absonus* and are new to entomological sciences. Virus infected larvae were collected from the field and also obtained from laboratory reared larvae of Indian Gypsy Moth. The larvae were homogenized, centrifuged, virus particles were purified using 1% SDS and were refrigerated. Identification was done under Transmission Electron Microscope in collaboration with Central Potato Research Institute (CPRI), Shimla. Further exploration of Nuclear Polyhedrosis Virus (NPV) is in progress.

5th Instar larva of *Lymantria obfuscata*

NPV infected larva of *Lymantria obfuscata*

Project 6: Standardization of nursery technology for mass propagation of selected medicinal plant species [HFRI-009/07(NWFP-01)/PLAN/2000-2007]

Status: Germplasm of 33 medicinal plants species growing in temperate Himalayas was maintained in Brundhar nursery (Manali), 30 species at Shilly nursery, Solan and 10 species each at Shillaru Nursery (Shimla) and Model Nursery (Shimla). Trials are in progress for improving the agro-techniques of economically important medicinal plant species e.g. *Picrorhiza kurrooa* (Karu), *Aconitum heterophyllum* (Patish), *Valeriana jatamansi* (Mushkbala) and *Angelica glauca* (Chora) etc. Work is in progress for obtaining vegetative propagation in these species.

Project 7: Standardization of nursery techniques of raising containerized seedlings of conifers and their broadleaved associates [HFRI-016/05(SFG-06)/PLAN/2000-2007]

Status: Maintained nursery stock of Deodar, Fir and Spruce and some broadleaved species as raised under various trials in root trainers at Model Nursery, Baragaon, Shimla and Research Nursery, Shillaru. Trials were conducted to find out the optimum size/ type of root trainer seedling production in *Cedrus deodara*, *Abies pindrow, Picea smithiana* and *Alnus nitida.* Trials have been initiated on potting media comprised of locally prepared compost under root trainer seedling production system. Field trials have been initiated to assess the survival and growth after out planting the nursery stock raised in root-trainers vis-à-vis traditional system in Deodar, Silver Fir and Spruce.

Root development in Silver fir nursery stock in root trainers

Project 8: Planting stock improvement programme in *Cedrus deodara* [HFRI-028/05(SFG-08) PLAN-03/2003-2008]

Status: Surveys in deodar forests to select best stands of deodar based on ocular estimates of morphometric traits were carried out. Ocular selection of seed stands was followed by sample plot study wherein each and every individual tree within the stand was assessed for quantitative as well as qualitative traits and the stands with maximum average were finally selected. Sample plot studies were carried out to supplement ocular selection of seed stands for their conversion into Seed Production Areas (SPAs). The Cheog Forest (20 ha) falling in Theog Forest Division and Nankhari Forest (15 ha) of Rampur Forest Division were finally selected for complete enumeration. Each individual tree in these selected forests was assessed and marked for retention and culling. In Cheyog Forest 1527 trees were assessed, of which 1230 have been retained and 297 marked for culling whereas in Nankhari Forest the total numbers of trees enumerated were 1137, of which 1011 have been retained and 126 marked for culling. Detailed marking lists of these stands are being prepared and will be submitted to authorities concerned to obtain culling permission. Deodar forests of Udhampur Forest Division falling in the state of Jammu & Kashmir have also been surveyed, however, more areas still to be surveyed for selecting 15 ha seed stands for their conversion into Seed Production Areas (SPAs). A total of 70 Plus Trees in different deodar areas both in the state of Himachal Pradesh and Jammu & Kashmir have been selected and seed will be collected this year to raise progeny trail.

Project 9: Establishment of Amla and Khair demonstration plantations in lower hills of Himachal Pradesh

Status: Carried out beating up of casualties and maintained about 2.5 ha demonstration plantations of Amla and Khair at two sites namely Upper Darogan and Bhareta situated on Hamirpur Sarkaghat National Highway near Tonidevi Town of Himachal Pradesh. The plantations are being maintained intensively for the development of realistic model of Amla and Khair plantation. Feed back received on the subject reveals that the farmers of nearby areas are also interested in such type of interventions in their underutilized grasslands.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006

Project 1: Mycorrhizal association in selected temperate medicinal plants of Himachal Pradesh and Jammu & Kashmir [HFRI-032/07(FPT-06)PLAN/2005-2008]

Status: Plants of *Angelica glauca* (Chora), *Aconitum heterophyllum* (Atish), *Valeriana jatamansi* (Mushkbala), *Picrorhiza kurrooa* (Karu), *Saussouria costus* (Kuth) and *Heracleum candicans* (Patrala) were collected along with roots and rhizosphere soil from Banshiru Dhar (Manali) and Hatu (Narkanda) areas. Root and soil samples of these species as collected during the survey were processed in the laboratory and later the root samples were fixed in F.A.A. (Formaldehyde, Acetic acid and Alcohol in the ratio of 5:5:9) for further studies. VAM colonization in roots confirmed the association of VAM species in all these species of medicinal importance. Spores were extracted from the soil by wet sieving and decanting methods. Chemical studies of rhizosphere soils have also been initiated.

Project 2: Survey, biology and control of insect pests of important medicinal plants in Himachal Pradesh and Jammu & Kashmir [HFRI-033/06(FPT-07)PLAN/2005-2010]

Status: Regular and systematic surveys were undertaken to record the incidence of various pests in research nurseries of the institute located at Shilly (Distt. Solan), Shillarru (Distt. Shimla), Brundhar (Distt. Kullu) and Baragaon (Distt. Shimla). Besides this, the nurseries/ experimental areas as maintained by Department of Ayurveda, Govt. of Himachal Pradesh at Neri (Distt. Hamirpur) and Joginder Nagar (Distt. Mandi) were also visited to record the above observations.

Project 3:Allozyme variation in natural populations of Deodar (*Cedrus deodara*) [HFRI-030/05(SFG-10) PLAN/03/2005-2008]

Status: Open pollinated seeds from at least 20 individuals from 11 different populations [Cheyog, Chopal, Manali, Chail, Dalhousie, Churah (RF Khani), Naldehra, Nankhadi, Karsog, Chajpur and Kalpa] in the state of Himachal Pradesh and 4 populations from Jammu & Kashmir are being used to study genetic diversity in populations of deodar. However, seed could not be collected from all these populations during the year as the same was found to be the lean seed year. However, the seed as collected form three populations of Karsog, Chopal and Manali were assayed for four enzyme systems.

Project 4: Diagnostic study of indigenous and institutionalized participatory forest management in Himachal Pradesh [HFRI-025/08(PFM-01) PLAN/2005-2008]

Status: The project aims at to carry out diagnostic survey of institutionalized and indigenous (traditional) participatory forest management approaches being tried in the state of Himachal Pradesh along with gender issues analysis**.** Conducted survey to select sites and also for carrying out diagnostic survey in different PFM areas of Kullu, Sirmour and Shimla districts of the state. Discussions with the Divisional Forest Officers in the field were held and secondary data regarding different VFC, VFDC were also collected. Village meetings during pilot surveys were conducted to probe the details of progress of PFM as per identified criterion. The survey of forest guards at forest training centre Sundernagar and forest school Chail was also conducted to analyze to attitudinal change and knowledge about PFM. Data from other forest circles is being collected.

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Development of suitable model for intercropping of commercially important medicinal plants with horticultural plantations in temperate region of Himachal Pradesh [BT/PR4372/PBD/17/285/2003-2006: DBT Funded Project]

Status: Data recording in various intercropping trials of medicinal plants as laid in different sites of Kullu and Shimla district of Himachal Pradesh continued. Data for pre-harvest agronomic growth characters is being statistically analyzed. Porometer studies were also carried out for some of the trials. The trials were maintained by carrying out weeding, hoeing and watering and casuality replacement were also done. Quality planting stock of selected species to

Picrorhiza kurrooa

Valeriana jatamansi

be used for intercropping trials was maintained at Brundhar and Shillaru research nurseries by carrying out regular nursery operations. Samples of *Aconitum heterophyllum, Angelica glauca, Polygonatum verticilatum, Picrorhiza kurrooa* and *Valeriana jatamansi* were collected from natural habitat as well as from the local market for carrying out comparison as far as the active principles of these species of medicinal importance.

Soil sample were also collected from the natural zones of occurrence of these species and analyzed in the laboratory. Periodic recording of data including the growth parameters is being continued.

Project 2: Ecological and management studies in certain dry temperate and alpine pastures of Lahaul and Spiti, Himachal Pradesh [BT/PR4102/NBDB/ 51/027/2003]

Status: Sites supporting alpine pastures in each part of the district i.e. Miar Nallah, Trilokinath, Dalang and Kwaring in Lahaul valley and Gue, Tabo and Kunjam in Spiti valley were identified as the representative sites for recoding floral elements including assessment and distribution of rare and endemic plants.

Alpine pasture site for reconnaissance survey at [a] Trilokinath (Lahaul) and [B] Kunjam (Spiti)

Base line data of all the study sites were collected from the available sources.

Sites at Khoksar (Lahaul valley) and Kiyato and Gate (Spiti valley) were selected for detailed investigations on structural and functional aspects of the alpine pastures including the assessment of floral elements.

Studies on floristic composition, phenology, phyto-sociology of the constituent species including biomass estimation and productivity potential in the respective sites were carried out at monthly intervals by using quadrates. New floristics and their association were recorded in both the valleys. In all about 100 species were recorded from different altitudes and majority of them adding to the fragmented studies made earlier in the region. Number of species of medicinal importance and endemic to the area were also recorded from these pastures. Vegetation types were also identified from some of the sites. Data on productivity and other parameter is being analysed.

Project 3: Ecological assessment of forest areas falling under Koldam hydroelectric project in Bilaspur district of Himachal Pradesh [FT48-88/86(FCA) 2004-2007 KOL DAM: HPSFD Funded Project]

Status: Selected study sites in different catchment areas of Bilaspur, Kunihar, Theog and Karsog Forest Divisions and afterwards detailed reconnaissance survey and ecological studies in the identified locations were carried out. Plant diversity studies were accomplished. Soil samples were also collected to assess the chemical properties of the soil.

Koldam catchment (Theog Forest Div.)

Taxus wallichiana

Project 4: Production of quality planting material of *Picrorhiza kurrooa* Royle ex Benth and *Valeriana jatamansi* Jones and Extension of their cultivation technology to local communities [GO/HP-2/2004-2007: NMPB Funded Project]

Status: Activities under the project mainly centered around production and maintenance of quality planting material of *Picrorhiza kurrooa* and *Valeriana jatamansi* at three research stations/ nurseries of the Institute located at Bruhandhar (Manali), Shilly (Solan) and Shillaru (Shimla). The activities during the year mainly included preparation of land for nursery beds, macro-proliferation (multiplication) of 1-2 years old existing stock of *Picrorhiza kurrooa* and *Valeriana jatamansi* in the nursery and procurement of sand, FYM etc. Target for the production of 4 lacs Quality Planting Material (QPM) of *Picrorhiza kurrooa* (Kutki) and *Valeriana jatamansi* (Mushkbala) has been given

by National Medicinal Plants Board (NMPB) under this project during 2004 to 2007. The Institute accordingly, has fixed target to raise at least 3.20 to 3.30 lacs plants i. e. 80% of the target of these species during first two years of the project period, so that in last year of the project more emphasis be given on distribution of material and extension activities. Up to March 2006, the Institute had raised 3.3 lacs of quality planting material of Kutki and Mushkbala under this project in different nurseries. 15,750 numbers plants of these two species were distributed amongst local communities during the year 2005.

Project 5: Development of elite planting material, establishment of model plantations and extension of nursery and plantation techniques of Wild Apricot to local communities in Himachal Pradesh [27-79/NOVOD/2004/1188-89/ 2004-2007: NOVOD Funded Project]

Status: Seeds of Wild Apricot were collected from Kinnaur and Shimla districts of Himachal Pradesh. The seeds were then provided pre-seed stratification treatment in moist sand at low temperature and later sown in the nursery beds. Around 10,000 quality seedlings of wild apricot raised and maintained in the research nurseries.

A survey was conducted for the selection of suitable sites for carrying out plantations of the species over an area of 25 ha. Based upon soil depth and moisture regime, the sites for plantations were selected at Bhaba Nagar (Kinnaur), Shillaru (Shimla), Barog (Solan) and at Sambal (Mandi) district. The plantation activities later were carried out during the month of January-February 2006. 2,700 plants of wild apricot (6.75 ha) were planted at Bhaba Nagar (Kinnaur Forest Division), 2,500 plants (6.25ha) at Shillaru (Kotgarh Forest Division), 2,500 plants (6.25 ha) at Barog (Solan Forest Division) and 2,300 plants (5.75ha) at Bahlidhar, Sambal (Nachan Forest Division). Three training programmes were also organized under the project.

