Annual Report
2006 - 2007

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

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Front Cover : Teak in line plantation, Devanahally, Bangalore.
Back Cover : Casuarina plantation along the coast at Casuarina Bay (North Andaman).

FOREWORD

Indian Council of Forestry Research and Education (ICFRE) has been implementing programmes aimed at holistic development of forestry research, education and extension for sustainable management and development of forestry resources in the country. 2006-2007 was particularly an important year as ICFRE hosted the 21st Asia Pacific Forestry Commission Meeting during April 2006 and offered its personnel a good opportunity of networking with international forestry organizations.

I am delighted to share this Annual Report with our forestry sector organizations, other partners, stakeholders, and people at large. The past year has been demanding and exciting with a number of new developments. The Council has been actively involved in the deliberations of the climate change as a United Nations Framework Convention on Climate Change (UNFCCC) observer and participated in meetings of Conference of the Parties (COP) and Subsidiary Bodies. The Council also established a platform for networking with partners on Forest Invasive Species. The Council in pursuance of its regular plan programme, approved research projects to cater to the needs of various target groups. Technologies and protocols developed in fields of silviculture, agroforesty, biotechnology, tree improvement, wood technology, forest products, and environmental management practices by the Council were extended to various user agencies at regular intervals through short and long term courses, workshops, trainings, diploma and awareness programmes.

Many national and international donor agencies play an important role in funding forestry research needs at the local, regional, national and international levels. The Council extends expertise in the form of consultancy to a varied clientele of hydropower firms, mining companies, water supply agencies, municipalities for tree avenue maintenance, and development of tree groves and avenues. Some specific consultancies include evaluation of projects funded by National Medicinal Plants Board, environment impact assessment, and drawing of management plan for hydropower projects of National Hydroelectric Power Corporation (NHPC), and socioeconomic survey and formulation of resettlement and rehabilitation programme for National Thermal Power Corporation (NTPC).

The Council has played a prominent role in the forest-climate debate on reducing emissions from deforestation, and influenced international negotiations with its reasonable, scientific and equitable stand in favour of forest conservation.

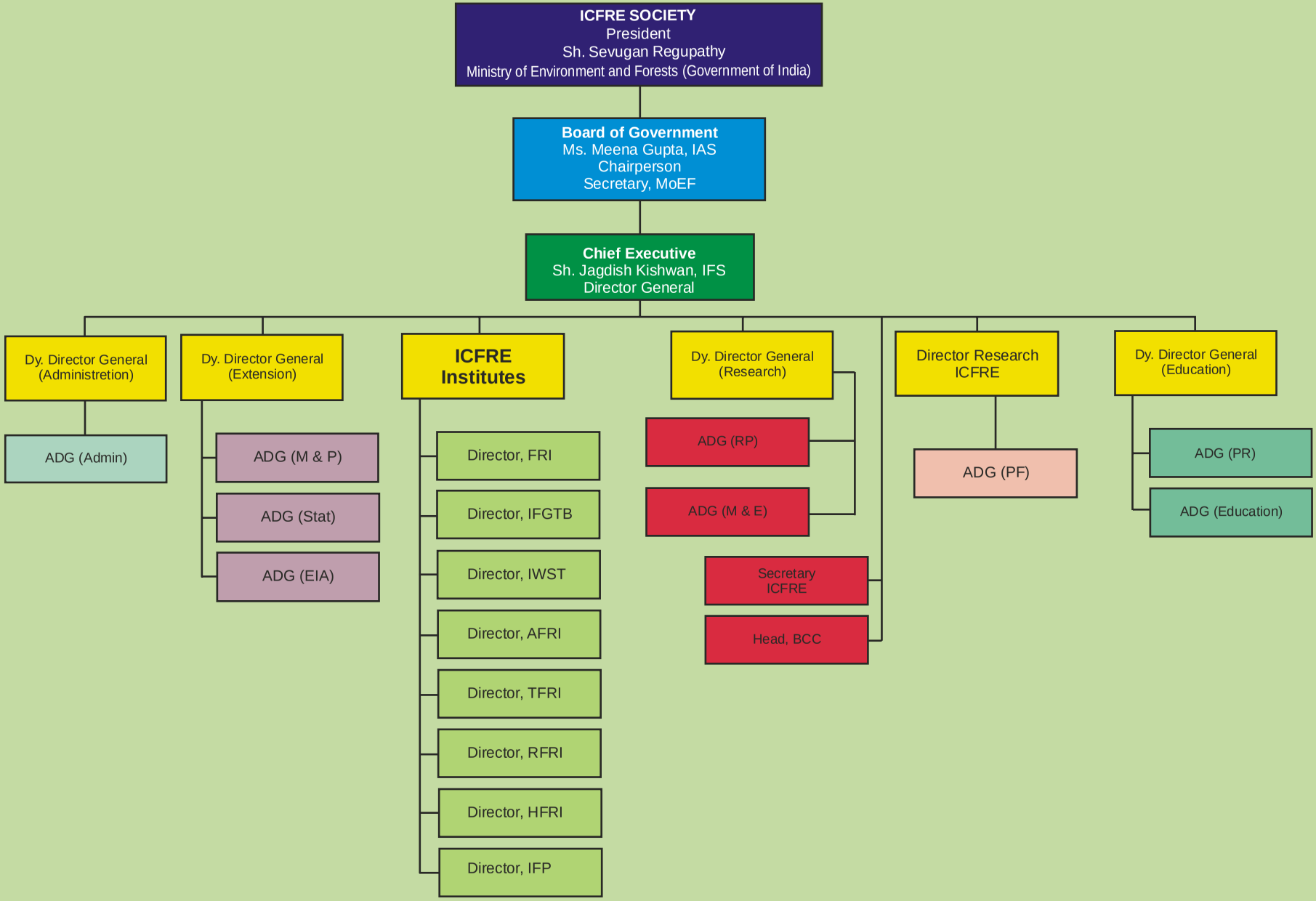
Countrywide forestry education is promoted by providing financial support to various universities imparting forestry education with a view to strengthening their infrastructure to augment teaching and research capabilities. Much emphasis is given on the quality of forestry education and placement of forestry students of FRI University.

The report provides insight into research, education and extension in the context of ICFRE activities, and it gives me immense pleasure in presenting this ICFRE Annual Report for the year 2006-2007.

Dated 27th August 2007

(Jagdish Kishwan)
Director General
Indian Council of Forestry Research and Education
Dehradun-248006

ORGANIZATIONAL STRUCTURE OF ICFRE



Introduction

Indian Council of Forestry Research and Education (ICFRE), an apex body in the national forestry research system, has been undertaking the holistic development of forestry research through need based planning, promoting, conducting and coordinating research, education and extension covering all aspects of forestry. The Council deals with the solution based forestry research in tune with the emerging issues in the sector, including 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.

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 information 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.

Institutes and Centres under the Council

ICFRE has eight Regional Research Institutes and four Research Centres located 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, Coimbatore, Bangalore, Jabalpur, Jorhat, Jodhpur, Shimla and Ranchi and the centres are at Allahabad, Chhindwara, Hyderabad and Aizawl.

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
* Advanced Research Centre for Bamboo and Rattans (ARCBR), Aizawl

Salient Achievements/Highlights of Research by ICFRE and its Institutes

ICFRE

* Quinquennial Review System for independent review of schemes, projects and institutes/centers adopted.
* 'Consultancy Rules' finalized and adopted.
* Finalized B.Sc. Forestry Syllabus in consultation with State Agricultural Universities and sent it to ICAR for concurrence.
* Barrier analysis study for CDM A/R projects under EU-India Small Projects Facility Programme conducted.
* Participation in the UNFCCC Workshop on "Reducing Emissions from Deforestation in Developing Countries" at Rome, Italy.
* Participation in the United Nations Climate Change Conference (COP12/MOP 2) held at United Nations Office in Nairobi, Gigiri, Africa.
* DG, ICFRE attended second workshop on "Reducing Emissions from Deforestation in Developing Countries", from 7th to 9th March 2007 at Cairns, Australia.
* ICFRE is working for grant of ISO 9001:2000 Certification. The first audit by internal auditors was conducted from 11th to 13th July 2006. A shadow audit was also conducted on 7th and 8th August 2006 by the Consultancy Development Centre (CDC), New Delhi.
* The Council based on information received from regional ICFRE institutes and State Forest Departments, prepared a brochure "Miniature Nature (Preservation Plots) A Status Report of India".
* Execution of a comprehensive project on "Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojana in Bihar State" (Phase-I) in coordination with Environment and Forest Department of Bihar State.
* Provided Rs. 700.00 Lakhs as Grant-in-Aid to 22 universities in the financial year 2006-2007.
* Establishment of a nation wide network to facilitate collection, processing and dissemination of statistics pertaining to tropical timber and other forestry products parameters in India through ITTO funded project.
* RPC of ICFRE has approved 109 projects to be carried out under plan projects.
* The Council conducted Environmental Impact Assessment studies and formulation of Environmental Management Plan for Kotlibhel, Stage-II (530 MW), National Hydroelectric Power Corporation, Tehri/Pauri Garhwal Project.
* The Council conducted Rapid Environment Impact Assessment studies in Chandigarh Industrial Area, PhaseIII for Chandigarh Administration, Chandigarh.
* Conducted monitoring and evaluation of projects funded by the Department of AYUSH, National Medicinal Plants Board under Promotional Commercial and Contractual Schemes being implemented by various agencies nationwide (except for central India).