Project 6: Suitability of *Jatropha curcas* L. seed sources in lower and mid Himalayan regions of Himachal Pradesh [BT/PR/5094/AGR/16/429/2005-2008: DBT Funded Project]

Status: Approximately 26,000 numbers of quality planting stock of *Jatropha curcas* from 25 different seed sources was raised and maintained in the nursery during March to August 2005. The stock thus raised was later used for establishment of experimental-cum-demonstration plantations over an area of 10 ha at 6 different sites located in Solan, Bilaspur and Sirmour districts of Himachal Pradesh during July/ August 2005.

About 80 Kg of seeds of *Jatropha curcas* were also collected from 26 different locations during October/November 2005 covering 7 district of the state of Himachal Pradesh. Out of the collection, around 15 kg seeds were sent to FRI, Dehradun and 10 kg seeds were provided to Divisional Forests Officers of Solan and Nalagarh Forest Divisions for sowing purposes.

Bir Plassi Nursery, Nalagarh and Majholi Nursery, Solan were used for sowing the seeds in the month of March and April 2006. Besides this, around, 10,000 cuttings have also been planted for the overall production of 30,000 planting stock of Jatropha for carrying out beating up operations and fresh plantations over an area of 10 ha.

PROJECTS INITIATED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Development of ecologically viable and socio-economically acceptable integrated model for Arresting Willow (*Salix* sp.) mortality in Lahaul Valley of Himachal Pradesh [GBPI/IERP/04-05/34/861]

Status: Nursery for raising the clones of willow was established at Sissoo (Lahaul valley) where both national and international clones, provenances and species were planted for their further screening. Besides, 8 international clones, 3 species as brought from the state of Jammu & Kashmir and 5 different provenances of Salix as identified in and around Karsog area of Himachal Pradesh were raised and maintained in this nursery. Besides this, material as collected from 14 different locations/ provenances within Spiti and Kinnaur valleys were also raised and maintained in the nursery at Tabo. A demonstration plantation in an area of 0.5 ha was established where 246 plants of Salix and 84 plants of *Populus ciliata* were raised.

Willow plantation in Lahaul Valley

While establishing this demonstration plantations at Sissoo, planting material of 5 different species of Salix from the state of Jammu & Kahsmir, 3 different provenances from Himachal Pradesh and 5 different international clones were used.

Nursery has been raised at Sissoo for assessment of Aphid attack on Willows including studies on their life cycle. Plantations of Willow as raised by villagers at Gompthang and at Keylong including plantations at Tandi and Satingri were visited. For recording populations of willow aphids, 9 twigs were marked and the required observations were recorded daily for 5 days.

The alatoid viviparous nymphs appeared when the colony became overcrowded. Alate aphids appeared and they were found taking shelter inside the crevices of rock. GWA was collected for the first time from Satingri in Lahaul valley.

Project 2: Studies on population status and Berberine content in different provenances of *Berberis aristata* DC in Himachal Pradesh and standardization of its propagation techniques [BT/PR 4695/PBD/17/300/2005-2008: DBT Funded Project]

Status: The Project aims to identify high berberine yielding *B. aristata* provenances in Himachal Pradesh and to develop nursery techniques for mass propagation of identified elite clones/ provenances of *B. aristata*. During the

initial phase of the project period, six provenances of *Berberis aristata* have been identified in Himachal Pradesh. Later 2 kg of root samples were collected after random selection of 2 to 3 mature plants from each of the provenance for further studies. The collected roots were cut into small pieces, dried in shade and sent to the Forest Research Institute, Dehradun for estimation of berberine content. To standardize nursery techniques for mass propagation of the species, one year old semi-hardwood cuttings collected from mature plants were treated with different concentrations of IBA, IAA and NAA and transplanted in mist chamber of the institute. Data on sprouting of stem cuttings are being collected from the nursery and mist chamber of the institute. For seed germination studies, seeds extracted from ripened fruits were subjected to 13 different pre-sowing treatments and the studies indicated that maximum germination was recorded in seeds with 24 hour hot water followed by 24 hour boiled water treatments.

Project 3: Invenorization, documentation of plant diversity and to evolve site specific management strategies for conservation of various sacred groves in Kullu Valley of Himachal Pradesh [GBPI/IERP/04-05/18/865/2005-2008: GBPIHED Funded Project]

Status: The present study aims at to inventorize and document the plant diversity, assess the regeneration status of trees in comparison to the adjacent forest area, create awareness amongst the local people and to develop site specific strategies for the rejuvenation and conservation of sacred groves through participation of local people.

A questionnaire was prepared to record data on the sacred groves and field visits were undertaken in the study area and meetings with the villagers were also held. Twenty two sacred groves were visited and information on plant diversity was recorded. Fifty five plant species belonging to 31 families have been recorded so far from the sacred groves. Traditional ethno-botanical information on 15 species have also been documented.

Project 4: Setting up 100 hectare demonstration plot in Himachal Pradesh and production of elite planting material of *Dendrocalamus hamiltonii* [BT/PR/5243/AGR/16/456/2005-2008/ DBT Funded Project]

Status: The site where demonstration plots of *Dendrocalamus hamiltonii* are being raised is situated about 28 km south-east of Solan. The area falls under Dhadiyarghat beat, Lugon Block, Parwanoo Range of Solan Forest Division.

Keeping in view the activity schedule and target of raising 10 ha demonstration plot, complete socio-economic survey of adjoining village Dadhog was carried out besides other related activities required for preparation of sites. Plantation was raised in 5 ha area by using tissue culture raised experimental (2.63 ha), conventionally raised (0.27 ha) and demonstration plots of 2.10 ha. Randomized Block Design was followed to raise experimental plots. The experimental plots for tissue culture raised plants as per the guidelines have been laid out at two spacing of 5 m x 5 m and 6 m x 6 m with four treatments of the fertilizers and three replications. For conventionally raised plants demonstration plot the spacing have been kept at 5 m x 5 m.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	4	9	4
External Projects	-	6	4
Total	4	15	8

EDUCATION AND TRAINING

Education

1. Probationers of Indian Forest Services from Indira Gandhi National Forest Academy, Dehradun, visited Himalayan Forest Research Institute (HFRI), Shimla on 17th May 2005.
2. Range Forest Officer Trainees of Uttranchal Forest Training Academy, Haldwani visited the institute on 19th May 2005.
3. Students from Sarswati Vidya Mandir School, Vikas Nagar, Shimla visited the institute on 22nd June 2005.
4. Forest Guard Trainees from Forest Training School, Chail, Himachal Pradesh visited the Institute on 22nd July, 2005. The trainees were made aware of the ongoing institutional research activities of the Institute through a presentation.
5. A team of farmers from Distt. Kinnaur alongwith officers from the Divisional Forest Office, Kinnaur was apprised of various activities being undertaken by the institutes and issues of common interest including ecology and suitable agroforestry models that can be practiced in the district were discussed on 21st March 2006.
6. Dr. Vaneet Jishtu from this institute was awarded Ph. D. Degree in forestry from FRI Deemed University, Dehradun.

Training Organized

1. Organized two days Farmers Training Programme on "Wild Apricot" on 2nd and 3rd September 2005 at Narag falling in Rajgarh Forest Division of District Sirmour, Himachal Pradesh. The Training was organized under the project funded by the NOVOD Board of Govt. of India. An open meeting under NOVOD funded project was also organized for the farmers of Baragaon village at Model Nursery, Baragaon on 17th March 2006, where farmers were made aware of importance of cultivation of Wild Apricot.
2. Organized two Farmer's Trainings Programmes on "Cultivation of Karu and Mushkbala" at village Sajla and Karjan of Kullu District on 10th March 2006 and at village Jhungi of Mandi

Training and demonstration programme on Wild Apricot

District on 12th and 13th March 2006 under the project funded by National Medicinal Plant Board, New Delhi.

3. One day Farmer's Training on "Commercial Cultivation of Medicinal and Aromatic Plants" at village Dhalwan on 14th March 2006, the funds for which were given by the State Forest Department, Himachal Pradesh


Training and demonstration programmes at Himachal Pradesh

Attended

1. Shri K.D. Sharma, IFS attended one week compulsory training course on "Wildlife Management: Issues, Concerns and Practices for Indian Forests Service Officers" from 20th to 24th June 2005 at Wildlife Institute, Dehradun (Uttaranchal).
2. Shri K.S. Thakur, DCF attended three days' training programme on Overview for Decision Makers at Indian Institute of Remote Sensing, Dehradun from 20th to 23rd September 2005.
3. Shri Surinder Kumar, Director, HFRI, Shimla attended two weeks Promotion Linked in-service Training for IFS Officer from 18th to 28th October 2005 at IGNFA, Dehradun.

LINKAGES AND COLLABORATION

The Institute remained in constant touch with the State Forest Departments of Himachal Pradesh and Jammu & Kashmir; State Forest Research Institute, National Bureau of Plant Genetic Resources, Shimla; Dr. Y.S. Parmar University of Horticulture and Forestry, Solan; CSK Himachal Pradesh Krishi Vishvavidayala, Palampur; Institute of Himalayan Bio-resource Technology, Palampur, Himachal Pradesh University, Shimla and Punjab Agriculture University, Ludhiana including other research and non governmental organizations working in the field of forestry and forestry research in the state of Himachal Pradesh and Jammu & Kashmir. Contacts were also established with Central Potato Research Institute, Shimla for Transmission Electron Microscopic (TEM) studies. Besides this, the institute is implementing two externally aided projects in close collaboration with CSK Himachal Pradesh Krishi Vishvavidayala, Palampur and Institute of Himalayan Bio-resource Technology, Palampur. This has enabled the institute to share the ideas and the research input with these organizations.

PUBLICATIONS

Brochures/ Technical Bulletins/ Booklets

1. Sharma, Sandeep; K.S. Thakur and Naina Joshi (2005). Jatropha: Bhavisya Ka Bio-diesel Paudha.
2. Thakur, K.S.; P.S. Negi and Sandeep Sharma (2005). Chuli: Paudhshala Avam Variksha Ropan Taknik.
3. Meena Bakshi, Surinder Kumar, Rajesh Sharma and K.S. Thakur (2006). Mass Vegetation Propagation of *Dalbergia sissoo* (Roxb).

Research Reports

Ranjeet Singh, Surinder Kumar, S. Chakrabarty and Ashok Kumar (2005). Resurgence of Indian Gypsy Moth, *Lymantria obfuscata* (Lepidoptera: Lymantriidae) on Ban Oak Forests of Rajgarh Forest Division, Himachal Pradesh. Research Report No. HFRI/RP/028, September 2005.

CONSULTANCY

To guide and to provide all necessary inputs, cooperation and technical assistance to M/s Gujarat Ambuja Cements Ltd. Darlaghat, District Solan (HP), Himalayan Forest Research Institute, Shimla signed a Memorandum of Understanding with the Company initially for a period of five years beginning from July 2005 for "Carrying out Eco-rehabilitation Activities in its Mined Out Areas at Kashlog". This consultancy is to be implemented by the Divisions of Ecology and Biodiversity Conservation and Silviculture and Tree Improvement of the institute. An amount of Rs. 3,97,347 has already been advanced to this institute for taking up the related works during 2005-2006.

CONFERENCE/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. Shri Surinder Kumar, IFS, Director, HFRI and Dr. K.S. Kapoor, Coordinator, Research attended the meeting of Research Policy Committee of ICFRE from 30th April to 1st May 2005 at ICFRE, Dehradun.
2. Dr. Sandeep Sharma, Scientist-D attended a workshop on "Traditional System of Medicine" at YMCA. Complex, Shimla on 25th June 2005.
3. Dr. K.S. Kapoor, Scientist-E attended an International Workshop on "Conserving Hill and Mountain Ecology from 24th to 26th August 2005 organized by United States Educational Foundation in India at Shimla in collaboration with Institute of Integrated Himalayan Studies, Himachal Pradesh University, Summer Hill (Shimla) and Forest Survey of India (NZ), Shimla.
4. Shri Ashok Kumar, Scientist-B participated in the National Symposium on Changing Concepts of Forestry in 21st Century on 21st and 22nd October 2005 held at Dr. Y.S. Parmar University of Horticulture and Forestry

Nauni, Solan sponsored by ICFRE, Dehradun and H.P. State Forest Department.