INSTITUTES

* Forest Research Institute (FRI), Dehradun conducted cultural studies, effect of pH, pathological resistance testing and fungicidal sensitivity, for 53 isolates of *Fusarium solani* collected from all over the country.
* FRI, Dehradun identified best performing clones of *Dalbergia sissoo* raised at Clonal Seed Orchard and Seedling Production Area, Bhitmera, Hissar (Haryana) (1997).

* FRI, Dehradun evaluated the health parameters of trees growing in New Delhi Municipal Council (NDMC), and suggested suitable management practices for up keep of trees.
* Institute of Forest Genetics and Tree Breeding (IFGTB), Coimbatore has developed a prototype database VAM WAMP environment namely **"**The *In Silico* Gene Bank for Abiotic Stress Tolerance - TIGBAST" for retrieval of information for salt tolerant genes.
* IFGTB has established two unpedigreed seedlings seed orchards one each of *Eucalyptus camaldulensis* and *E. tereticornis,* and a provenance - progeny trial of *E. tereticornis* in different locations in South India.
* IFGTB has standardized agroforestry models for black gram, horse gram and fodder sorghum with *Accacia mangium*.
* IFGTB has established Aonla based agroforestry models in farmers' fields with medicinal plant *Withania somnifera.*
* IFGTB reported the incidence of an invasive insect pest *Leptocybe invasa* Fisher and La Salle (Hymenoptera: Eulophidae) in *Eucalyptus* plantations, for the first time.
* IFGTB has standardized selection criteria for plus trees of *Terminalia chebula.*
* IFGTB has standardized estimation methods of active biochemical compounds for *Terminalia bellerica.*
* IFGTB has established 31 ha plantations of *Casuarina equisetifolia* in Andaman Group of Islands to stabilize the coastline.
* Institute of Wood Science and Technology (IWST), Bangalore collected data on 426 plant species out of which 26 lesser-known potential plant species were collected for the first time from the tribes of Godavari valley. A rare cane, *Calamus latifolius* Roxb. was collected for the first time from southern India.
* IWST has developed a simple, less expensive, user friendly and field oriented colour reaction for identification of high yielders in sandal.
* A total of 344 insect species belonging to 12 orders have been identified from the 6 selected sandal provenances by IWST.
* Studies commissioned by IWST on the sucking insect pests' complex of sandal exposed 73 species breeding on sandal. Out of these 14 species were reported for the first time.
* IWST published a book entitled "A guide to some imported timbers in south Indian markets" containing 25 species of imported timbers.
* Tropical Forest Research Institute (TFRI), Jabalpur found that supplementing egg parasitoid, *Trichogramma raoi* in teak seed orchards has proved effective to minimize the intensity of pest attack and loss in annual growth.
* TFRI, Jabalpur prepared and submitted compendium on Achanakmar Amarkantak Biosphere Reserve to Ministry of Environment and Forests, Government of India.
* TFRI, Jabalpur identified new genera of fungi, *Acrodictiella* and *Kamalomyces*, reported for the first time and new to the science world.
* TFRI, Jabalpur screened four strains of *Ganoderma lucidum* for enzyme production, which has medicinal value.
* TFRI, Jabalpur has standardized cultivation techniques of *Rauvolfia serpentina*, *Andrographis paniculata*, *Gymnema sylvestre* and *Tinospora cordifolia*.
* TFRI, Jabalpur has developed non-destructive harvesting practices of *Terminalia arjuna*, *Rauvolfia serpentina*, *Andrographis paniculata*, *Gymnema sylvestre* and *Tinospora cordifolia*.

* TFRI, Jabalpur developed tissue culture protocols of *Bambusa nutans* and *Bambusa tulda.*
* Rain Forest Research Institute (RFRI), Jorhat conducted studies on reclamation of highly eroded site of Cherrapunjee, Meghalaya using *Alnus nepalensis* and *Ex-bucklandia* with a survival percentage of 90.8% and 75.18% respectively.
* Population fluctuation of *Calopepla leayana* on *Gmelina arborea* was studied in and around Jorhat, by RFRI. The population trend was correlated with abiotic factors indicating significant dependence on temperature, relative humidity, and rainfall. Entomopathogenic fungus, *Beauveria bassiana* was isolated and identified as an effective natural pathogen against the larval and adult stages of *C. leayana*.
* Arid Forest Research Institute (AFRI), Jodhpur has developed generalised height-diameter equations for *Tecomella undulata* plantations in IGNP area of Rajasthan State to assess the growth parameters.
* AFRI, Jodhpur developed potential density and basal area projection models for *Acacia nilotica* and *Eucalyptus* hybrid plantations in Gujarat State.
* AFRI, Jodhpur developed a method for identification of the right stage immature embryo containing unripened seeds of Guggal (*Commiphora wightii*) for initiation of the embryogenic callus cultures. This method enables establishment of callus with higher somatic embryogenesis rate.
* Himalayan Forest Research Institute (HFRI), Shimla has developed macro-proliferation technique for *Picrorhiza kurrooa* and *Valeriana jatamansi* in the nursery.
* HFRI, Shimla has designed and fabricated a nursery implement namely 'Multiple Nursery Planting Bar' for maintaining desired spacing of *Valeriana jatamansi* in the nursery.
* HFRI, Shimla recorded occurrence of two species of mites, *viz., Panonychus ulmi* (Koch) and *Tetranychus urticae* (Koch), normally recognized as pests of Apple in Himachal Pradesh, in *Valeriana jatamansi* Jones an important medicinal plant of temperate Himalayas which caused severe damage to its foliage in the nursery conditions.
* HFRI, Shimla recorded defoliation in willow - locally known as Dokchang - plantations along Shyok and Indus rivers falling in Khalsi and Nubra Forest Ranges of Leh Forest Division, Ladakh, due to out-break of *Clostera cupreata* Butler (Lepidoptera: Notodontidae) insect.
* HFRI, Shimla recorded occurrence of *Datisca cannabina* (Akalbir) which belongs to the family Datiscaceae and is generally distributed in temperate Himalayas from Kashmir to Nepal, in cold desert area of Pooh Sub division of District Kinnaur, Himachal Pradesh. The species was also found in the moist locations along the nallah in Chila top area of Pooh valley at an elevation of 3,100 m above msl. The plant is endangered in Himachal Pradesh as per Conservation Assessment and Management Prioritization (CAMP).
* Institute of Forest Productivity (IFP), Ranchi developed a low-cost, simple and quick technique for compost production.
* IFP, Ranchi prepared a book on 40 species of medicinal plants on their propagation, cultivation and use for various target groups.

Indian Council of Forestry Research and Education

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

FORESTRY RESEARCH

Biodiversity, Climate Change Division (BCC) has taken up short term and long term policy programmes to address the problems of Climate Change and Biodiversity Conservation.

A. BIODIVERSITY

1. **Preservation Plots:** Based on information received from Regional ICFRE Institutes and State Forest Department, a Brochure "Miniature Nature (Preservation Plots) A Status Report of India" was prepared and draft report was submitted for publication.

   BCC Division has provided all the research materials towards development of Project Proposal on "Phytodiversity Network through Preservation Plots" for XI Five Year Plan.

2. **Forest Invasive Species:** BCC Division also prepared a Country Report on "Stocktaking of National Activities on FIS" submitted by MoEF to Asia Pacific Forest Invasive Species Network (APFISN), 61 species of plants (including 12 species of fungi) and 14 species of insects have been identified as invasive having national distribution and 36 species having regional distribution. Of these 28 species have been reported to be native to India but have taken invasive proportions in other bio-geographical regions of the country.

B. CLIMATE CHANGE

BCC Division had taken up 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 Projects":** The overall objective of the project was to create an enabling environment through dissemination of information and policy reforms for implementation of bilateral Clean Development Mechanism (CDM) Sinks Projects at the local level in India.

   The Division organized a two days Meeting of stakeholders on "Proposed Policy Reforms to remove the barriers to CDM Afforestation and Reforestation (A/R) Projects" on 14th and 15th September 2006. A total of 76 delegates representing various stakeholders from Govt. of India, like NRSA, IIRS, State Forest Departments, institutes, NGOs and Farmer Association participated in the Meeting. Dr. B. S. Burfal, Principal Chief Conservator of Forests, Uttarakhand was the Chief Guest of the function who delivered inaugural address.

   Under this project, BCC Division of ICFRE conducted a Barrier analysis study for C D M A/R Projects. The study report was discussed in the meeting and the suggestions/

recommendations were deliberated upon to suggest ways and means to remove these barriers through policy interventions at National level, DG, ICFRE laid stress on accounting at agro-forestry and tree plantation on farm bunds. He advocated development of a system to convert strip plantation into notional hectares for facilitating A/R CDM activities. He further opined that all the potential areas including poverty and agriculture need to be identified with the help of NRSA, FSI and ICAR. Creation of a carbon Directorate at national level was also suggested during the meeting. The identified barriers along with recommendation have been forwarded to Govt. of India for speedy implementation of CDM A/R projects in India.

The project has been successfully completed and the final technical report of the project has been accepted by the European Union.

2. **FORCLIMIT India (MoEF-USEPA Programme-Forests and Climate Change Mitigation Network:** Under the FORCLIMIT India Project, development of regional base lines in selected watersheds in the country has been initiated.

C. OTHER ACTIVITIES

1. **Participation of ICFRE at UNFCCC Workshop on "Reducing Emissions from Deforestation in Developing Countries" in Rome, Italy, from 30th August to 1st September 2006:** Shri Sandeep Tripathi, ADG and Head, BCC Division, ICFRE attended the aforesaid workshop conducted on the invitation of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC).

Avoided deforestation is a newly debated mechanism under CDM, where developing countries volunteer to reduce their national level of deforestation rate to below a historical average baseline e.g. a 1980-1990 level, and commit, to stabilize or further reduce deforestation in future would receive post facto compensation. Shri Tripathi put forward the country's view on the issue of avoided deforestation. He emphasized that the Government of India was not in favour of any "optional" or "voluntary" protocol exclusively for "Deforestation" during the first commitment period or subsequent periods. He also deliberated that the proposed mechanism would act as a disincentive towards the countries, which have conserved or increased their forest cover. He also stated that before embarking upon any such mechanism, all technological, methodological and other related issues needed to be addressed and firmed up through a scientific body like IPCC.

The workshop provided an opportunity for parties to share experiences and consider relevant aspects relating to reduce emissions from deforestation in developing countries.

2. **Participation of ICFRE delegation in United Nations Climate Change Conference (COP 12/MOP 2) Nairobi, Kenya, from 6th to 17th November 2006 at United Nations Office in Nairobi, Gigiri, Africa:** Kenya hosted the second meeting of the parties to the Kyoto Protocol (COP/MOP 2), in conjunction with the twelfth session of the Conference of the Parties to the Climate Change Convention (COP 12), at Nairobi from 6th to 17th November 2006.

The ICFRE delegation, comprising Shri Jagdish Kishwan, DG, ICFRE; Dr. Shashi Kumar, Director (Research); Shri Sandeep Tripathi, Head, BCC Division and Dr. A. Ramchandran, Forest Utilisation Officer, Tamil Nadu, participated in the COP-12 along with the Government of India delegation.

The ICFRE delegation actively participated in different assigned agenda discussions relating to the COP, COP/MOP, SBSTA, SBI and AWG during the Nairobi meet. In particular, the following items were closely followed during the meet: (i) Reducing emissions from deforestation in developing countries (Agenda item 5 of SBSTA) (ii) Clean Development Mechanism (Agenda 5 of COP/MOP) (iii) Adaptation Fund: (Agenda item 6), Financial Mechanism (Kyoto Protocol) India proposed the mechanism of 'Compensated Conservation' for providing compensation to the countries for maintaining and increasing the carbon stocks as a result of conservation and improvement/ increase in forest cover backed by input of verifiable monitoring system.

3. **Participation of DG, ICFRE in second workshop on "Reducing Emissions from Deforestation in Developing Countries", from 7th to 9th March 2007 in Cairns, Australia:** Shri Jagdish Kishwan, DG, ICFRE, participated in the aforesaid workshop as the country's representative.

Shri Kishwan made a presentation on "Reducing Emissions from Deforestation in Developing Countries: The Indian Proposal" wherein an alternate policy approach to Avoided Deforestation was suggested and the concept of "compensated conservation" to reward the countries that have increased their forest cover in spite of great population pressure and demand for land resources was proposed. It was projected that India would be entitled to claim incentive for maintaining baseline stock estimated at 8.79 GtC in 2006 as also an annual increment of 0.96 GtC effected till 2030 as a result of improvement of the present extent of forests and due to afforestation outside legal forest area. These interventions led to making noticeable headway in meeting India's concern towards providing incentive to countries for conserving and improving its forests.

4. **Climate News Letter:** Quarterly climate news letters covering latest developments in the area of climate change and upcoming events etc. were prepared and uploaded on the ICFRE website during 2006-2007.

5. **ISO 9001:2000 Implementation:** ICFRE is working hard for ISO 9001:2000 certification. The Quality Manuals as per ISO 9001:2000 have been completed and kept at various user locations. The first audit by internal auditors was conducted from 11th to 13th July 2006. A shadow audit was also conducted on 7th and 8th August 2006 by the consultants, M/s Consultancy Development Centre (CDC), New Delhi.

All the requirements as per the ISO 9001:2000 QMS have been met by ICFRE and the system put in place for ISO 9001:2000 certification.

Research Planning Division, under the Directorate of Research, deals with the planning, processing and execution of new research project proposals funded by ICFRE. It follows bottom-up, transparent and participatory approach.

During the year 2006 - 2007, following achievements have been made by this division:

* It coordinated the Research Advisory Group (RAG) meetings at Institute level on the dates mentioned below:

IFGTB, Coimbatore	-	22nd Aug. 2006
TFRI, Jabalpur	-	30th Aug. 2006
IWST, Bangalore	-	26th Sept. 2006
HFRI, Shimla	-	18th Oct. 2006
FRI, Dehradun	-	30th Oct. 2006
IFP, Ranchi	-	17th Nov. 2006
RFRI, Jorhat	-	22nd Nov. 2006
AFRI, Jodhpur	-	28th Nov. 2006

This year the base of the Research Advisory Groups was made broader by including young scientists, representative of Planning Commission and representative of JFM Committees. All the RAGs discussed about adopting Rolling Research Plan and revision of National Forestry Research Plan.

Research Policy Committee (RPC): The new research proposal submitted by eight Research Institutes under ICFRE and recommended by the RAGs were placed before the RPC in its meeting held on 26th and 27th February 2007 for obtaining final approval. The meeting was chaired by Shri Jagdish Kishwan, DG, ICFRE.

In all, 122 new projects were discussed by RPC, of which 6 projects were not approved, 7 projects were approved for external funding, 72 projects were approved after modification and 37 projects were approved without modification.

The chairman, during the RPC meeting, desired that every project should have extension and IPR component. The All India Coordinated projects on identified species were assigned to different Institutes for taking lead role as under.

Name of the spp.	NodalInstitute
Casuarina, Eucalyptus	IFGTB, Coimbatore
Poplar, invasive species, lesser known species, Sissoo, Sal	FRI, Dehradun
Bamboo	RFRI, Jorhat
Jatropha	AFRI, Jodhpur
Teak	TFRI, Jabalpur

Directors' Meet:

On 28th February 2007, Directors meet was organized in the Board room of ICFRE headquarters under the chairmanship of Shri Jagdish Kishwan, DG, ICFRE. The meet was organized to discuss some of the important issues for which agenda was fixed by different directorates in

consultation with the Directors of the Institutes. Some of the issues discussed were Grant-in-Aid provided by ICFRE to the Universities, appointment of JRFs and SRFs, HRD issues, budget issues, establishment of Van Vigyan Kendras in States/UTs, selection of villages by ICFRE institutes for extension of technologies, revise the mandate of each institute for renaming, adoption of five years research rolling plan, and revision of NFRP, etc.

Monitoring and Evaluation Division, under the Directorate of Research, deals with the review and evaluation of all the ongoing research projects of ICFRE institutes. It suggests corrective measures for timely completion of the projects and achievement of the objectives with perfection. During 2006-07, the review/evaluation of 355 (199 ICFRE funded and 156 externally aided) ongoing research projects of all ICFRE institutes was done. Apart from above, independent review of completed/ongoing research projects has also been carried out through independent subject matter experts/agencies. This Division also collects information on Annual Action Plan from the institutes for preparation of consolidated Annual Action Plan for ICFRE.

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 regards to their suitability in the identified thrust areas.

Externally Funded Projects

A number of Research Project Proposals submitted by ICFRE Institutes/Centres were scrutinised as per the guidelines and funding requirements of donor agencies in identified thrust areas and suitable proposals were processed for their approval and submitted to National and International donor agencies. Presently, 170 Projects funded by National donor agencies and 14 Projects funded by International and National donor agencies are being implemented. Besides this, there are 146 Projects and 15 Projects in the pipeline for funding, with National and International donor agencies respectively.

Some of the National Donor Agencies are Ministry of Environment and Forests (MoEF), Department of Biotechnology (DBT), Department of Science and Technology (DST), National Medicinal Plant Board (NMPB), National Bank for Agricultural and Rural Development (NABARD), Council of Scientific and Industrial Research (CSIR) etc. The International Donor Agencies are Japan International Co-operation Agency (JICA), Swedish International Development Agency (SIDA), International Foundation for Science (IFS), International Tropical Timber Organisation (ITTO) and United State Department of Agriculture (USDA) etc.

Bihar Project

The Division co-ordinated in the execution of a comprehensive Project titled, “Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojana in Bihar State” (Phase I) being implemented by ICFRE with Department of Environment and Forests of Bihar State. Activities relating to ICFRE Component on Poplar Based Agroforestry Programme on farmer's field in Vaishali District of North Bihar were monitored. Review meetings were arranged regularly and minutes issued by this Division to monitor the progress of the project and record the decisions for taking further necessary actions in this regard.

The Status Reports of National and International Research Projects were updated (as on November, 2006). Projects were categorized as Approved, Submitted and Rejected as per the inputs received from the ICFRE Institutes / Centres.

A Compendium of National and International donor agencies for Project funding was published. The base document gives all the information related to Project development and National / International donor agencies at one place to help the researchers develop suitable Projects in the areas which warrant immediate attention.

A proposal worth Rs. 50 Crores was prepared for XI Five Year Plan relating to strengthening of forestry research capabilities of State Forest Research Institutes (SFRIs) to support their R&D wings through collaboration with ICFRE.

A draft proposal on "Forestry Research Support Project for Poverty Alleviation" for funding by World Bank was conceptualized and submitted.

The Division contributed towards the successful organisation of 21st Asia Pacific Forestry Commission (APFC) Meeting held at ICFRE from 17th to 21st April 2006.

FORESTRY EDUCATION

Directorate of Education provides financial support in the form of Grant-in-Aid to the universities imparting forestry education in the country in order to strengthen the infrastructural facilities and to enhance the teaching and research capabilities of their forestry faculties thereby promoting 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 building.
* Purchase of equipments.
* Purchase of books, periodicals and journals for the libraries.
* Developing glass houses, mist chambers and other such teaching/research facilities.
* Developing sports/games and other students' amenities.
* Establishment/strengthening of communication-cum-museum and instrumentation centers.
* Purchase of transport and camping equipments for practical training and extension education.
* Development of computer centres 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, considered necessary by the ICFRE Accreditation Committee.