5. Officers and Scientists of this institute attended one day's workshop on "Acts and Rules for Environmental Conservation" on 25th November 2005 as organized by State Director, World Wide Fund, Shimla in collaboration with HFRI, Shimla.
6. A Regional Workshop on Forestry Extension Strategy Review was organized by the Institute on 27th December 2005. Besides participation of officers and scientists from this institute, about 25 participants representing different Research Organizations, Universities, NGOs, Farmers and State Forest Departments like Forest, Horticulture and Animal Husbandry also attended the workshop.
7. Shri Surinder Kumar, IFS, Director, HFRI attended a workshop on Climatic Change Mitigation in Forestry Sector at New Delhi on 23rd and 24th January 2006.
8. Shri Surinder Kumar, IFS, Director; K.S. Kapoor, Coordinator research and Dr. Sandeep Sharma, Scientist-D attended Silviculture Conference as organized by FRI, Dehradun from 1st to 3rd February 2006.
9. Himalayan Forest Research Institute, Shimla in collaboration with State Forest Research Institute (SFRI), Jammu & Kashmir organized a one day Liaison Meeting on 7th February 2006 for the Senior Forest Officers of the Jammu & Kashmir, State Forest Department.
10. Dr. Rajesh Sharma, Scientist-D attended a national workshop on Tree Biotechnology Indian Scenario as organized by TFRI, Jabalpur on 9th and 10th February 2006.
11. Dr. Sandeep Sharma, Dr. R.K. Verma and Shri Jagdish Sharma attended a national workshop on Conservation and Cultivation of Medicinal Plants as organized by Haryana State Forest Department in close collaboration with State Medicinal Plant Board, Govt. of Haryana on 15th and 16th February 2006.
12. Shri Surinder Kumar, IFS, Director, HFRI attended workshop on Forestry Education in India: Issues and Opportunities at Deemed University, Dehradun on 20th and 21st March 2006.
13. Shri Surinder Kumar, IFS, Director, HFRI attended Research Policy Committee Meeting on 22nd and 23rd March 2006 at FRI, Dehradun.
14. Dr. K.S. Kapoor, Scientist-D and Dr. R.K. Verma, Scientist-D attended National Seminar on Wasteland Development in Shiwaliks with Particular Reference to Himachal Pradesh at Dr. Y.S. Parmar University, UHF, Nauni, Solan on 22nd and 23rd March 2006.
15. Sh. K.D. Sharma, IFS, DCF, HFRI attended one day Symposium on Disaster Management on 23rd March 2006 at Indus Hospital, Shimla.
16. Dr. Ranjeet Singh, Scientist-D attended a three days National Congress of Entomology from 15th to 17th March 2006 at Department of Zoology, Punjabi University, Patiala.
17. Shri P.S. Negi, Research Officer, HFRI, attended one day workshop on Nursery Propagation and Marketing of Medicinal Plant at Village Rakchham, Tehsil Sangla, Distt. Kinnaur, organized by Wildlife Division, Sarahan, Shimla.

DISTINGUISHED VISITORS

1. Shri R.P.S. Katwal, IFS, Ex. DG, ICFRE and now ADGF (Wildlife), Ministry of Environment and Forests, Government of India visited the Institute on 9th June 2005.
2. Dr. Dev Dutt, Scientist from the National Oilseeds and Vegetable Oils Development Board (NOVOD), Gurgaon visited the Institute from 24th to 26th August 2005 to assess and to review the ongoing research and demonstration activities under the project titled, "Development of Elite Planting Material, Establishment of Model Plantation Techniques of Wild Apricot to Local Communities in Himachal Pradesh" and funded by the Board.

CHAPTER 3.8

Institute of Forest Productivity Ranchi

The eastern region of our country comprises of diverse ecosystems. This encompasses the pristine, picturesque and fragile Western Himalayas in North-West Bengal and Sikkim, the fertile and alluvial Eastern Plains strewn with riverine wastelands of the lower reaches of Ganga basin in Bihar and West Bengal, deltaic and coastal mangrove of the world famous Sunderbans, a pocket of Terai Sal Forests in North-West Corner of Bihar, and the Tropical deciduous forests of Kaimur and Chhotanagpur Plateau overlying rich and enticing coal and other mineral deposits.

The concomitant features are vast stretches of degraded forests of Chhotanagpur Plateau and adjoining tracts of Jharkhand, South-West Bengal and South Bihar, threatened biodiversity of the forests dwindling species richness especially those of medicinal plants, bamboo and canes; heavy pressure of mining and development of industrial processes. Major portions of this region support one of the densest rural populations of the world and require environmental amelioration and enhancement of potential productivity of land through R & D activities in this region, which faces a wide ranging research problems.

To take up the role of Research and Development in the core of the bio-physical natural systems linked with the forestry and allied sectors to address the main problems born and accentuated by the aforesaid features with region specific characteristics, the Institute has taken up a number of research and training programmes for the benefit of different stakeholders and user agencies, NGOs, Research Organizations, States of Bihar, Jharkhand, Sikkim, West Bengal and the public at large. Six agroecological zone and eight main forest types are covered within its jurisdiction.

PROJECTS COMPLETED DURING THE YEAR 2005-2006

Project 1: Soil Vegetation interaction with special reference to nutrient cycling in some selected plantations under different edaphic conditions [IFP-9/SLR/P-III/2002-2006]

Findings: Field survey for growth and assessment of productivity and soil vegetation interaction: Growth of most common tree species planted in South-West Bengal viz., *Acacia auriculiformis, A. mangium, Azadirachta indica, Dalbergia sissoo,* Eucalyptus, *Gmelina arborea, Shorea robusta* and *Tectona grandis* from 132 plantation sites under alluvial, coastal and lateritic soils of South-West Bengal were compared. Litter fall seasonality of Eucalyptus, *A. auriculiformis, A. mangium* and *Dendrocalamus strictus* of 6 years old plantations have been worked out and found that *A. mangium* produced maximum litter (9.18 ton/ha) followed by *A. auriculiformis* (6.95), Eucalyptus (5.97) and *D. strictus* (4.50 ton/ha).

Nursery trials on plant nutrient assessment: A series of nursery trials have been conducted to study the role of major plant nutrients (N, P, K, Mg and Lime) on growth, uptake pattern of nutrients for optimisation of most suitable combinations of nutrient doses for *A. auriculiformis, A. mangium* and Eucalyptus species. The optimum doses of individual N, P and K for *A. mangium* seedlings on degraded lateritic soil without liming were found to be 140 to 160 mg N , 125 mg P_2O_5 and 115 mg K_2O per kg soil. While combined dose of 150 to 175 mg N, 110 to 115 mg P and 110 to 115 mg K per kg soil was found to be optimum. For *A. auriculiformis* individual doses of N, P and K are 140 to 160 mg,

115 to 130 mg and 110 to 115 mg per kg soil respectively. The corresponding doses for Eucalyptus are some what higher i.e., 150 to 175 mg N, 120 to 140 mg P and 115 to 130 mg K. Liming (@ 28.4 mg/kg soil) of degraded soil favoured growth of all the three tested species and combined application N, P and K have further improved the growth.

To assess the response of Eucalyptus, *A. auriculiformis* and *A. mangium* seedlings on Mg under degraded lateritic soil condition, out at Netaipur Mg dose ranges from 5 to 75 mg per kg soil were given. Increased growth of the seedlings was observed as compared to those without Mg treatment. Lower doses of Mg i.e., 15 to 35 mg Mg per kg soil increased the growth of Eucalyptus and *A. auriculiformis*.

Field trials on tree nutrient assessment: 5 years old *Acacia auriculiformis, A. mangium* and *Eucalyptus* sp. were subjected to 20 to 350 g N, 10 to 250 g P and 10 to 250 g K per plant and it was observed that 150 to 170 g N, 75 to 85 g P and 45 to 55 g K were found to be most favaourable combinations for Eucalyptus and 120 to 130 g N, 85 to 100 g P and 45 to 55 g K for *Acacia auriculiformis* and *A. mangium.*

Project 2: Development of biofertilizers and standardization of their application in relation to productivity of forest tree species under degraded lateritic soil condition [IFP-3/BGT-SP-3/P-I/2002-2005]

Findings: Arbuscular Mycorrhizal Fungi associated with forest tree species and their influence on plant growth: Plantations of *Acacia auriculiformis, A. mangium,* Bamboo, *Tectona grandis* and natural coppice sal (*Shorea robusta)* forests were surveyed for distribution study of AM fungi and altogether 8 species were recorded from rhizosphere soils.

Isolation of Azotobacter and Rhizobium bacteria and study of their role: Pure cultures of 21 Azotobacteria and Rhizobium bacteria were isolated from rhizosphere soils of different species cultivated in East and West Midnapore districts of South - West Bengal. Cultures isolated from bamboo, banana, *Shorea robusta* and *T. grandis* are superior in terms of N-fixation. Maximum quantity of atmospheric nitrogen fixed by the isolated culture is 25.98 mg N/100 ml medium consumed within 3 days under laboratory condition.

Rhizobium and Azotobacter inoculation in soils treated with rice husk, compost, bamboo litter and vermicompost were found more effective in nodulation by Rhizobium and in enhancing growth of *A. auriculiformia* and *Eucalyptus* sp. respectively. Double inoculation of AM fungi with Azotobacter or Rhizobium was found better than single application.

Optimization of time of application of biofertilizers: Rhizosphere application of Rhizobium after two weeks of germination with or without seed inoculation exhibited better nodulation and growth of host specie (*Acacia auriculiformis* and *A. mangium*). Five isolated cultures of Rhizobium showed better results while pre-treatment with Rhizobium cultures (24 hu both containing 100 to 1000 M cells/ml @ 10 ml/100 seed) along with seedling treatment (1 ml/seedling injected at rhizosphere soil grown in 1 kg pot) did not show additional increment of host tree growth or nodulation.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Multilocational field trial of tissue culture raised plantlets of *Dendrocalamus as per* [IFP-4/BGT-SP-4/P-1/2002-2006]

Status: Plantations are of 3.5 years as suggested by the RAG all members experiment on nutritious value of bamboo as a food is being assessed.

Project 2: Genetic Improvement of Eucalyptus through progeny trial and hybridisation [IFP-7/BGT-SP-7/P-1/2002-2006]

Status: Half-year growth data (Total height, Clearbole height, and Collar diameter) of all the plants planted have been recorded and the performances are being evaluated. General Combining Ability (GCA) has been established for above characters along with breeding values. Mortality rate was checked and replaced. The current mortality rate at the end of February 2005 was 4.17 %.

Project 3: Studies on variability of bamboo species, their performance, conservation and economics with reference to Bihar, Jharkhand and West Bengal [IFP-10/BS/P-IV/2002-2007]

Status: Nursery trials on development of bamboo propagation techniques: In the first trial, cuttings with double nodes, single node and bifurcated single node (collected from 1-2 years old *B. tulda* culms) were used with or without hormone and planted in mother bed containing surface forest soil (without treatment) maintaining the culm bud levels at i) bed soil layer, ii) 1 cm above and iii) 1 cm below bed soil layer. The cuttings were covered with straw mulch and maintained with proper irrigation, weeding and insecticide use. After 30 days, sprouting were recorded in all the treated cutting. Root development was also recorded. Double node cuttings favoured maximum rooting in comparison to single node cuttings. Bifurcated nodes containing single bud showed 100% sprouting but 20 to 30% rooting after 30 days. Beds are maintained for further observation.

Bamboo seedling from double node cutting

***Ex-situ* conservation of Superior Bamboo planting materials:** Superior Bamboo planting materials (Rhizome, culm cuttings etc.) have been collected and planted at Mandar for *ex-situ* conservation. The plants are being maintained as per standard silvicultural methods. The growth parameters of the planted bamboos are being recorded periodically.

Market Survey, Survey on Bamboo Utilities and Socio-economic Survey: Data in relation to economics on plantations raised in forests and villages, harvest data etc. have also been collected from North and South Bengal and Jharkhand. Utilities of bamboos in different locations were recorded. Data for Socio-economic analysis due to bamboo forests and bamboo plantations in different states were also collected.

Project 4: Standardization of suitable potting media and root trainer size for improved planting stock production of some mandate species of Jharkhand and Southern-West Bengal [IFP-1/BS-SP-1/P-I/2002-2006]

Status: With the variation of treatment i.e. different potting media mixture and fertilizer, growth of the seedlings varied considerably. Application of FYM and compost in the potting media mixture enhance the growth of seedlings. With the increase of hykopot size from 150 cc, 250 cc and 350 cc the height, collar dia and biomass of the seedling increases for *Acacia mangium* and *D. sissoo* in all treatments. In 250 cc hykopot maximum height of seedling was found for *G. arborea* and *Eucalyptus camaldulensis* but collar dia of the seedlings were found less than that of 350 cc hykopot. As a result total seedling biomass was found higher in 350 cc hykopot though height was found lower than 250 cc hykopot. Nutrient content and physical characteristics of the potting of the 17 potting media varies considerably among the different mixtures of pot material.

Project 5: Exploration of Lac cultivation on non-traditional host *Flemingia* spp. and its possibility in sustainable plantation forestry [IFP-13/NWFP-SP-I/P-VII/2002-2005]

Status: Aghani-05 broadlac harvested in control as well as experimental condition in *Flemingia macropylla* as well as *Flemingia semialata* plots is under progress.

Project 6: Trials on composting for Specific afforestation needs and development of cost-effective packages [IFP-2/BS-SP-2/P-I/2002-2007]

Status: Compost has been prepared from chakor within 120 days by remixing the material with water. Time taken for compost preparation decreased to 70 days with the addition of soil with the raw material and remixing of the material with water. Addition of soil and 1 % urea (w/w basis) with the raw material again decreases the time taken for compost production to 60 days. Production cost of compost was found Rs. 5.00 per kg.

Project 7: Development of appropriate agro-silvicultural systems for selected medicinal flora of Chotanagpur and Santhal Parganas [IFP-20/ERM (MP)/2003-2008]

Status: Successfully cultivated *Withania somnifera* plants from seeds, which are very difficult to propagate.

Project 8: Creation of germplasm resource bank of threatened medicinal plants of Darjeeling Himalaya [IFP-11/ERM (MP)/P-V/2003-2008]

Status: *Ex-situ* conservation of certain species have been carried out in the foothill at Sukna and Sonada under Darjeeling District (Eastern Himalaya). Data on growth rate and flowering, fruiting and yield were recorded.

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: *Schleichera oleosa* (Lour.) Oken, a lac host: *In vitro* propagation (Funded by DBT) [IFP/2003-2006]

Status: Leaf drop of kusum culture *in vitro* has been arrested. Healthy elongated shoots were observed.

Project 2: Development of Bio-aesthetic habitat by Central Coalfields Limited over a 5 hectare company's land at Ranchi (Funded by CCL, Ranchi) [IFP/ 2003-2008]

Status: Field work is under progress.

Project 3: Development of agro-techniques for *Gymnema sylvestre* and *Embelia ribes*- medicinal plants of high marketing potential [IFP-22/ERM(MP)-P-VIII/2004-2007]

Status: *Gymnema sylvestre* cuttings have been collected from both natural forests and from Forest department nurseries.

Project 4: Documentation of indigenous knowledge on conservation and sustainable management in Darjeeling Himalayas [IFP-25/EE/2004-2007]

Status: Due to non -availability of scientist in the station, no progress achieved during the financial year 2005-2006.

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Creation of medicinal plants gardens in different agro-climatic zones in Eastern Himalayas for demonstration and distribution of planting materials to the farmers [GO/JR-1/2005-2007]

Status: Vegetative cuttings of certain species were raised in the propagation centre and two lacs seedlings are ready for free distribution and planting. Developed Herbal garden and Propagation centre at Dilaram, hills of Darjeeling Himalayas.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Project	2	8	-
External Projects	-	4	1
Total	2	12	1

TECHNOLOGY ASSESSED AND TRANSFERRED

1. Improved techniques of Lac cultivation were transferred to SFDs, Jharkhand. Chhattisgarh and West Bengal as well as trainees sponsored by S.E.P.C., Kolkata under the project "Development of Pilot Broodlac Farm and Lac finishing facilities in Purulia, West Bengal".
2. Propagation of bamboo through scientific methods was transferred to personnels of SFD, Jharkhand.
3. Development of aerobic process for compost production has been done in above ground chamber.
4. Quality Planting materials of different medicinal plants were ready for free distribution to the villagers of North-West Bengal.
5. Vermicomposting unit have been set up for production of improved vermicompost.

EDUCATION AND TRAINING

Education

1. Entrance Test Examination for M.Sc. and Diploma Courses in Forestry under FRI Deemed University, Dehradun was conducted by the Institute on 15th May 2005 at Ranchi centre, in which out of 25 candidates, 22 candidates were turn up.

2. Dr. Animesh Sinha, Scientist-C of the Institute visited Central Institute of Medicinal and Aromatic Plants, Lucknow on 19th and 20th October 2005 to discuss and explore the possibilities of under taking research on *in vitro* conservation of forest genetic resources and molecular aspect of lac host plants.

3. Shri Sandeep Kujur, IFS, DCF proceeded for attending "Promotion Linked Advance Forest Management Course" for Officers of 10 years in service held from 25th July to 12th August 2005 at Indira Gandhi National Forest Academy, Dehradun.

4. Shri Dinesh Prasad attended a three weeks training programme on "Agromet Observers' Course" at India Meteorological Department (Agrimet Division), Shivaginagar, Pune from 20th February to 10th March 2006.

Training Organized

1. Training organized on Improved techniques of Lac cultivation for SFD personnel, villagers, Foresters, Forest Guards, Foresters of Kathghora Forest Division and Van Samiti Members of Chhattisgarh State and trainees

of SEPC, Kokata from 29th March 2005 to 2nd April 2005; 4th to 8th April 2005; 13th to 17th April 2005; 25th to 29th April 2005, 2nd to 6th May 2005 and 19th to 23rd September 2005.

2. Training organized on Propagation of bamboo through scientific method for ACFs, Range Officers, Foresters, Forest Guards of SFD, Jharkhand from 21st to 23rd June 2005; 24th and 25th June 2005 and 28th to 30th June 2005.
3. Organized a training on 'Tassar Cultivation' with the collaboration with Central Tassar Research and Training Institute, Ranchi for Forest Guard/ Forester of SFD, Jharkhand from 23rd to 25th November 2005.
4. Training on Modern Technique of Lac Cultivation for Forest Guard/ Forester of SFD, Jharkhand from 28th November to 2nd December 2005.
5. Training on Bamboo propagation for ACFs, ROFs. Forester, Forest Guard of SFD, Jharkhand from 5th to 10th and 12th and 13th December 2005.

LINKAGE AND COLLABORATION

International

EWI, USA; DFID (U.K.) and IDRC.

National

NABARD; Medicinal Plant Board; Department of Biotechnology; Central Coalfields Limited; Damodar Valley Corporation; ILRI, Namkum; ISM, Dhanbad; HARP; Plandu; BAU, Kanke, Ranchi; SFD, Jharkhand; SFD, West Bengal; SFD, Bihar; FSI, Eastern Zone, Kolkata; and TATA Steel, Hazaribagh.

PUBLICATIONS

1. Annual Lac Bulletin of the Institute.
2. Brochures / Booklets on improved method of Lac cultivation.
3. Brochures on "Bans Utpadan ki Unnat Takniquie ewam Pravardhan Vidhi".
4. Proceedings of National Seminar on "Rehabilitation of Lands under Anthropogenic Stress and Degradation" organized by the Institute on 20th January 2004 was published.

CONSULTANCIES

The Institute is providing consultancy and other services to a number of organization including SFDs. It includes:

1. Bamboo Resource Survey of Jharkhand funded by Jharkhand State Forest Development Corporation Ltd.
2. Estimation of Organic Carbon contents of forest soil samples and forest floor litters of various districts of Eastern Zone and Evaluation of Dry weight % at 65°C of forest floor litters under MOU signed between ICFRE & FSI, Eastern Zone, Kolkata.
3. Development of Green Belt at Maithon Right Bank Thermal Power Project, DVC & Chandrapura Thermal Power Station, DVC, Chandrapura.

4. Development of Bio-aesthetic habitat by Central Coalfields Limited over a 5-hectare company's land at Ranchi.
5. Collaboration of SEPC, Kolkata with IFP in the field of scientific cultivation of lac and for development of pilot broodlac farm and lac finishing facilities in Purulia district, West Bengal.
6. Setting up of 120 MW Thermal Power Unit by TATA Power Company Limited.
7. Estimation of 'Physico Chemical Analysis' and 'Physical Analysis' of soil samples received from Tata Steel, Ghatotand and Hazaribagh.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. Shri R. Krishnamurty, Director of the Institute attended Society Meeting at Paryavaran Bhawan, CGO Complex, Lodhi Road, New Delhi on 23rd November 2005.
2. Pre-RAG meeting was held on 17th November 2005 for Power Point Presentation.
3. The 7th RAG meeting of the Institute was conducted on 15th December 2005.
4. A meeting was also conducted on 25th January 2006 with Mr. J. Biswas, Dy. Director, DVC (Soil Conservation), Hazaribagh on 'Greening of ash dump and degraded areas at Chandrapura Thermal Power Station, Chandrapura'.
5. Senior Officials from CCL, Ranchi visited the Institute on March 2006 for discussion and finalization of TOR for preparation of conservation plan of Magadh and Amrapali OCP's.

Attended

1. Shri R. Krishnamurty, Director of the Institute attended the meeting as a member of Research Advisory Committee at Ranchi on 26th May 2005 organized by Central Tasar Research and Training Institute (CTR&TI), Piska Nagri, Ranchi.

2. Shri H.C. Sindhuveerendra, Research Officer attended International Conference on "Facilitating Forestry Mitigation projects in India: promoting Stakeholder Dialogue and Capacity building" from 15th to 17th June 2005 organized by ICFRE at Dehradun in partnership with Joanneum Research, Institute of Energy Research, Austria and Freiburg University, Germany co-sponsored by the European Union-Small Projects Facility.

3. Shri R. Krishnamurty, Director, IFP, Ranchi proceeded for attending Advance Forest Management Course at IGNFA, Dehradun from 20th June to 1st July 2005.

4. Shri R. Krishnamurty, Director and Shri Premjit Anand, Dy. C.F. of the Institute attended a joint meeting held on 10th June 2005 with personnel of Chandrapura Thermal Power Station, DVC at Chandrapura in connection with the plantation work to be undertaken under the project "Green Belt Development/Plantation at Chandrapura Thermal Power Project Consultancy and relevant services".

5. Director, IFP, Ranchi was nominated as member of the committee of Administration of the Shellac Export Promotion Council. He attended the 296th meeting of the committee of Administration at Kolkata on 20th August 2005.

6. Shri R. Krishnamurty, Director attended the meeting of Paryavaran Impact Assessment Expert Committee held at the office of Secretary, Deptt. of Forest and Environment, Govt. of Jharkhand, Ranchi on 30th August 2005. The meeting was in connection with setting of 120 MW Thermal Power Unit by TATA Power Company Limited.

7. Attended the meeting on 'Development of Lac in Jharkhand' on 9th September 2005 in the chamber of Commission and Secretary, Forests, Govt. of Jharkhand.

8. Shri Premjit Anand, DCF attended the meeting on "National Consultation on Forestry Statistics" on 20th and 21st December 2005 at Van Vigyan Bhawan, Sector - V, R.K. Puram, New Delhi as Nodal Officer (Statistics) of the Institute. The meeting was chaired by Dr. Shashi Kumar, DDG (Extension), ICFRE, Dr. Bipin Behari, DIG of Forests, MoEF, Dr. Devendra Pandey, Director, Forest Survey of India and Dr. K. D. Singh, Ex-FAO Expert in Session-I, Session-II, Session-III and Session-IV respectively.

9. A meeting was held on 9th December 2005 with Conservator of Forests (Working Plan and Research Circle), SFD, Jharkhand in connection with Pilot Project on Lac Development.

10. Shri R. Krishnamurty, Director of the Institute attended the 25th meeting of Research Advisory Committee of Central Tassar Research and Training Institute (CTR&IT), Nagri, Ranchi on 23rd and 24th January 2006 as an esteem member.

11. Dr. Animesh Sinha, Scientist-C attended the National Conference on "Tree biotechnology: Indian Scenario" organized on 9th and 10th February 2006 at TFRI, Jabalpur with a presentation of an abstract research paper entitled *"In vitro* shoot proliferation from nodal explants of mature trees of Kusum (*Schleichera oleosa)"*. During his visit Dr. Sinha was advised to take up consultations with NCL, Pune, Jadavpur University, Kolkata, IICB, Kolkata and Indian Agricultural Research Institute, New Delhi for taking up research on *in vitro* conservation of forest genetic resources and molecular aspect of lac host plants for further development of progress of DBT assisted project.

12. Dr. Malabika Ray, Scientist-D attended the National Seminar on "Growing, processing, value addition and marketing of Medicinal and Aromatic Plants" from 6th to 8th February 2006 at SFRI, Jabalpur for presentation of research paper titled "Variation in growth performance of some endangered species of medicinal plants of Jharkhand".