In the financial year 2006-2007 Rs. 700.00 lakhs was provided as Grant-in-Aid to 22 universities.

The Directorate has also taken up work related to standardization and unification of B.Sc./M.Sc. (Forestry) courses being run in various state agricultural universities to ensure delivery of quality education thereby safeguarding the interests of students community and forestry sector in particular. For validation of the course curriculum and the college imparting the same, process of accreditation on the pattern of AICTE has also been initiated.

JRFs/SRFs/RAs are appointed by the Directorate for implementation of projects in the ICFRE institutes. It also conducts trainings/programmes for scientists of ICFRE and its institutes with the objective to hone up their knowledge/research skills for making effective contribution in the forestry research.

Policy Research Division carries out work on Policy Research related to forestry sector on technical, sociological, policy and programme related issues. Policy Research Advisory Committee of ICFRE under the chairmanship of ADG (FC), Ministry of Environment and Forests, Govt. of India, New Delhi has been constituted. Following key research issues/topics have been identified and work has been initiated on the same;

(i) Need for an institutional and regulatory mechanism for certification of planting stock material of forest seeds and vegetative origin.

(ii) Analyzing the linkage between poverty alleviation and forestry programmes.

(iii) Scientific rationale for prescribing the requisite forest and tree cover in India.

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 various R&D activities of ICFRE institutes and keeps MoEF apprised of them. The division publishes the Quarterly Newsletter of ICFRE (that brings out the latest significant achievements made by the ICFRE institutes) and the ICFRE Brochure. 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 is taken up by this division and is mandatory before their final publication.

Work on establishment of Van Vigyan Kendras (VVKs) in collaboration with SFDs and selection of villages for adoption by ICFRE institutes have been initiated with the objective of promoting forestry extension among farmers and other targeted groups. ICFRE shall provide the Van Vigyan Kendras, funds for literature, printing of brochures, newsletters etc., model nursery technology, equipments for extension besides training and capacity building of farmers. In the villages selected by ICFRE Institutes, there will be demonstration and extension of technologies for example Agroforestry models, establishment of Model/Hi-tech nurseries, training and transfer of simple technologies, etc.

Statistics Division, under the Directorate of Extension, published 4 volumes of Timber/Bamboo Trade Bulletin, Nos. 46, 47, 48, and 49 during the year 2006-2007.

The Division is also implementing a project funded by ITTO entitled 'Establishment of a Network to Facilitate Collection, Processing and Dissemination of Statistics Pertaining to Tropical Timber and Other Forestry Parameters in India'. The total budget of ITTO is USD 2,16,378.00. The first installment of USD 59,150.00 was received on 28th June 2006 and the project was initiated on the 1st July 2006. The following activities have been carried out:

a) A Forestry Statistics India Stakeholders' Meet was organized on 29th and 30th November 2006. The organizations that participated in the meet were Central Statistical Organization; Wildlife Institute of India; Forest Survey of India; Chattisgarh State Forest Department; Directorate General, Customs Intelligence and Statistics, Kolkata and the ICFRE institutes. The following main agenda items were discussed in the meet:

   1. Review the existing formats of Forestry Statistics India.
   2. Constitute a National Working Group of stakeholders.
   3. Constitute a calendar for data collection.
   4. Decide the frequency of data collection and its format.
   5. Identify the areas where data availability is low and sample surveys may be resorted to in order to fill in the gaps.

b) Computerization of data collection and dissemination of formats is under process.

c) A National Forestry and Environmental Statistics Laboratory has also been established at ICFRE Headquarters with adequate hardware and data analysis software (STATISTICAL).

Statistics Division also provided statistical services to consultancy projects as under:

a) Statistical services were rendered to EIA Division of ICFRE for monitoring and evaluation of compensatory afforestation raised by Tehri Hydro-electric Development Corporation (THDC) for Tehri Dam Project.

b) Monitoring and evaluation of projects funded by National Afforestation and Eco-development Board (NAEB).

c) Socio-economic Survey for Kotlibehl Hydro-Power Project.

The division disseminated data in respect of forestry sector to ITTO in the form of Joint Forest Sector Questionnaires (JQ1 and JQ2).

Environmental Impact Assessment Division of the Directorate of Extension has been undertaking EIA studies nationwide for various developmental activities. The following studies have been completed by the Environmental Impact Assessment Division during the year:

1. Monitoring and Evaluation of projects funded by the Department of AYUSH, National Medicinal Plant Board under Promotional Commercial and Contractual Schemes to various agencies nationwide except for central India.

Medicinal plant farming under the projects funded by
Department of AYUSH, NMPB

1. Rapid Environment Impact Assessment studies for Chandigarh Industrial Area Phase III in Chandigarh Administration, Chandigarh.

2. Environmental Impact Assessment studies and formulation of Environmental Management Plan for Kotlibhel stage II (530 MW), National Hydroelectric Power Corporation, Tehri/Pauri Garhwal.

PRA for socio-economic studies and view of dam
site of KBHEP-II, NHPC

The following studies undertaken by the Council are in progress:

1. Evaluation of Catchment Area Treatment Plan of Tehri Dam Hydro Electric Project, Tehri Hydroelectric Development Corporation.

Evaluation of engineering work and plantations for CATP of Tehri Dam

2. Preparation of Catchment Area Treatment Plan (CATP) for bauxite mining in Muliagalugu, Anantagiri and Sunkermetta Reserve Forests in favour of Andhra Pradesh Mineral Development Corporation (APMDC).

3. Preparation of EIA/EMP covering socio-economic and ecological aspects for diversion of forest land for bauxite mining in Muliagalugu, Anantagiri and Sunkermetta Reserve Forests in favour of Andhra Pradesh Mineral Development Corporation (APMDC).

Chittamkondi Bauxite mining site, APDMC

4. Monitoring and Evaluation of National Afforestation Programme a scheme being implemented under the decentralized system of Forest Development Agencies (FDA) and funded by the National Afforestation and Eco-Development Board of the Ministry of Environment and Forests, Government of India.

5. Preparation of Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) for diversion of 125 ha, 289 ha, 900 ha and 335 ha forest land for bauxite mining in Jerrela Block-III of Reserve forest respectively in favour of Andhra Pradesh Mineral Development Corporation (APMDC), Hyderabad.

GENERAL ADMINISTRATION

Information Technology Cell

Directorate of Administration, caters to all the Information Technology needs of the users at ICFRE and its Institutes/Centres. The activities of the cell include LAN-WAN support, procurement and maintenance of hardwares, E-Governance, trainings, providing IT support for the technical presentations in the meetings, conferences, seminars, workshops etc. The important achievements are as follows:

* Regular maintenance of 512 Kbps leased line taken from BSNL, Dehradun.
* Regular maintenance and reporting of e-mail, internet, CD-Service etc. for around 400 users across ICFRE Headquarters and FRI.
* Development and updation of www.icfre.org a website of the Council.
* Regular maintenance and reporting of File Server for data storage service provided to users of ICFRE Headquarters and FRI.
* Regular maintenance and reporting of Network Antivirus facility at the ICFRE Headquarters and FRI campus through a centralized AV Server.

* Maintenance of computer and peripheral hardware at ICFRE Headquarters and FRI through the third party vendor's.

* The HCL Pentium IV Desktops (81 nos.), HP Laserjet 1320N (31 nos.) Printers and APC UPS (81 Nos.) were received from MoEF, New Delhi under E-Governance and put to use after installation.

* A consolidated portal is being planned for ICFRE as a whole to suit the e-Governance needs of the organisation.

* The Indian Forestry Research and Information System is being planned and a consultancy for formulation of its Project Development Document (RFP) is underway.

* A separate proposal has been initiated to install a Virtual Private Networking (VPN) for ICFRE.

* Imparted in-house training to Officers and staff of ICFRE and its Institutes.

* Securing computer through proposer usage of Centralized Antivirus.

* Conducted Training programme on “Securing Computer and Network”.

* IT Service support provided to ICFRE Headquarters and FRI with regards to the IT and audio-visual arrangements in all the meetings, conferences, seminars and workshops etc. organized at ICFRE Headquarters and FRI during the year 2006-2007.

EDUCATION AND TRAINING

1. One week refresher training course for Indian Forest Service Officers on “Climate Change and Relevance to Forestry Sector” sponsored by Ministry of Environment and Forests, Govt. of India, New Delhi was organized at ICFRE Dehradun from 9th to 13th October 2006. 18 IFS officers of different States participated in this training programme.

2. Scientists of BCC Division participated as resource persons to impart short term training and education on Climate Change and Biodiversity Conservation related issues to officials of Government of India, State Forest Department, Public Sector Undertakings, NGOs and representatives from various industries.

PUBLICATIONS

BROCHURES / PAMPHLETS

1. Sandeep Tripathi and V.R.S. Rawat (2006): Resource Manual on “Climate Change and Relevance to Forestry Sector” for Indian Forest Service Officers ICFRE, Dehradun.

2. Shashi Kumar, Sandeep Tripathi and V.R.S. Rawat (2006): CDM Afforestation and Reforestation Projects in India Analysis of Barriers. An ICFRE Publication under EU-ICFRE SPF Project.