13. Dr. S. Nath, Scientist-E and Dr. P.K. Das, R.O. participated in the Workshop cum Exhibition on "Technology Development, Utilization and Transfer" organized by BIT, Mesra, Ranchi on 6th March 2006.

14. Dr. Malabika Ray, Scientist-D attended the National Seminar on "Medicinal plants its Present Status, Prospect and Conservation" held on 22nd and 23rd March 2006 at Midnapore college, Midnapore, West Bengal.

15. Shri R. Krishnamurty, Director and Shri Premjit Anand, DCF visited Patna on 8th March 2006 for attending meeting

with Shri G.K. Prasad, DG, ICFRE and Shri Mudit Kumar Singh, ADG (PF / JFM), ICFRE, PCCF, Govt. of Bihar, Chief Secretary, Govt. of Bihar and Secretary, Deptt. of Environmental and Forests, Govt. of Bihar for finalization of the project "Sanudai Adharit Samanvit Van Prabandhan Evam Sankrachan Yojna in Bihar State".

16. Dr. Animesh Sinha, Scientist-C as representative of the Director, IFP, Ranchi attended the meeting of VII Research Policy Committee on 22nd and 23rd March 2006 at Dehradun.

DISTINGUISHED VISITORS

1. Thirty Forest Ranger trainees of 2003-2005 Rangers' Course of Eastern Forest Rangers' College, GoI, MoEF, Kuresong, Distt. Darjeeling (West Bengal) visited IFP, Ranchi from 24th to 26th May 2005 on East India Tour Programme for study of management and activities related to Forests and Wildlife.

2. Shri G.K. Prasad, IFS, D.G., ICFRE and Shri Prodipto Ghosh, IAS, Secretary to the Govt. of India, MoEF, New Delhi visited IFP, Ranchi and its research centre 'FRC, Mandar' on 6th July 2005.

3. Dr. S. Kumar, Head, and Dr. P. Dey, Principal Scientist of HARP, Plandu, Ranchi visited IFP, Ranchi on 18th July 2005 in the issues of collaboration with the IFP.

4. Dr. Bengali Baboo, Director, Dr. A. Bhattacharya, Head TOT, Dr. R. Ramani, Scientist and Dr. Niranjan Prasad, Scientist of ILRI, Namkum, Ranchi visited IFP and Mandar Research Centre, Ranchi on 19th July 2005 in the issues of collaboration with the IFP.

5. Chairman, Vice Chairman and Executive Director of Shellac Export Promotion Council, Kolkata (Ministry of Commerce, GoI) visited IFP (HQ), Ranchi on 11th August 2005 for collaboration with IFP in the field of scientific cultivation of lac, and for development of pilot broodlac farm and lac finishing facilities in Purulia district, West Bengal.

6. Director, Institute of Science and Management, Ranchi visited the Institute on August 2005 to discuss on possible collaboration with IFP, Ranchi.

7. Senior Officials from CMPDIL & CCL, Ranchi, and trainees from DVC, Hazaribag visited the Laboratory and other facilities at Forest Research Centre, Mandar, Ranchi during the month.

8. Mr. J. C. Kala, Director General of Forests, MoEF, Govt. of India accompanied with Shri R.P.S Katwal, Addl. D.G. Wildlife, MoEF, Govt. of India and Mr. J. Kiswan, Inspector General of Forests (FC), MoEF, Govt. of India visited the Institute on 9th January 2006.

9. A meeting was conducted with Mr. Prakash Oraon, State Project Director, Jharkhand Tribal Development Society regarding taking up studies on "Forest Product Marketing system in selected programme villages of JTDS.

CHAPTER 3.9

Centre for Social Forestry and Eco-Rehabilitation Allahabad

Centre for Social Forestry and Eco-Rehabilitation (CSFER), Allahabad was established in October, 1992 as an advanced Centre under the umbrella of ICFRE, Dehradun. Presently, it is a branch of Forest Research Institute (FRI), Dehradun. The Centre aims to nurture and cultivate professional excellence in the field of Social Forestry and Eco-Rehabilitation in Eastern Uttar Pradesh, North Bihar and Vindhyan Region of Uttar Pradesh and Madhya Pradesh.

PROJECTS COMPLETED DURING THE YEAR 2005-2006

Project 1: Re-vegetation of Silica mining tracts through microbial technology at Vindhyan Range of Allahabad District [FRI-141/CSFER-01]

Findings: The biofertilizers - Azotobacter, Rhizobium, Phosphate Solubilizing Microbes, Blue Green Algae and Vesicular Arbasculam Mycorrhiza (VAM) were used on selected species, observed remarkable results. Nursery trial results indicated that the germination time was reduced in seeds treated with different bio fertilizer combinations as compared to control. The results of field trial of these inoculated seedlings at silica mining tract of Shankargarh, Allahabad indicated that *Pongamia pinnata* and *Butea monosperma* performed well over two other species.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: To develop medicinal plant nursery for generating awareness amongst local people [FRI-254/CSFER-05]

Status: The selected medicinal species have been planted in herbal garden of research nursery and are maintained. Training-cum-demonstration are being organized for awareness amongst local people.

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Research and development of Jatropha under National Network Programme [Sponsored by NOVOD Board]

Status: Progeny field trial of Jatropha has been carried out with the seeds collected from the Candidate Plus Trees (CPTs) marked at Shankargarh, Allahabad (CSFER1), and procured from Tropical Forest Research Institute, Jabalpur (TFRI I and TFRI II) at Silica mining area of Shankargarh, a degraded site of Allahabad District. Survival and growth data were recorded. To establish National Networking Trial of Jatropha, the seedlings raised from the seeds obtained from the different research organizations from all over India were planted in field in RBD with three replications and 2m X 2m spacing at Silica mining area of Shankargarh, Allahabad under rainfed condition. For zonal trail, the seedlings raised from the seeds obtained from the different zonal centres were planted in field in RBD with three replications and 2m X 2m spacing at Silica mining area of Shankargarh, Allahabad under rainfed condition.

A block plantation with 9300 plants were established at Silica mining area of Sankargarh, Allahabad and 700 plants were planted at Padilla nursery in agroforestry trial. Phenological studies of CPTs marked in previous year were carried out. Survey of Superior planting material as per the guidelines decided by the NOVOD Board was carried out in eastern U.P. total twenty two CPTs have been marked in different district of eastern U.P. Seed characteristics viz. seed diameter, seed length and no. of seeds per 100 gm have been recorded. Seeds from the marked CPTs were collected and sent to TERI, New Delhi for chemical evaluation. Nursery has been raised from the seeds collected from marked twenty CPTs.

Jatropha seedling in Padila nursery under NOVOD project

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	1	1	-
External Projects	-	1	-
Total	1	2	-

EDUCATION AND TRAINING

Two training programmes for the farmers on Research and Development of Jatropha have been organized. The techniques related to nursery, planting methods, field demonstration, various uses and biodiesel applications of seed oil have been shared and discussed with the participants. Field trips were also organized for the participants for strengthening their knowledge about Jatropha on site.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. Two Farmer's Training under NOVOD project on Research and Development of Jatropha on 28th and 29th March 2006.
2. Training-cum-demonstration programme on Medicinal Plants on 30th March 2006.

Attended

Shri Birendra Choudhary, IFS attended the National Conference on Forestry at CII, New Delhi on 22nd February 2006 and National Workshop on Forestry Education : Issues and Opportunities at FRI Deemed University, Dehradun on 20th and 21st March 2006.

DISTINGUISHED VISITORS

Shri M. L. Arrawatia, IFS, Chief Conservator of Forests, Sikkim visited the Centre from 24 to 26th October 2005. He also visited Central Research Nursery, Padila.

CHAPTER 3.10

Centre for Forestry Research and Human Resource Development Chhindwara

Centre for Forestry Research and Human Resource Development (CFRHRD), Chhindwara came in to existence on 30th March 1995 and declared as Satellite Centre of Tropical Forest Research Institute, Jabalpur under the ICFRE, Dehradun on 3rd January 1996. The mandate of the centre is to take up the forestry research in the specialized areas like biodiversity conservation, non-wood forest products, forest protection, socio-economics, silviculture and tree improvement. In addition to this, the centre has also been assigned to develop the human resource in forestry sector by imparting vocational training leading to poverty alleviation through self-employment.

PROJECTS COMPLETED DURING THE YEAR 2005-2006

Project 1: Studies on the feasibility of cultivation of medicinal and aromatic plants as intercrop in natural forests and plantations and their phytochemical investigations [049/CFRHRD-(2001-2002)/1(2)]

Findings: A herbal garden comprising of 90 medicinal and aromatic plants species and with several endangered/threatened species has been established in the centre. Ganwarpatha (*Aloe vera*) was planted as intercrop with Amla (*Emblica officinalis*) while Chironji (*Buchnania lanzan*) was planted natural forests of sal. Satawar (*Asparagus racemosus*) was planted as intercrop with Amla (*Emblica officinalis*). The results revealed that root production from single plant of Satawar was maximum in the natural forest as compared to the yield from plantations. An income of about Rs.13,000 (thirteen thousand rupees) has been generated from the sale of medicinal planting material.

Project 2: Studies on the insect pests of *Emblica officinalis* and *Gmelina arborea* in agroforestry and plantation ecosystems [050/CFRHRD-(2001-2002)/2(3)]

Findings: Seasonal history of shoot gall forming insect *Betousa stylophora* was studied. The plants of *E. officinalis* and *G. arborea* were infested by 14 pests. Their period of prevalence, nature of damage, status and incidence of major insect pests in different localities were recorded. The mean weekly incidence / population of shoot gall forming insect *Betousa stylophora* on *E. officinalis* and *Tingis beesoni* on *G. arborea* was correlated with weather parameters. Field trials were laid out against shoot gall forming insect *B. stylophora* in 3 years old plantation of *E. officinalis*. It was observed that soil application of phorate followed by carbofuran @ 10 gm per plant was found to be most effective against this pest. Five varieties of *E. officinalis* were screened against *B. stylophora*. Different age group plantations of *G. arborea* in west Maharashtra were evaluated for monitoring the status of pests. Top dying in Hi Tech plantations of *G. arborea* was observed due to the role of insect disease complex i.e. lace bug *Tingis beesoni* and fungus *Hendersonula toruloidea*, effective control measures were suggested at the interval of 15 days.

Project 3: Standardization of nursery techniques and propagation methods of *Buchnania lanzan* spreng. (Achar or Chironji) [051/CFRHRD-(2001-2002)/3(4)]

Findings: Studies on effect of different seed treatments on germination and seedling vigor of *Buchnania lanzan* has been conducted and the seed of *Buchnania lanzan* treated mechanically by hammer gave better germination results

other treatments. The treatment registered 33% increase in germination percentage than control. Studies on morphological characters and seed germination using seeds collected from Allapalli (MS), Gondia (MS) and Delakhari, Chhindwara (MP) was carried out. Seed collected from Delakhari (Chhindwara) resulted in higher germination percentage as compared to seeds collected from other sources. Studies on germination as influenced by different months of the year, have been conducted by storing the seeds of *Buchnania lanzan* at room temperature. The results of the studies showed that seed sown in the month of August gave comparatively better performance than the seeds sown in the any other month of the year. The observation on performance of various planting stocks of *Buchnania lanzan* was recorded and six year old plants of *Buchnania lanzan* was found to flower. Generally *Buchnania lanzan* flowered after eight years onward. Early flowering observed in the present plantation may be due to the high inputs provided and timely cultural operation carried out.

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Field trial of agroforestry model in farmers field with medicinal trees and herbs in Satpura plateau of Madhya Pradesh [110/CFRHRD/2006-3(NMPB)(10)]

Status: Seeds of Satawar (*Asparagus racemosus*), Sarpagandha (*Rauvolfia serpentina*) were sown in germination bed for the production of seedlings for distribution to the farmers. Seeds of Bael (*Aaegle marmelos*) were sown in polythene bags.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	3	-	-
External Projects	-	1	-
Total	3	1	-

EDUCATION AND TRAINING

Centre organized and conducted 13 training programmes for 462 trainees/stakeholders during the financial year 2005-2006.