3. lnhi f=ikBh] fot ; jkt flg jkor ,o vke dekj (2006) % “lh- Mh- ,e- fld ifj;ktuk; % ouhdj.k ,o iuouhdj.k ifj;ktukvk dfØ;kUo;u ij i'ukRrjh”, vkb- lh- ,Q- vkj- b- idk'kuA

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIUM/ EXHIBITION

1. Jagdish Kishwan and V. R. S. Rawat (2006): Compensated Conservation: A New Concept for Compensating Nations for Carbon Conservation by Maintaining and Enhancing Forest Cover. Paper presented in the International Conference on Planted Forests: Ecosystems Goods and Services, from 13th to 15th December 2006 at Forest Research Institute, Dehradun.

2. Shashi Kumar, Sandeep Tripathi and V.R.S. Rawat (2006): Creating an Enabling Environment for CDM Afforestation and Reforestation Projects in India. Paper presented in the International Conference on Planted Forests: Ecosystems Goods and Services, from 13th to 15th December 2006 at Forest Research Institute, Dehradun.

3. Shashi Kumar, Sandeep Tripathi and V.R.S. Rawat (2006): "Potential of Production Forestry for Carbon Sequestration in India". Paper presented in the Regional Conference(s) on "Scope of Production Forestry for Carbon Sequestration" organized by Ashoka Trust for Research in Ecology and Environment (ATREE), New Delhi and British High Commission, from 7th to 8th December 2006 at Forest Survey of India, Dehradun.

4. Shashi Kumar and Om Kumar (2006): Afforestation A Tool for Combating Desertification. Paper presented in National Workshop Forestry for Food Security in Dry Zone on 5th and 6th October 2006, organized by Arid Forest Research Institute, Jodhpur.

Chapter 3

Institutes and Centres of ICFRE

Forest Research Institute Dehradun

Forest Research Institute (FRI), Dehradun erstwhile known as Imperial Forest Research Institute was established in 1906 to organize and lead forestry research activities in the country. The institute caters, in particular, to the research needs of the States of Punjab, Haryana, Chandigarh, Delhi, Uttar Pradesh and Uttarakhand. This institute also has the status of 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. The year 2006 was celebrated as Centenary Year of FRI and 5th June 2006 as Centenary day. Year long celebrations included First Brandis Memorial Lecture by Dr. M.S. Swaminathan, Chairman, M.S. Swaminathan Research Foundation, Chennai; followed by many international and national events. The Centenary year ended with a special function of its kind in the country in which a two km long symbolic and ceremonious green linen bearing the signatures of lakhs of school children of Uttarakhand with their pledge to protect and conserve the forests and environment, was wrapped around the FRI Main Building, a historical event of its kind in the arena of forestry science in tropical world.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

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

Findings: Seeds of *P. juliflora* are a waste and not being utilized properly. Endosperm adhered to the interior part of the seed was separated manually from the seed coat. Two polysaccharides were isolated from the endosperm, namely hot water-soluble polysaccharide (hws) (yield~3.3%) and cold water soluble polysaccharide (cws) (yield~81%). Molecular weight of the cws polysaccharide was determined by Mark-houwink equation using ubbelohde viscometer, and was found to be 10.7 x 10^5. Complete hydrolysis of polysaccharide produced a mixture of monosugars D-galactose and D-mannose. The polysaccharide partially hydrolysed with dilute sulfuric acid (0.05N), furnished mixture of oligosaccharides along with monosaccharides. Oligosaccharides and polysaccharide were completely methylated by Hakomori and Purdie methylation reactions. GLC of the polysccharide indicates nonreducing end of the main backbone and shows that the nonreducing single galactose units are attached to the branched mannose units through α- (1> 6) glycosidic linkages, 2, 3-di-O-methyl- D-mannose and 2, 3, 6-tri-O-methyl-D-mannose indicate that the main chain is composed of β- (1> 4) glycosidic linkages. The structure of polysaccharide was further confirmed by ^{1}H NMR, ^{13}C NMR and periodate oxidation. The abundant availability of the seed as waste material makes the seed polysaccharide a potential cost effective natural thickener.

Project 2: Inventorisation of multipurpose trees and shrubs for domestication and introduction in agroforestry for socio-economic upliftment of rural sector of Dehradun [FRI-199/SF-5/2002-2007]

Findings: Experimental work has been completed; data and final report is being prepared.

Project 3: Bio-ecology of insect pests of *Paulownia* and enumeration of their natural enemies [FRI-196/FED- 11/2002-2007]

Findings: *Paulownia* nursery and plantations at New Forest, Devipur, Sahaspur in Uttarakhand and Saharanpur in U.P. were surveyed. Light to moderate intermittent infestation of *Helicoverpa armigera, Hyposidra talaca, Orgyia postica, Spodoptera litura, Acherontia styx, Ceryx godarti, Euproctis* sp., *Mimastra cyanura, Dolycoris indicus, Nezara viridula* and *Pingasa chlora* was observed.

Studies on nutritional behaviour of an important defoliator of *Paulownia* and *Spodoptera litura* indicated that the insect could consume as much as 9245.50 mm^2 of *Paulownia* foliage during its entire larval stage.

Project 4: 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]

Findings: *Taxonomy of Parasitic Braconid Parasites (Hymenoptera)* - 2 species of braconids genus *Apanteles,* 1 spp. of *Chelonus*, some braconid parasites of subfamily Hormiinae and 2 parasites of subfamily Rogadinae were collected and identified. Study of parasitoids of *Stauropus alternus* known as *Apanteles taprobanae* on *Acacia catechu* has also been done.

***Updating of Parasitic Braconid Parasites (Hymenoptera)* -** Updating of sub family Microgastrineanae, Doryctinae and Hormiinae (housed in NIRC) and family Braconidae was completed.

Project 5: Bio-ecological studies on insect pests of bamboos and their management [FRI-144/FED-8/2001-2007]

Findings: Chemical control of bamboo ghoon was carried out at bamboo depot Kotdwar (Pauri Garhwal). Efficacy of various stickers with Cypermethrin 0.4% in diesel was tested. Stickers used were Neogenpin, Neogen PAN, Teepol, Triton and molasses. Best protection of felled bamboos was achieved for one year with the application of 20 ml. of molasses per litre of emulsion of Cypermethrin 0.4% in diesel followed by 20 ml. Neogen PAN, when used as prophylactic treatment.

Project 6: 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]

Findings: Data on cupping, spring and bow of *Eucalyptus* planks sawn under balanced tangential sawing pattern and radial sawing was compiled. An analytical study shows that there is certain range of length for which spring and bow are minimum. There are also certain ranges of widths for which cupping is minimum. The final project report is under preparation.

Project 7: Prediction of plants for plantation on 'a soil' based on cationic properties of soil and plant roots [FRI-317/FSLR-22/ 2005 2007]

Findings: Experiments conducted with three leguminous (*Cassia fistula, Dalbergia sissoo* and *Albizia procera*) and three non-leguminous (*Eucalyptus tereticornis, Terminalia arjuna* and *Terminalia chebula*) species in normal and sodic soils indicated that uptake of nutrients by plants is related to cation exchange capacity of soil and plants roots that was higher in normal soil than sodic one, and

leguminous species than non-leguminous species. Plant growth (height and biomass) increased with increase in cation exchange capacity of soil and plant roots.

Project 8: Development of protocol for multiplication and Germplasm conservation of *Oroxylum indicum* and *Gymnema sylvestre* [FRI 243/G&TP 14/2003-2007]

Findings: *In-vitro* shoots were multiplied and *in-vitro* rooting was standardized for *Oroxylum indicum* and *Gymnema sylvestre*. Half strength MS medium was found to be the best for *O. indicum* and half strength MS medium supplemented with NAA was found to be the best for *G. sylvestre*.

Project 9: Development of forest fire control tools [FRI-325/Silva-27/2005-2007]

Findings: Forest fire tools were fabricated, tested and demonstrated in various conferences and workshops. The technical know how of these tools was also given to M/s Atul Trading Corporation, Dehradun for further fabrication and supply on nonexclusive basis.

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Assessment of wood quality parameter in seed raised plantations of different age series of *Dalbergia sissoo* Roxb. [FRI -299/Bot-44/2005-2008]

Status: Measurement of fibre length, fibre diameter, wall thickness, vessel length and diameter of 12 trees was completed from maceration and 2 trees from slides. Further, data on 22 growth rings of a tree was completed.

Project 2: Inventorization and monitoring of biodiversity of threatened wetland sites of Doon valley and surroundings, Uttaranchal [FRI-250/Bot-33/2003-2008]

Status: Florisitics for the threat value vis-a-vis conservation value assessment was done on the fresh water swamps, namely Ramgarh, Mothronwala, Golatappar, Tinpani, Manu swamp, Nakraunda, Asan etc. Doon Valley. Categorization of threatened sites was done from the restoration point of view. Taxonomical and nomenclatural aspects on 150 species of the area were completed for a treatise.

Project 3: Exploration, ethnobotanical evaluation and preservation of rare and endangered flora of Jaunsar-Bawar [FRI -298/Bot-43/2005-2008]

Status: Floristic and ethnobotanical surveys were carried out in Chakrata hills of Jaunsar and Bhabar region of Uttarakhand. Nearly 300 specimens along with ethnobotanical data were collected.

Project 4: Evaluation of the principal chemical constituents of medicinal plants available with NWFP Division [FRI 300 / Chem.-14/2005-2008]

Status: Plant species under the project were propagated and maintained in the nursery of NWFP Division at FRI and Chakrata. Analysis of *Andrographis* paniculata and *Bergenia ligulata* was carried out in respect of Andrographolide and Bergenin content respectively for the periodic assessment of the active components. The physico-chemical analysis was also done as per Indian Ayurvedic Pharmacopoiea. The propagated materials of *Oroxylum* indicum were maintained in the nursery.

Project 5: To study ecological succession in restored mined lands [FRI 302/Eco-19/ 2005-2008]

Status: Phytosociological studies have been carried out at Rockphosphate mines (Maldevta), Dehradun. Floristic survey, collection of litter, plant and soil sample has been done at bimonthly intervals. Chemical analysis of plant and litter samples is in progress.

Project 6: To study the undergrowth ecology of natural and man-made forests of Terai belt of Uttaranchal [FRI-301/Eco-18 /2005-2008]

Status: Natural regeneration of teak was observed in least disturbed plantations. Highly disturbed natural forests were invaded by Parthenium hysterophorus weed. Forest fire caused mortality to teak seedlings and boosted grass production. Undergrowth biomass production under natural forests was found higher than in teak plantations.

Project 7: Effect of *Populus deltoides* plantation on shade loving medicinal plants [FRI-305/SF-8/2005-2011]

Status: Two demonstration plots showing shade effects of *Populus deltoides* on medicinal plants were established in village Kuahedi, Gurukul Narson, District Haridwar, Uttarakhand. Survival and growth performance of medicinal plants viz. Tulsi *(Ocimum sanctum)*, Satawar *(Asparagus racemosus)*, Ashwagandha *(Withania somnifera)* and Chitrak *(Plumbago zeylanica)* were recorded. *Asparagus racemosus* and *Plumbago zeylanica* were found growing better than *Withania somnifera* and *Ocimum sanctum.*

Project 8: Tree crop interactions: Effect of *Melia* sp. on crops [FRI-306/SF-9/2005-2011]

Status: Survey on current practices of *Melia* spp. in certain parts of Punjab State was conducted to improve the traditional agroforestry practices with special reference to Melia. Twelve demonstration plots of Melia based agroforestry were established in Districts of Mohali, Fategarhsahib and Hoshiarpur. Data on growth performance of Melia plants under different planting patterns are being recorded. Soil properties of concerned agroforestry fields are under study.

Project 9: Effect of pine and oak forests on agriculture crops [FRI-327/SF-10/2005-2008]

Status: Selection for experimental site has been completed. Study on soil profile of experimental site is in progress. Surveys on agriculture practices in Khirsu (Pauri) have been done.

Project 10: Integrated pest management of mandate species in nurseries and plantations with special reference to biopesticides and microbial pesticides (Name of species: *Dalbergia sissoo* and *Populus deltoides*) [FRI-198/FED-13/2002-2008]

Status: Identified two new insect pests *Eupterote undata* and *Orgyia postica* on *Dalbergia sissoo* and two namely, *Bellipa lohor* and *Eupterote undata* on *Populus deltoides.*

In continuation of the previous year's experiments on control were repeated against major pests and the results showed that:

Two strains of *Bacillus thuringiensis* viz. BioAsp and BioLep when sprayed @ 1-1.5% proved highly effective and gave 100% mortality against the larvae of *Plecoptera reflexa, Clostera cupreata, Eupterote undata, Dichomeris eridantis* and *Phalantha phalantha* in the laboratory conditions in 72 hours.

Out of the identified 11 new entomopathogenic fungi of the major pests, 3 fungi viz. *Fusarium fusaroides*, *Beauveria bassiana* and *Nomuraea rileyi* were mass produced and tested for their efficiency. It was observed that all of them gave effective mortality against the pests.

Commercially available four neem products, namely Neemexel, Achook, Nimbicidin and Neemazal were tested for their efficacy against the major pests of shisham and poplar. Neemexcel when sprayed @ 0.00075-0.005%, Achook @ 0.5-1.0%, Nimbicidin @ 1.5-2.0% and Neemazal @1.0-2.0% gave promising results. Seven species of plants e.g. *Jatropha curcas* [leaves and seeds], *Eucalyptus* [leaves], *Acorus calamus* [rhizome], *Adhatoda vasica* [leaves], *Lantana camara* [leaves], *Vitex negundo* [leaves] and *Pongamia pinnata* [leaves] were subjected to extraction in Petroleum ether, Acetone, Chloroform, Benzene, Methanol and Ethanol and tested for their efficacy against the major pests.

Project 11: Bio-ecology and nutritional behaviour of polyphagus insect pests with special reference to *Spilarctia obliqua* [FRI-304/FED-21/2005-2008]

Status: Collected larvae of *Spilarctia obliqua* and its natural enemies from the selected sites and reared on important forest tree species such as *Paulownia*, poplar (*Populus*), teak (*Tectona grandis*), toon (*Toona* spp.) etc. The insect has completed its life cycle in 42 days in laboratory with a span of 26 days as larvae. Studies on the nutritional preference on *Paulownia*, poplar, teak and toon revealed that larvae fed on *Paulownia* and poplar could survive and reached up to adult stage while larvae reared on teak and toon died at different stages of development. *Paulownia* was found to be preferred food, if choice is available. Consumption studies revealed that the larvae consumed 4752.70 mg of *Paulownia* foliage as food, whereas it is 3360.82 mg in case of poplar. Further studies revealed that 3rd instar larva of *S. obliqua* consumed 1100 mm^2 of *Paulownia* foliage while the 4th instar was able to consume 1650 mm^2.

Mass culture of *Corcyra cephalonica* was maintained on Sorghum flour. It was observed that over 6,000 moths emerged during the period. Laboratory culture of four species of egg parasitoids of *Trichogramma brasiliensis, T. chilonis, T. japonicum* and *T. poliae* was maintained on the eggs of *C. cephalonica*.

Project 12: 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: Studies were completed on termite collection from Punjab - 28 species with 12 genera belonging to 2 families, which include 14 new records; Haryana - 21 species with 11 genera belonging to 3 families, with 9 new records and Himachal Pradesh - 19 species with 12 genera belonging to 2 families, having 9 new records. Identification keys to the termites reported were prepared. Camera Lucida diagrams of the recorded termites were made for further studies.

Certain termites identified earlier were examined and correctly identified following latest nomenclature: *Odontotermes bangalorensis* Holmgren = now *O. obesus (Rambur), O. parvidens* Holmgren & Holmgren = now *O. distans* Holmgren & Holmgren, *O. feae (*Wasmann*)* = now *O. indicus* Thakur (specimens from northern India only as *O. feae (*Wasmann*)* is known only from peninsular India), *O. guptai* Roonwal & Bose = now *O. lokanandi* Chattarjee & Thakur and *Microtermes anandi* Holmgren = now *M. obesi Holmgren.*

Project 13: Up-gradation and computerisation of National Insect Reference Collection (NIRC) [FRI-233/FED-16/2003-2008]

Status: a) ***Taxonomy of parasitic micro-hymenoptera (Chalcidoidea):*** A new genus and a new species *Aassamencyrtus jorhatensis* and another species of *Epitetracnemus dehradunensis* were described. Work on ten new by new described species of *Psyllaephagus,* parasites of psyllids, which make galls on many tree species, was continued. Slide preparation, diagrams and morphometrics of two new spp. of genus *Neococcidencyrtus*, and one each of *Adelencyrtus* and *Coccidencyrtus* were completed. All the four species are parasitoids of diaspidid scales.

b) ***Upgradation of NIRC 314: New incorporations:*** Accession of the collection was increased from 21404 to 21717. Primary and secondary types of about 1700 species, earlier scattered throughout the collection, were segregated and placed for better maintenance and safety.

c) ***Computerisation of NIRC:*** Data of 6000 species, totaling 17,000, belonging to the orders Coleoptera, Diptera, Dermaptera, Neuroptera, Orthoptera and Lepidoptera were incorporated into the database, with information on species name, hosts, locality, bionomics, location of the collection etc.

Project 14: Evaluation of natural termite resistance in timber species [FRI-303/FED-20/2005-2008]

Status: Four imported timber species: Ivory coast teak, Golden teak (Malaysian sal) - yellow meranti group, *Pinus sylvestris* and *Cryptomeria japonica* (Japanese cedar) have been tested in the laboratory for their natural resistance against subterranean termites.

Project 15: Studies on enhancement of natural durability of bamboo and plantation grown species with conventional/eco-friendly preservatives [FRI-236/FPD (WP)-43/2003-2008]

Status: ZiBOC, a new eco-friendly wood preservative at 0.5, 1.0 and 2.0 % concentrations and at 2.3, 5.4 and 10.8 kg/m^3 exhibited complete protection of chir (*Pinus roxburghii*) veneer samples in field ground test whereas controls were badly damaged. poplar (*Populis* spp.) samples treated with 2% concentration of this preservative exhibited complete protection after 24 months of installation. In advance field trials i.e stake test of chir and poplar wood treated with CCA and ZiBOC installed at 3 test centers exhibited complete protection after six months of installation whereas moderate to bad microbial attack was observed in control samples. Borax: Boric acid, CCA and CCB treated bamboo species exhibited good protection of bamboo in ground as compared to control.

Project 16: Exploration of copper lignin complexes for wood preservation and effect of post treatment processes on precipitation or fixation in wood [FRI-252/FPD (WP)-44/2003-2008]

Status: Pine and mango sticks were treated with 1.0, 0.5 and 0.25% concentration of Copper Lignin complex A and B by five different methods. After 19 months, it was observed that pine samples at higher concentrations were either normal or very slightly affected by termite or fungus whereas mango sticks exhibited slight effect of fungus.

Project 17: Development of eco-friendly water repellent preservative finishes for handicrafts items [FRI-307/FPD(WP)-52/2005-2008]

Status: Gloss at three different degrees was taken of copperised cashew nut shell liquid-treated samples with five different polish treatments. Results show that Gloss at all three degrees increased for the treated samples compared to the control.