LINKAGES AND COLLABORATION

Linkages were developed with State Forest Departments, Forest Development Corporation, Agriculture Research Station, Chhindwara for conducting research / training and with Forest Survey of India, Nagpur for analysis of forest floor and soil samples.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS ORGANIZED

1. A. Vijayaraghavan attended international conference on multipurpose tree species in tropics at Jodhpur, organized by ICFRE and UFRO, presented a paper on "*Ex-situ* conservation of Ganwarpatha (*Aloe vera*) in Madhya Pradesh".
2. A. Vijayaraghavan attended and presented one paper in National Symposium on "Recent advances in Science a prospective" at Dolphin PG Institute of Biomedical and Natural Sciences, Dehradun from 3rd to 5th June 2005.
3. P.B. Meshram and R.S. Sahoo attended Regional Workshop on "Management of Extension Activities in Forestry Sector" held at TFRI, Jabalpur on 14th and 15th September 2005.
4. P.B. Meshram and D. L. Nandeshwar attended and presented paper in the National workshop on "Biodiversity and Wildlife Conservation" held at Sevadal Mahila Mahavidyalaya, Nagpur on 2nd October 2005.
5. Suneesh Buxy participated in the National workshop on "Soil Waste Management and Urban Governance" held at Bhopal on 28th and 29th September 2005.
6. A. Vijayaraghavan participated in the National seminar on Non-conventional energy resources of biological origin held at PSGR Krishnammal College for Women, Coimbatore on 7th December 2005 and presented two research papers, Silviculture of important tree borne oil seeds Pungam L. and Role of tree borne oil seeds in climate amelioration.
7. P.B. Meshram and D.L. Nandeshwar participated in the National Seminar on "Recent Advances in Forestry Science" held at Guru Ghasidas University, Bilaspur (Chhattisgarh) on 30th and 31st January 2006 and presented research papers entitled 'Recent advances in forest protection against major insect pests and effect of different growth promoters on germination and initial seedling growth of *Buchnania lanzan'*, respectively.
8. Suneesh Buxy participated in the forest fire fighting workshop held at Ecocentre Dept., Poama and delivered a lecture on "Forest Fire Fighting" on 30th and 31st January 2006.
9. P.B. Meshram participated in the National Conference on "Tree Biotechnology: Indian Scenario" held at Tropical Forest Research Institute, Jabalpur on 9th and 10th February 2006.
10. A. Vijayaraghavan participated and presented a research paper entitled 'Effect of halogenation in seed germination and seedling vigour of stored *Albizia lebbeck* seeds' in the XII National Seed Seminar held at Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad from 24th to 26th February 2006.

AWARDS

The research paper entitled "Effect of halogenation in seed germination and seedling vigour of stored *Albizia lebbeck* seeds" of Shri A. Vijayaraghavan, Scientist-B has been judged as the best research paper among the papers published in Seed Research Journal by the Indian Society of Seed Technology (IARI), New Delhi. The award was

given in the XII National Seed Seminar held at Acharya N.G. Ranga Agricultural University, Rajendranagar, Hyderabad from 24th to 26th February 2006.

DISTINGUISHED VISITORS

1. Shri Arun Pandey, IAS, Collector, Chhindwara had visited the centre on 9th July 2005.
2. Dr. A.K. Mandal, Director, TFRI, Jabalpur visited the centre on 12th and 13th July 2005.
3. Shri R.P. Singh, IPS, Deputy Inspector General of Police, Chhindwara visited the centre on 26th October 2005.
4. Prof. M.K. Rai, Head, Dept. of Biotechnology, Sant Gadge Baba University, Amravati (M.S.) visited the centre on 9th March 2006.

CHAPTER 3.11

Forest Research Centre Hyderabad

Forest Research Centre (FRC), Hyderabad started functioning under the administrative control of Institute of Wood Science and Technology Bangalore since July 1997. The Centre was established to cater research needs of the states of Andhra Pradesh, Karnataka and Goa in the field of forestry. It is situated 22 km north of Secunderabad railway station. The campus is spread over 100 acres in Dullapally reserved forest with laboratories, administrative block, library, rest house, research nursery, experimental plots and a residential complex for the staff.

PROJECTS CONTINUED DURING THE YEAR 2005-2006

Project 1: Performance of different agroforestry systems in semi-arid tropics of Andhra Pradesh [FRC/X02/2002-2007]

Status: Trials of Teak + Sandal; Rosewood + Sandal; Eucalyptus + Sandal and Teak+Sandal +Rose wood have been established and castor as a rainfed crop was raised. The castor growth and performance was monitored across different tree combinations.

Project 2: Screening of natural populations of *Lagerstroemia* spp. for domestication [FRC/X04/2003-2006]

Status: Two species of Lagerstroemia prevalent in Andhra Pradesh and Karnataka have been surveyed. The processes of germplasm collection and multiplication have been initiated.

Project 3: Natural variation studies in Rosewood (*Dalbergia latifolia* Roxb.) for tree improvement [FRC/X08/2003-2006]

Status: The number of plus trees were marked in various parts of the Andhra Pradesh and Karnataka. The process of germplasm collection has been initiated.

Project 4: Estimation of Variability in *Pterocarpus marsupium* and germplasm collection [FRC/X03/2003-2006]

Status: The number of plus trees were marked in various parts of the Andhra Pradesh and Karnataka. The process of germplasm collection has been initiated.

Project 5: Studies on phenotypic variation in *Pterocarpus santalinus* and collection of germplasm [FRC/X07/2003-2006]

Status: Surveyed Kurnool, Cuddapah and Chittoor districts of Andhra Pradesh and identified certain trees for collection of germplasm.

Project 6: Dynamics of insect populations in cotton based agroforestry systems of Andhra Pradesh [FRC/X06/2003-2006]

Status: Data on incidence of insect populations on cotton in combination with Bamboo (*Dendrocalamus strictus*), Eucalyptus, Neem, Custard apple, and Amla is being recorded from time to time. Data is being recorded on incidence of tree crops also.

Eucalyptus+Cotton Agroforestry System

Project 7: Reclaimation of Iron Ore Limestone Mine Spoils in Andhra Pradesh and Karnatakaka [FRC/X05/2002-2008]

Status: Nursery experiment is to be conducted for the selection of suitable tree species and soil amendment for the Iron Ore Mine Spoils.

Project 8: Assessment of the impact of forest fire on regeneration of forests in Andhra Pradesh [FRC/X01/2003-2007]

Status: Phyto-social studies were conducted in Mancherial and Jannaram forest divisions of Andhra Pradesh representing southern dry deciduous forest types to study the effect of fire on natural regeneration of forest vegetation. Soil samples are collected to study the effect of fire on physical and chemical properties of the soil.

Effect of fire on natural regeneration of tropical dry deciduous forest in Adhra Pradesh

PROJECTS CONTINUED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: Estimation of Forest Carbon Pool in Western Ghats, Karnataka Development of biomass expansion factors for major forest types [2004-2007]

Status: Root biomass estimation in respect of the tropical deciduous forests is being done and data is being interpreted.

Estimation of underground biomass in carbon pool project NRDA collaborative project

Project 2: Impact of the Clonal Eucalyptus plantations on physical and chemical properties of soil in farmers land in Andhra Pradesh

Status: Soil samples were collected from the Eucalyptus clonal plantation of different ages

NEW PROJECTS INITIATED DURING THE YEAR 2005-2006 (Externally Aided)

Project 1: HUDA- Biomass Estimation and Carbon Sequestration in Urban Forests-Raised by HUDA [2005-2006]

Status: Above and below ground biomass estimation is being done for the plantation raised under urban forestry.

Abstract: No. of Projects

	No. of projects completed in 2005-2006	No. of ongoing projects in 2005-2006	No. of projects initiated in 2005-2006
Plan Projects	-	8	-
External Projects	-	2	1
Total	-	10	1

TECHNOLOGY TRANSFER

As part of transfer of technology programme, demonstration plantations and certain agroforestry systems have been established in FRC, Hyderabad campus.

EDUCATION AND TRAINING

A group of twenty five educated youth under an NGO named Village reconstruction Organisation (India) visited the Centre. On going research and other developmental activities in forestry sector with respect to employment opportunities to rural youth were discussed.

LINKAGES AND COLLABORATION

National

FRC, Hyderabad presently have two ongoing projects. One in collaboration with NRSA, Hyderabad and ITC-PSPD, Bhadhrachalam and the other with Andhra Pradesh Forest Department and APFDC.

CONSULTANCIES

1. Impact Assessment on wild fauna due to the diversion of forest land (154.96 ha) for mining at Singareni Collieries Company Limited, Kothagudem, Andhra Pradesh.

2. Monitoring and evaluation of NMPB schemes sanctioned in Andhra Pradesh.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS ORGANIZED

1. M. Lokeswara Rao attended National Seminar on ”Tree Biotechnology” organized by Tropical Forest Research Institute, Jabalpur.

2. M. Lokeswara Rao presented “Status of FRC Projects on Carbon Sequestration” in Workshop-cum-Training on “Clean Development Mechanism” on 16th September 2005 at Andhra Pradesh Forest Academy Dullapally, Hyderabad

3. Dr. G.R.S. Reddy attended Workshop-cum-Training on “Clean Development Mechanism” on 16th September 2005 at Andhra Pradesh Forest Academy Dullapally, Hyderabad.

4. Mr. D. Jaya Prasad IFS DCF, Dr. G.R.S. Reddy and Dr. Y. Sridhar attended national seminar on, “Current Trends in Cultivation, Processing, Value Addition and Marketing of Medicinal and Aromatic Plants and Herbal Product on 27th January 2006 at Cyber Gardens (Adjacent to Shilparamam), Madhapur, Hyderabad-500 001.

CHAPTER 4

Audited Annual Accounts

I.C. Sanghal B.Com (Hons.) LL.B., F.C.A | A.K. Jain B.Com, F.C.A

I. C. Sanghal & Co.
Chartered Accountants
17, Rajpur Road, Dehradun - 248001
✆ (0135) 2654607, 2653402, Fax (0135) 2745502

AUDITOR'S REPORT

We have examined the attached Balance Sheet of **INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION, DEHRADUN,** as at 31st March 2006 and the annexed Income & Expenditure Account for the year ended on that date. These Financial Statements are the responsibility of the Council's Management. Our responsibility is to express an opinion on these financial statements based on our audit.

We have conducted our audit in accordance with the accounting standards generally accepted in India. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material mis-statements. An audit includes examining on test basis evidence supporting the accounting and disclosures in the financial statements. An audit also includes assessing the accounting principles and significant estimates made by the management as well as evaluating the overall financial statements presentation. We believe that our audit provides a reasonable basis of our opinion.

In our opinion and to the best of our information and according to the explanations given to us the said accounts give a true and fair view :-

i) In the case of the Balance Sheet of the State of Affairs of the above named Council as at 31st March 2006,

ii) In the case of the Income & Expenditure Account, of the SURPLUS for the year ended on 31st March 2006.

For I.C. Sanghal & Co.,
Chartered Accountants,

(I.C. SANGHAL)
Partner

17-Rajpur Road, Dehradun
Dated : 08-08-2006

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

BALANCE SHEET AS ON 31ST MARCH, 2006

PREVIOUS YEAR	LIABILITIES	AMOUNT	TOTAL AMOUNT
	CAPITAL FUND		
1,401,965,868	Opening balance	1,401,965,868	
	Add : Transferred from General Reserve	94,827,469	
	Less : Depreciation	109,355,080	1,387,438,257
	GENERAL FUND		
179,275,840	(As Per Annexure 'A')		195,028,551
	PENSION FUND		
681,763,073	(As Per Annexure 'B')		745,135,956
	CURRENT LIABILITIES & LOANS		
	Amount Payable to Controller ICFRE		
12,760	(As Per Annexure 'C')		31,969
	Amount Payable to PAO, New Delhi		
43,365	(As Per Annexure 'D')		24,764
	Amount Payable to Other Units		
165,639	(As Per Annexure 'E')		160,869
	Amount Payable to Others		
4,305,875	(As Per Annexure 'F')		5,224,293
45,139,381	Project Balances		70,657,496
	EMD/Security		3,935,419
2,853,351	(As Per Annexure 'G')		
2,315,525,152	TOTAL		2,407,637,574

JAGDISH KISHWAN, (Director General, ICFRE)

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B.D. JOSHI
(Controller Pension / E & A.O.)

As per our Seperate Report of even date

I.C SANGHAL & CO.
Chartered Accountants
17, Rajpur Road, Dehradun

08 AUG 2006

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
BALANCE SHEET AS ON 31ST MARCH, 2006

PREVIOUS YEAR	ASSETS	AMOUNT	TOTAL AMOUNT
	FIXED ASSETS		
	Fixed Assets		1,387,438,257
1,401,965,868	(As per Annexure 'H')		
39,938,000	**Work In Progress**		39,938,000
71,872,955	**Advance for Capital Works**		37,290,519
	(As per Annexure 'I')		
0	**INVESTMENTS**		
	CURRENT ASSETS, LOANS & ADVANCES		
	A. CURRENT ASSETS		
	CASH & BANK BALANCES		
765,593,264	(As per Annexure 'J')		910,485,186
	B. LOANS & ADVANCES		
	Staff Advances		
19,099,906	(As per Annexure 'K')		18,688,850
	Recoverable from Controller ICFRE		
6,730,356	(As per Annexure 'L')		7,006,381
	Recoverable from PAO,New Delhi		
8,896,609	(As per Annexure 'M')		5,362,187
	Recoverable from Other Units		
1,428,194	(As per Annexure 'N')		1,428,194
0	Recoverable from Others		0
2,315,525,152	**TOTAL**		2,407,637,574

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

DETAILS OF GENERAL FUND AS ON 31ST MARCH 2006

ANNEXURE A	TOTAL
GENERAL FUND	
Opening	179,275,840
Add : Excess Of Income Over Expenditure	117,082,453
Add : Tfd.From Projects	6,813,167
Add : Received from other units	30,471,585
Less : Transferred to Revenue ICFRE	43,787,025
Less : Transferred to Capital Fund	94,827,469
	195,028,551

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
DETAILS OF PENSION FUND AS ON 31ST MARCH 2006

ANNEXURE B PENSION FUND	GPF	GSLIS	PENSION	TOTAL
Opening	168,640,340	312,986	512,809,747	681,763,073
Add : Excess Of Income Over Expenditure	9,856,141	3,471	81,119,430	90,979,042
Add :				0
Saving Fund under GSLIS		379,053		379,053
Death Claim		266,746		266,746
Received from PAO	2,685,559		0	2,685,559
Subscription/contribution	38,636,848	1,610,296	13,445,182	53,692,326
Received from OthersDepartments	875		197,492	198,367
Refund of Excess Payment			13,040	13,040
	41,323,282	2,256,095	13,655,714	57,235,091
Less :				0
Death Claim Paid		221,285		221,285
Saving Fund		484,448		484,448
Subscription to LIC		1,626,600		1,626,600
GPF Advance Reimbursement	14,678,674			14,678,674
GPF Part/Final Payment	16,176,360			16,176,360
GPF Final Payment	9,470,873		0	9,470,873
Pensionary Benefit paid			35,591,647	35,591,647
DCRG			6,591,363	6,591,363
	40,325,907	2,332,333	42,183,010	84,841,250
	179,493,856	**240,219**	**565,401,881**	**745,135,956**

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

PART OF ANNEXURE B :

PENSION-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2006

INCOME		AMOUNT
GRANT IN AID		
Received through DDG(ADMIN)		36000000
Received from Revenue ICFRE		30000000
Received from DDO ADMIN		
Interest		15119430
		81119430
EXPENDITURE		
Excess Of Income Over Expentiture		81119430
		81119430

GPF-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2006

INCOME		AMOUNT
Interest & Dividend		9,856,141
		9,856,141
EXPENDITURE		
Loss on Sale of Investments		-
Excess Of Income Over Expentiture		9,856,141
		9,856,141

GSLIS-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2006

INCOME		AMOUNT
Interest		3471
		3471
EXPENDITURE		
Excess Of Income Over Expentiture		3471
		3471

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Details of Amount Payable to Controller ICFRE as on 31st March 2006

ANNEXURE C	TOTAL
Amount Payable to Controller ICFRE	
GPF Subscription	18324
Refund of GPF Advance	(172)
GSLIS	727
Pension Contribution	13090
	31969

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN	
Details of Amount Payable to PAO NEW Delhi as on 31st March 2006	
ANNEXURE D	TOTAL
Amount Payable to PAO New Delhi	
GPF Subscription/Refund	10,658
CGEIS	5,760
Any Other Recovery	8,346
	24,764

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Details of Amount Payable to Other Units as on 31st March 2006

ANNEXURE E	TOTAL
Amount Payable to Other Units	
Saving Fund	64,071
Death Claim	44,013
Advance Recovery	57,555
GPF Subscription	(4,770)
	160,869

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Details of Payable to Others as on 31st March 2006

ANNEXURE F	TOTAL
Amount Payable to Others	
LIC	710,830
TDS	2,452
Professional Fees	7,960
Computer Advance	4,000
Payble to Conttroller ICFRE	1,909,371
Misc. Recoveries	2,589,680
	5,224,293

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Details of Security /EMD as on 31st March 2006

ANNEXURE 'G'	TOTAL
SECURITY/EMD	3,935,419
	3,935,419

JAGDISH KISHWAN, (Director General, ICFRE)

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE 'H'

Details of Fixed Assets as on 31st March 2006

	OPENING BALANCE AS ON 01/04/05	ADDITIONS	ADJUSTMENTS	GROSS BALANCE AS ON 31/03/06	DEPRICIATION	CLOSING BALANCE AS ON 31/03/06
PLAN ASSETS						
Land	5,072,750		-	5,072,750	-	5,072,750
Scientific Equipments	86,722,553	10,209,568	-	96,932,121	13,774,101	83,158,020
Furniture & Fixtures	14,905,255	76,175	-	14,981,430	1,494,334	13,487,096
Books & Journals	55,497,833	513,356	-	56,011,189	8,363,177	47,648,012
Vehicles	22,489,696		-	22,489,696	3,373,454	19,116,242
Building & Road	1,024,550,314	81,775,000	-	1,106,325,314	53,271,891	1,053,053,423
Office Equipments	175,738,138	2,251,370	-	177,989,508	26,529,573	151,459,935
Tools & Equipments	10,183,790	2,000	-	10,185,790	1,527,719	8,658,071
Electrical Fittings	6,805,539		-	6,805,539	1,020,831	5,784,708
						-
TOTAL	1,401,965,868	94,827,469	-	1,496,793,337	109,355,080	1,387,438,257

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(Controller Pension / E & A.O.)

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Details of Advance for Capital Work/ Equipment as on 31st March 2006

ANNEXURE 'I'	TOTAL
Advance for Capital Works/Equipment	
CPWD	3,492,564
CCU	33,475,334
OTHERS	322,621
	37,290,519

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Details of Cash & Bank Balances as on 31st March 2006

ANNEXURE 'I'	TOTAL
Cash In Hand	681,892
Cash at Bank	183,595,610
FDRs	726,207,684
	910,485,186

JAGDISH KISHWAN, (Director General, ICFRE)

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN	
Details of Staff Advances as on 31st March 2006	
ANNEXURE 'K' :	
STAFF ADVANCES	**TOTAL**
> Forest Advance	3,451,413
> Festival Advance	888,780
> Car Advance	469,125
> Scooter Advance	916,021
> Cycle Advance	7,896
> House Building Advance (HBA)	6,207,262
> TA Advance	1,625,558
> TTA Advance	409,173
> LTC Advance	878,157
> Pay Advance	155,500
> Medical Advance	1,519,722
> Other Advance	2,160,243
	18,688,850

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN Details of Amount Recoverable from Controller ICFRE as on 31-3-2006	
ANNEXURE 'L'	**TOTAL**
Amount Recoverable from Controller	
ICFRE	
GPF Advance	1,990,341
DCGRG	3,190,871
Provisional Pension	217,910
GPFPart/Final Payment	1,607,259
	7,006,381

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Details of Amount Recoverable from PAO, New Delhi as on 31-3-2006

ANNEXURE 'M'

	TOTAL
Amount Recoverable from PAO, NEW DELHI	
GPF Advance	2,395,147
CGEGIS	1,014,584
DCRG	1,666,683
Provisional Pension	259,373
GPF Part/ Final Payment	26,400
	5,362,187

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Details of Amount Recoverable from Other Units as on 31-3-2006

ANNEXURE 'N'	TOTAL
Amount Recoverable from Other Units	
DDOs (Premium for the month of March)	168,944
DEPUTATION & OTHERS	12,168
Service Tax	1,247,082
	1,428,194

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31-3-2006

PREVIOUS YEAR	INCOME	AMOUNT	TOTAL AMOUNT
	GRANT IN AID		
	PLAN		
300000000	- GENERAL COMPONENT	420000000	
20000000	- EDUCATION & TRAINING	93500000	513500000
	NON PLAN		
102800000	- GENERAL COMPONENT	150039000	
11759000	- EDUCATION & TRAINING	11070000	161109000
	PLAN		
30000000	- NORTH EAST JOHRAT	20000000	
2500000	- NORTH EAST MIZORAM	0	20000000
4000	Revolving Fund		2000
7346906	Grant from IGNFA for KVS		4130980
476000	Grant from Foreign Project		2135577
29609263	Revenue Receipts & Others		41088022
504495169	**TOTAL**		**741965579**

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION
INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31-3-2006

PREVIOUS YEAR	EXPENDITURE	AMOUNT	TOTAL AMOUNT
	NON PLAN (GENERAL COMPONENT		
51091541	Salary Research	77474763	
51794990	Salary Non Research	70891599	148366362
	EDUCATION & TRAINING		
11759000	Payment to KVS	11070000	
6860154	Payment to KVS (from IGNFA)	4262000	15332000
	PLAN (GENERAL COMPONENT)		
	Salaries		
133305777	Research Staff	118922415	
81463022	Non Research Staff	64588065	183510480
	Travelling		
3625360	Research Staff	4940487	
2680547	Non Research Staff	5558937	10499424
53159067	**O.E. (Research Staff)**		73879543
	Others		
537620	Publication	508864	
540300	M & S (Lab. Contingencies)	3025218	
6959640	Minor Work / Maintenance	25880182	
23787	Others	0	
188601	Building & Roads	4381274	33795538
20000000	**EDUCATION & TRAINING**		93499779
20000000	Grant to Pension Fund	36000000	
23742000	Revenue Paid to Pension Fund	30000000	
3457720	Revenue Receipts Refunded	0	66000000
33306043	Excess of Income Over Expenditure		117082453
504495169	**TOTAL**		**741965579**

0

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2006

ANNEXURE C **Amount Payable to Controller ICFRE**	TOTAL
GPF Subscription	18,324
Refund of GPF Advance	(172)
GSLIS	727
Pension Contribution	13,090
	31,969

ANNEXURE D **Amount Payable to PAO New Delhi**	TOTAL
GPF Subscription/Refund	10,658
CGGEIS	5,760
Any Other Recovery	8,346
	24,764

ANNEXURE E **Amount Payable to Other Units**	TOTAL
Saving Fund	64,071
Death Claim	44,013
Advance Recovery	57,555
GPF Subscription	(4,770)
	160,869

ANNEXURE F **Amount Payable to Others**	TOTAL
LIC	710,830
TDS	2,452
Professional Tax	7,960
Computer Advance	4,000
Payble to Conttroller ICFRE	1,909,371
Misc. Recoveries	2,589,680
	5,224,293

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2006

ANNEXURE 'G'	TOTAL
SECURITY/EMD	3,935,419
	3,935,419

ANNEXURE 'I'	TOTAL
Advance for Capital Works/Equipment	
CPWD	3,492,564
CCU	33,475,334
OTHERS	322,621
	37,290,519

ANNEXURE 'J'	TOTAL
Cash In Hand	681,892
Cash at Bank	183,595,610
FDRs	726,207,684
	910,485,186

Annexure forming part of the Balance Sheet as on 31st March 2006

ANNEXURE K : STAFF ADVANCES	TOTAL
> Forest Advance	3,451,413
> Festival Advance	888,780
> Car Advance	469,125
> Scooter Advance	916,021
> Cycle Advance	7,896
> House Building Advance (HBA)	6,207,262
> TA Advance	1,625,558
> TTA Advance	409,173
> LTC Advance	878,157
> Pay Advance	155,500
> Medical Advance	1,519,722
> Other Advances	2,160,243
	18,688,850

ANNEXURE 'L' Amount Recoverable from Controller ICFRE	TOTAL
GPF Advance	1,990,341
DCGRG	3,190,871
Provisional Pension	217,910
GPFPart/Final Payment	1,607,259
	7,006,381

ANNEXURE 'M' Amount Recoverable from PAO, NEW DELHI	TOTAL
GPF Advance	2,395,147
CGEGIS	1,014,584
DCRG	1,666,683
Provisional Pension	259,373
GPF Part/ Final Payment	26,400
	5,362,187

ANNEXURE 'N' Amount Recoverable from Other Units	TOTAL
DDOs (Premium for the month of March)	168,944
Deputation & Others	12,168
Service Tax	1,247,082
	1,428,194

INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION - DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2006

ACCOUNTING POLICIES & NOTES TO ACCOUNTS

1. SYSTEM OF ACCOUNTING :
   The council follows cash system of accounting.
   The Opening Balances of Units are subject to reconciliation.