Studies on the effect of UV radiation on the performance of the different treatments were carried out. Observation up to 600 hours of UV radiation exposure showed that double-treated samples (preservative plus polish treatment) are better than the samples that received only polish treatment.

Project 18: Effect of Ammonia Fumigation on glue line strength of plywood from plantation species [FRI-312/FPD(CW)-57/2006-2008]

Status: The plywood boards prepared using poplar and *Eucalyptus* veneers were fumigated with Ammonia for various durations of time, i.e. 30 minutes, 2 hrs, 24 hrs and 48 hrs. In another experiment, veneers of poplar and *Eucalyptus* were first fumigated with Ammonia for similar durations of time, and subsequently combi plywood boards were prepared with them. The combi plywood boards prepared by both these methods were tested for their density, moisture content, glue shear strength in dry, wet and mycological state. The data collection and analysis are in progress.

Project 19: Velocity gradient induced single glass modified solar kiln for drying of timber and NWFPs [FRI-310/ FPD(WS)-55/2005-2008]

Status: The solar kiln with a new design consisting of single layer of glass was completed. Studies on the efficiency of this kiln are in progress.

Modified Solar Kiln

Project 20: 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: Physical and mechanical properties of material obtained from Andhra Pradesh and Uttarakhand (FRI) were evaluated. Data analysis and writing of report is in progress.

Project 21: Bending and compression properties of small diameters round plantation timbers [FRI-311/ FPD(TM)-56/2005-2008]

Status: Testing of *Eucalyptus* spp. (Eucalyptus) in round form was completed. Data compilation and analysis is under progress. *Melia azedarach* (Bakain) has been procured from local market and

Dalbergia sissoo (Shisham) from Hoshiarpur, Punjab. Samples of *Melia azedarach* have been prepared and testing is in progress in round form.

Project 22: Evolving kiln schedules under vacuum drying for selected plantation species [FRI-308/FPD (WS)-53/2005-2008]

Status: A tentative two-step simple schedule has been evolved for drying 2.5 cm (one-inch) thickplanks of poplar.

Project 23: Studies on soil geological and geomorphological linkages with different forest communities for sustainable management of Uttaranchal forests [FRI-314/ FSLR-19 /2005-2008]

Status: Collected soil and rock samples from Kempti range of Mussoorie Forest Division from five different sites with *Pinus roxburghii, Quercus leucotrichophora* and *Dalbergia sissoo,* mixed and barren land (Control) on the basis of types of vegetation, parent material and range of altitude. Vegetation analysis was also carried out in the study area. Physical and chemical analysis of soil samples collected has been completed and chemical analysis of rock samples is in progress. Different utility maps like location, drainage, geology, soil, vegetation are being prepared, Slides of sand fractions separated from soil samples have been prepared for mineralogical investigations and oriented slides of clay fractions are being prepared for X-ray diffraction analysis.

Project 24: Effect of different plantations on soil properties and carbon store [FRI-315/FSLR-20 /2005 - 2008]

Status: Soil samples were collected from different sites selected in Uttarakhand and Haryana under poplar, *Eucalyptus*, shisham and teak plantations from predetermined depths of 0 10, 10 30, 30 60, 60 90, 90 120 cm. Barren land near plantation was selected in each site and soil samples from similar depths were also collected from there as control. Vegetation study was conducted at each site and trees were enumerated for density, d b h, crown area and height. Soil samples collected from field were processed in laboratory and analysis for various physico-chemical attributes is in progress. Organic carbon, organic matter, available nitrogen and porosity estimation was completed in the samples under poplar and *Eucalyptus* plantations of Uttarakhand and Haryana.

Project 25: Soil and vegetation survey and preparation of pedonarium in New Forest Estate Dehradun [FRI-316/FSLR-21/2005-2008]

Status: Physical and chemical properties of the soil samples collected from plantations, grassland, agricultural land and khaddar area were determined. The data was processed and interpreted. Data on temperature and humidity in plantation area were collected. Vegetation study was carried out. The Bangalore Centre of National Bureau of Soil Survey and Land use Planning was visited to make arrangements for hands-on-training for preparation of Pedonarium.

Project 26: Genetic evaluation of selected genotypes for exploring clonal forestry potential in *Dalbergia sissoo* [FRI-319/G&TP-16/2005-2008]

Status: The site of about one hectare was selected in each of three locations in Punjab (Hoshiarpur, Ludhiana and Patiala) and one in Uttarakhand (Chiriapur, Haridwar) and prepared for the planting of the

trial. The clonal trial of 36 selected clones of shisham has been taken up and planting completed. The trial was maintained and gap filling was done wherever required. The wood samples collected are being tested for anatomical and wood properties.

Project 27: Establishment of breeding arboretum of *Eucalyptus* and production of interspecies hybrids [FRI-318/G&TP-15/2005-2010]

Status: Breeding arboretum has been established at Forest Research Institute with 10 species of *Eucalyptus* in 20 replications, in open pollinated mating design at 3x3 m spacing. Data on initial stage have been taken for height, collar diameter and branching pattern. Phenological observation has been recorded on flowering and fruiting in different *Eucalyptus* species growing in New Forest campus.

Project 28: To develop propagation i.e. micropropagation technique of economically important bamboos - *Arundinaria falcata* and *Bambusa balcooa* [FRI-219/G&TP-10/2002-2007]

Status: Developed tissue culture protocol for multiplication of *Arundinaria falcata* through axillary bud culture. *In-vitro* shoot multiplication experiments were conducted. Effect of different concentration of BAP, Kn was studied. Effect of pH, sucrose and number of shoots in a propagule was studied for shoot multiplication. *In-vitro* rooting was standardized and effect of different concentration of auxin studied for *in-vitro* rooting

Project 29: Development and multiplication of superior bioactive clones of *Stevia rebaudiana* [FRI-320/ NWFP-19/2005-2008]

Status: Twenty one accessions of *Stevia rebaudiana* have been made from areas in Uttarakhand, Delhi, Himachal Pradesh and Haryana and introduced under field conditions for assessing their performance. The collected accessions are being analyzed for physical and chemical characterization for undertaking breeding programmes.

Project 30: Assessment of shisham die back (decline) in northern India and its remedial measures [FRI-245/Path-12/2003-2008]

Status: Pathological resistance testing on the seedlings of *Dalbergia sissoo* raised from 107 trees spread in 21 locations was carried out. The germplasm of Amritsar (Punjab) showed maximum resistance against wilt pathogen *Fusarium solani*. Similarly seeds collected from five heavily infested locations in Uttar Pradesh and Bihar, namely Gonda, Maharajganj, Tulsipur, Betiah and Motihari were tested for their pathological resistance. Motihari germplasm was found to be the most resistant while Gonda germplasm susceptible. Isolates of *Pseudomonas fluorescence* collected from rhizoplane of healthy shisham trees were tested against *Fusarium solani* in dual culture. The Khizrabad (Yamuna Nagar) isolate was found most effective.

Project 31: Screening for disease resistance in genetic material raised under tree improvement programmes [FRI-207/Path-13/2002-2007]

Status: Evaluation of 77 clones of *Dalbergia sissoo* raised at Clonal Seed Orchard (45 clones) and Seedling Seed Production Area (22 clones), Bhitmera, Hissar (Haryana) was done for phenological characters in respect to *Ganoderma lucidum* root rot. It was found that clone Nos. 219 (Compt. No.

Birpur 4A, Bhambhar Beat, Tulsipur Range, Gonda Forest Division, U.P.), 194 (Compt. No. 2, Hasanpur Beat, Tulsipur Range, Gonda Forest Division, U.P.), 266 (Comp. No. 3, Lalpani Beat, Rishikesh Range, Dehradun Forest Division, Uttarakhand), 304 (Beat Uttrinala, Shyampur Range, Haridwar Forest Division, Uttarakhand) and 276 (Lalpani beat, Rishikesh Range, Dehradun Forest Division, Uttarakhand) were best performers for height growth, girth, clear bole and disease resistance. It is recommended that these clones should be used for raising *D. sissoo* in future plantation programmes for combating infection of *G. lucidum* under conditions prevailing in Haryana and Punjab states. The poor performing clones with respect to phenological characters and root rot mortality were identified as Clone Nos. 88, 193, 81, 57, 101, 94, 281, 272, 290, 291, 298, 288, 289 and 293, which should best be avoided for raising *D. sissoo* plantations.

In a trial for testing of *Eucalyptus* hybrids (*Eucalyptus citriodora* X *E. torrelliana*), being carried out by the Genetics and Tree Propagation Division, at New Forest campus (Kaulagarh), a new stem and twig canker disease caused by *Phomposis* spp. along with its perfect stage in *Chrysoporthe* spp. was noticed and assessed for damage. The parents as well as F1 progeny were found to be affected.

Project 32: Biological control of *Lantana camara* and *Parthenium hysterophorus* by fungal pathogens [FRI-206/Path-12/2002-2007]

Status: Poison food technique showed that all the adjuvants and herbicides screened were toxic to fungal pathogens of *L. camara,* hence they were not applied in a tank mix with fungal pathogens. Application of herbicides prior to the fungal biocontrol agents was done in glasshouse experiments. In the subsequent glasshouse experiments, pathogens were administered 15 days after the application of herbicides.

It was concluded from the glasshouse experiments that sublethal doses of glyphosate or atrazine when followed by sequential application of *Phomopsis archeri* controlled 6 to 8 months old *Lantana camara* plants. Other pathogens were not able to kill *L. camara* plants in combination with sublethal doses of herbicides. Optimum dew period for *P. archeri* infection was also standardized.