2. FIXED ASSETS :
   All Fixed Assets are stated at historical cost less depreciation.

3. DEPRECIATION :
   Depreciation has been provided at the rates prescribed by the Income Tax Act 1962. Depreciation on the additions made during the year has been provided for Six months only.

4. RETIREMENT BENEFITS :
   No provision for gratuity & leave encashment liabilities is made.

5. AMOUNT RECOVERABLE FROM CONTROLLER, PENSION CELL :
   The amount recoverable from Controller has been arrived at based on the data produced by the unit and after reconciling the same with the books of the controller, pension Cell.

6. PROJECT BALANCES :
   Balance outstanding of various projects are subject to reconciliation.

7. PENSION FUND :
   That the Council has been accounting interest on maturity of FDR's and the actual liability in respect of Pension has not determined by the actuary.

8. PREVIOUS YEAR FIGURES :
   Previous year figures have been regrouped and recasted wherever necessary.

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Chartered Accountants
17, Rajpur Road, Dehradun

08 AUG 2006

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2006

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
OPENING BALANCE AS ON 1-4-2005					
Cash	531068		Salary Research (Non Plan)	77474763	
Bank	87721102		Salary Non Research (Non Plan)	70691599	148366362
FDR	677341094				
Investment	0				
Money in Transit					
		765593264			
			Salary Research (Plan)	118922415	
GRANT IN AID			Salary Non Research (Plan)	64568065	183510480
RECEIVED FROM MINISTRY			**By Travelling Expenses**		
PLAN			> Research Staff	4940487	
-General	420000000		> Non Research	5558937	10499424
-Education & Training	93500000				
-North East Johrat	20000000	533500000	**By O.E. (Research Staff)**		
NON PLAN			> Maintenance of Vehicle		
-General Component	150039000		- Fuel	4569243	
-Education & Training	11070000	161109000	- Repair	3248614	
-Sponsored Project			- Taxes	735114	
-Foreign Projects	2135577	2135577	> Electricity Charges	22103646	
-Workshop from Ministry			> Telephone charges	3830975	
			> Revenue Expenditure (Coimbtore)	225178	
-Revolving Fund		2000	> Maintenance of Equipments		
To Revenue Receipts from DDO'S		30471585	- Scientific	3482574	
To Revenue Receipts Payable to Own Account		1393604	- Office	1675056	
To Revenue Earned		41088022	> Others		
To Transfer of Fund		0	- Water Charges	1402784	
To Sharing Cost of Facilities for KVS		4130980	- Stationery	1513771	
To Amt Recd by Controller from ICFRE Rev		30000000	- Contingency Expenditure	12103654	
To Grant in Aid through DDG (Admin)		0	- Legal / Consultancy charges	489758	
To Reimbursement from Controller ICFRE			- Municipal Tax	1093221	
			- Medicines / X-ray	4406982	
> GPF Advance	15003240		- Liveries	234416	
> DCRD	7032690		- Postal / Stamp Charges	695987	
> Provisional Pension	130628		- Advertisement	414754	
> GPF Part/Final Payment	469483		- Field Research Expenses	8118697	
>GSLIS	0	22636041	- Seminar / Conference / HRD	2077941	
			- Newspaper Bill	421380	
To Reimbursement from PAO(F), New Delhi			- Extension	387136	
			- Rent building / Equipment	648662	
> GPF Advance	12173412			0	73879543
> DCRG	118446		By Others		
> Provisional Pension			> Publication	508864	
> GPF Part/Final Payment	0		> M & S (Lab. Contingencies)	3025218	
> CGEGIS	0	12291858	> Minor Work / Maintenance	25880182	
			> Others	0	
			> Building & Roads	4381274	
			> Service Tax	0	33795538

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2006

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
To Recoveries from Staff on behalf of ICFRE			By Advances		
> GPF Subscription	22397024		> CPWD	3492564	
> GPF Advance Refund	5413970		> CCU	43700000	47192564
> GSLIS	1605056				
> Pension Contribution	13325293	42741343	**By Equipment / Library Books**		
To Recoveries from Staff on Behalf of PAO(F)			> Scientific Equipments	10209568	
			> Office Equipments	2251370	
> GPF Subscription	11362057		> Furniture & Fixtures	76175	
> CGEGIS	158490		> Books & Journals	513356	
> Pension Contribution	0		> Tools & Equipments	2000	13052469
> CGHS	4500		> Advances		
> Other Recovery	82916	11607963	- Scientific Equipments	0	
			- Office Equipments	0	
To Recoveries from Staff on Behalf of Others			- Furniture & Fixtures	0	
			- Books & Journals	0	
> GPF Subscription	2289409		-Tools & Equipments	0	
> CGEGIS / GIS	49422		- Any Other (Specify)		
> Intt. On Car Advance	0				
> Other	737367	3076198	By Vehicles		
			> Vehicles Purchase	0	
To Recoveries of Advance from Staff on behalf of ICFRE			> Advance Payaments for Vehicles	0	0
			By Revenue Receipt Refunded		43787025
			By Revenue Receipt paid to DG ICFRE		799070
>Forest Advance	21262455		By EMD / Security Refunded		30000000
> Festival Advance	1657732		By Revenue receipt paid to Controller ICFRE		1051871
> Car advance	602540		By Revenue Receipts paid to own Revenue A/c		
> Scooter Advance	719813				
> Cycle Advance	84001		**By Payment made on behalf of PAO (F)**		
> House Building Advance (HBA)	1940968		>GPF Advance	8612141	
> TA Advance	11471923		> CGEGIS	138539	
> TTA Advance	607308		> DCRG	6756	
> LTC Advance	3035746		> Provisional Pension	0	8757436
> Computer Advance	45538		> GPF Part / Final Payment		
> Pay Advance	218174				
> Medical Advance	2145342		**By Payment made on behalf of the**		
> Flood Advance	0				
>Electric Charges	0				
> HLF	0	43791540	**Controller (ICFRE)**		
			>GPF Advance	14644415	
To Other Deduction & Recoveries			> DCGRG	7703230	
			> Provisional Pension	153523	
> TDS (Salary)	5036777		> GPF Part / Final Payment	410898	22912066
> TDS (Contractor)	508093				
> LIC	2356561		**By Payment made to PAO (F) on Behalf of Staff**		
> Professional	345266		> GPF Subscription / Refund	11356104	
> Others	4260646	12507343	> CGEIS	158250	
			> Interest on House Building Advance	0	
To EMD / Security		1881138	> Car Advance	12072	
To Sale of Assets		0	> Scooter Advance		
			> Interest on car advance		
			> HBA	8000	
			> Any Other Recovery (Specify)	92138	11626564

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2006

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
Amount Received by Controller ICFRE			**By Payment made to The Controller (Pension Cell ICFRE on behalf of staff**		
Amount received from PAO (F) on account of GPF transfer		2685559	> GPE Subsripiton	22384435	
			> Refund of GPF Advance	5417287	
Amount received from Various DDO'S on account of GPF Subscription		38636848	> GSLIS	1604716	
			> Pension Contribution	13315696	42722134
Amount Received from Others on account of refund of refund of excess GPF Payments		875	**By Payment made to Other Offices on Behalf on**		
			> GPF Subsripiton / Refund	2294179	
Dividends on Govt. Securities Bank & FDR Interest		10117197	> CGEGIS	49422	
			> TDS	2421199	
Amount received on account of Saving Fund Under GSLIS		379053	> Sales Tax	782861	
			> Professional Tax	343276	
Amount received on account of Death Claim under GSLIS		266746	> Income Tax	3193157	
			> House Building Advance	377032	
Subscription from various DDO'S		1610296	> Car Advance	132396	
			> Scooter Advance	12998	
Pro-rata Pensionary benefit received from PAO (F)			> LIC	1645731	
			> Any Other Recovery (Specify)	3544434	14796685
Amount received from Various DDO's on account of Pension contribution		13445182	**By Advances paid to Staff**		
			> Forest Advance	21947062	
Amount recovere on account of excess payment of pension by bank		13040	> Festival Advance	1626132	
			> Car Advance	84837	
Amount Received from other Departments on account of Pensionery Benefits		197492	> Scooter Advance	17178	
			> Cycle Advance	45726	
Govt. Securities		14861845	> HBA	283920	
			> TA Advance	11632585	
FDR Interest			> LTC Advance	3205607	
			> Medical Advance	3055464	
Total Project Receipts		98552660	> Pay Advance	235297	
			> TTA Advance	604464	
			> Computer Advance	45538	
			> Any Other Recovery (Specify)	811615	43595425
			By Any Other Payments (Specify)		
			By Project Payments		66221378
			Amount paid by Controller ICFRE		
			By GPF reimbursement to DDO's		14678674
			By GPF Part Final payment		16176360
			By GPF Final payment		9470873
			Death Claims Paid		221285
			Saving Fund Paid		484448
			Amt of premium to LIC for GSLIS Subsrcription		1626600
			Pensionary benefit paid		35591647
			Rembursement of DCRG, Pension to Various DDOs		6591363

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2006

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
			By KVS Expenditure		11070000
			By Traning & Education - Plan		93499779
			By Sharing Cost of Facilities for KVS		4262000
			CLOSING BALANCE		
			CASH	681892	
			BANK	183595610	
			FDR	726207684	
			Transfer of Fund	0	
					910485186
		1900724249			1900724249

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(FIN. ADVISOR & CHIEF Accout officer ICFRE)

B.D. JOSHI
(Controller Pension / E & A.O.)

LIST OF ABBREVIATIONS

AFRI	Arid Forest Research Institute
AMF	Arbuscular Mycorrhizal Fungi
APFDC	Andhra Pradesh Forest Development Corporation.
APMP	Alkaline Peroxide Mechanical Pulping
CD-ROM	Compact Disc Read Only Memory
CFR&HRD	Centre for Forestry Research and Human Resource Development
CPT	Candidate Plus Tree
CSF&ER	Centre for Social Forestry Research and Eco-Rehabilitation
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CSO	Clonal Seed Orchard
CTG	Cassia Tora Gum
ESF	Extension Support Fund
FRC	Forest Research Centre
FREE-P	Forestry Research Education and Extension Project
FRI	Forest Research Institute
FRLHT	Foundation for Revitalization of Local Health Tradition
FYM	Farm Yard Manure
GACL	Gujarat Alkali and Chemicals Ltd.
GEF	Global Environmental Facility
GHG	Green House Gas
HFRI	Himalayan Forest Research Institute
HPLC	High Performance Liquid Chromatography
ICFRE	Indian Council of Forestry Research and Education
IFFDC	Indian Farm Forestry Development Cooperative
IFGTB	Institute of Forest Genetics and Tree Breeding

IPM	Integrated Pest Management
IPMA	Indian Paper Manufacturers Association
IPT	International Provenance Trial
IR	Infra Red
IRS	Institute of Remote Sensing
ISSR	Inter Sample Sequence Repeat
IWST	Institute of Wood Science and Technology
KFD	Kerala Forest Department
LAN	Local Area Network
LOSP	Light Organic Solvent Preservative
MPT	Multi Purpose Tree
NABARD	National Agricultural Bank for Agriculture and Rural Development
NFLIC	National Forest Library and Information Centre
NFT	Nitrogen Fixing Trees
NMR	Nuclear Magnetic Resonance
NOVOD	National Oil Seed and Vegetable Oil Development
NRDC	National Research Development Corporation
NWFP	Non-Wood Forest Produce
PFM	Participatory Forest Management
PGD	Post Graduate Diploma
PSB	Phosphate Solubilizing Bacteria
PSIP	Planting Stock Improvement Programe
PT	Progeny Trial
PTG	Primitive Tribe Groups
RAPD	Randomly Amplified Polymorphic DNA
RBD	Randomized Block Design

RCBD	Randomized Complete Block Design
RDBMS	Research Data Base Management System
RFRI	Rain Forest Research Institute
SP	Self Pruning
SPA	Seed Production Area
SPM	Suspended Particulate Matter
SSO	Seedling Seed Orchard
SSPA	Seedling Seed Production Area
TFRI	Tropical Forest Research Institute
TKP	Tamarind Kernel Powder
TLC	Thin Layer Chromatography
TNFD	Tamil Nadu Forest Department
USDA	United States of Department of Agriculture
UV	Ultra Violet
VAM	Vasicular Arbuscular Mycorrhiza
VMG	Vegetative Multiple Garden
WAN	Wide Area Network

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