Project 33: Evaluation of appropriate technology and its adoption as applicable in rural environment [FRI-321/PLO-3/2005-2008]

Status: Surveys in the villages Sherpur, Badonwala, Harbajwala and Mehuwala Mafi on Dehradun-Shimla road were undertaken. Villagers were motivated to raise bamboo seedlings in their area and to develop a nursery for the same. After survey, Harbajwala village was selected. A two-day bamboo training programme was organised at the Shatabdi Van Vigyan Kendra (Rangers College, City Centre), Dehradun for the selected villagers. During the training, lectures were imparted on bamboo multiplication, preparation of beds, sowing of bamboo seeds, micro proliferation technique of bamboo multiplication and its importance etc. General field visits of the participants to the Central Nursery were also undertaken. The raised seedlings during the training period were provided to the participants of the training programme for introduction in their villages during July 2006.

Project 34: Regeneration study on *Quercus semecarpifolia* and *Carpinus viminea* [FRI-324/ Silva- 28/2005-2008]

Status: Seeds of *Carpinus viminea* were collected from Nainital (Uttarakhand). Seed morphology and biology of collected seeds were carried out with respect to seed length, width, colour, shape, 1000 seed

weight, moisture content, number of seeds in 1 kg. Germination study is in progress. Seeds were kept for stratification and also stored at different temperatures i.e. 5°C, 15°C and at room temperature for storage study. Soil study of Mandal forest was carried out to see the impact of soil on regeneration of *Carpinus viminea* and *Quercus semecarpifolia.*

Project 35: Development of technology for cultivation of commercially important under-exploited Lesser Known Tree Species (LKTS) [FRI-322/Silva-26/2005-2008]

Status: Fruits of *Averrhoa caramkabola* (kamarakh) were collected and measured for length and diameter. Hundred seed weight of kamarakh is 2.75 gm. Seeds in quartz sand showed better germination as compared to germination paper in germinator at 25-30 °C. *Ficus palmata* seeds were sown in two different media, sand and soil mix with coal. Observation revealed that seedlings grown in soil have more height and dbh than seedling in coal. Vegetative propagation studies on *F. racemosa* (Syn. *F. glomerata)* and *F. palmata* showed best rooting in 2000 and 3000 ppm of IBA treated cuttings. Hard cuttings resulted in good rooting as compared to hollow cuttings.

Project 36: Multilocation trials of promising clones of *Gmelina arborea* Roxb. [FRI-326/Silva- 30/2005-2008]

Status: Vegetative propagation material from 19 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 37: Field evaluation of new clones of poplar [FRI-323/Silva-27/2005-2008]

Status: Established nursery of 25,000 plants belonging to 200 clones of poplar. Plants of *P. deltoides* x *P. euphratica* were raised in nursery. These clones and hybrids have been developed by Forest Research Institute, Dehradun. Field trials will be laid out during spring the season of 2008.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Impact of ban on green felling on the plant diversity of selected sites in Uttaranchal [FRI-357/Bot-52/2006-2009]

Status: Field surveyed for the unallotted, seeding and final felling compartments of Deodar and Chirpine forests of Chakrata and selected the sites for vegetative analysis.

Project 2: Studies on the development of biopesticides from *Eucalyptus* hybrid [FRI-344/Chem-16/2006-2008]

Status: Leaves of *Eucalyptus* hybrid were collected from the New Forest campus, Forest Research Institute, Dehradun. The essential oil was isolated using hydro distillation method. Three extractives using petroleum ether, chloroform and methanol were prepared. Screening of the extracts and oil demonstrated insecticidal activity against poplar defoliator, *Clostera cupreata*. Collection of the foliage and their extraction using the solvent of increasing polarity were repeated. The acetone extractive was fractionated into acetone soluble and insoluble portions. Ursolic acid rich fraction was isolated. Pesticidal screening of the extractives and the solid obtained is in progress.

Project 3: Production and value addition by chemical derivatization of alpha cellulose of *Lantana camara* for its useful applications [FRI-345/Chem-172006-2009]

Status: Cyanoethyl cellulose was prepared from the alpha cellulose isolated from *Lantana camara.* Thirty one derivatives were prepared. Reaction conditions were standardized with respect to sodium hydroxide concentration, acrylonitrile concentration, cyanothylation time and temperature. Degree of substitution (DS) of the modified cellulose of cyanoethyl cellulose was determined by calculating the nitrogen content in the samples.

Project 4: Utilization of fungi for biotreatment of industrial waste waters [FRI-346/Eco-20/2006-2009]

Status: ***Effluent analysis:*** Textile and distillery effluents were collected and analysed for their physico-chemical parameters like temperature, pH, turbidity, conductivity, total solids, chloride, nitrogen, hardness, calcium, alkalinity, phosphate, potassium, sodium, BOD, DO, COD and heavy metals.

Fungi culturing: Different species of fungi were collected from the dead materials from the adjacent areas of effluent disposal sites and cultured in the lab.

Fungal treatment: Effluents collected from different fungi for the preliminary screening of the effective fungi.

Preliminary screening: On the basis of optical density and mycelial weight, six fungi namely, *Merulius tremelosus, Pycnoporus sanguineus, Trametes ravidus, Trichoderma* species, *Penicillium* sp. and *Mucor hiemalis* treatment, 5 fungi namely *Schizophyllum commune*, *Trametes ravidus, Trametes versicolor, Trametes cingulata* and *Pyconoporus sanguineus* were screened for distillery effluent treatment.

Project 5: Endangered and rare entomogenous fungus *Cordyceps sinensis*, identification of its insect hosts and food plants of insect hosts in the Bugyals of Uttarakhand [FRI-347/FED-28/2006-2009]

Status: *Cordyceps sinensis* infested larvae were collected from Bedini bugyal of Badrinath Forest Division (Uttarakhand). Average length of larvae was 2.25 cm and fruiting body 4.44 cm while average of total length of larva with fruiting body was found 6.69 cm. Some plants growing in the vicinity of fungus infested larvae were identified by the botanists of the Institute as *Jurina dolicocephala, Geum elatum, Polygonum polystachum, P. affinis, Impatiens sulcata, Parnesia nubicola, Taraxacum officinale, Pedicularis* sp., *Saxiphraga* sp. and *Tanasetum* sp. etc.

Project 6: Control of shisham leaf miner *Leucoptera sphenograpta* using systemic insecticides [FRI-349/ FED-24/2006-2009]

Status: Seventy seedlings of *Dalbergia sissoo* were procured from nurseries and planted in the field for study of the biology of the leaf miner.

Survey of shisham plantation and nurseries was carried out in Uttarakhand and Haryana. Cocoon of *Leucoptera sphenograpta* were collected from host plants and kept in the laboratory for emergence. Light to moderate attack of the shisham leaf miner *L. sphenograpta* was noticed at Thano Forest Range and Chhachrauli Range. Infested materials were reared in the laboratory and emerged moth was identified as *Leucoptera sphenograpta* Meyr. (Lepidoptera: Lyonetiidae). The larval parasitoid associated with the leaf miner was identified as *Paraharmius* Jason (Hymenoptera: Braconidae). Some pupal parasitoids were also recovered and they are being processed for identification. Further work is in progress.

Project 7: Butterfly diversity in moist temperate forests of Garhwal: Evaluating species of conservation priority and indicator taxa of habitat disturbance in Ban oak forest ecosystem [FRI-348/FED-23 /2006-2009]

Status: Sampling surveys of butterflies was carried out in Garhwal Himalayas: Chamoli-Rudraprayag Districts (Kedarnath Musk Deer Reserve) and Tehri Garhwal (Benog sanctuary-KotiKimoi-Dhanaulti-Nag Tibba) along fixed transects in both undisturbed and degraded Ban Oak forest habitats. Studies revealed more than 60 species of butterflies with one having new range extension from North-East India and another species new to science that is being described.

Project 8: Eco-friendly preservatives and fire retardants combinations for protection of structural bamboos for low cost houses [FRI-350/FPD (WP)-60/2006-2009]

Status: Bamboo species treated with 15% ZiBOC and fire retardants gave substantial retention of preservative in three species of bamboo, which is under testing for performance evaluation.

Project 9: Studies on performance of plantation grown species in cooling towers [FRI-351/FPD (WP)-61/2006-2009]

Status: Procurement, conversion, seasoning and treatment of timber yielding species of Toon (*Toona ciliata*), *Pinus radiata* and *Pinus roxburghii* and *Ailanthus excelsa* have been completed.

Project 10: Evaluation of Australian seed sources and families of *Eucalyptus tereticornis* for productivity and genetic improvement PHASE II [FRI-358/G&TP-20/2006-2009]

Status: Experimental plantation was maintained through execution of cleaning, weeding and soil working operations. Flowering behavior of different provenances was observed. Data recording and analysis work on various morphometric traits were completed. About forty-seven superior trees have been identified and marked. The North Queensland provenances maintained their superiority over other provenances.

Project 11: Development of organic cultivation protocols for enhancing productivity of selected medicinal and aromatic plants in Uttaranchal [FRI-359/NWFP-23/2006-2009]

Status: Research on developing organic cultivation protocol for medicinal plants such as *Asparagus racemosus, Rauvolfia serpentina* and *Ocimum sanctum* is under way. Experiments using FYM, vermicomposts, soil moisture conservation, soil nutrient replenishment and weed control are in progress.

Project 12: Studies on nursery diseases of important medicinal plants of Uttaranchal [FRI-352/ NWFP-22/2006-2009]

Status: Studies are in progress to identify the causal organisms of various nursery diseases of medicinal and aromatic plants in the state of Uttarakhand. Many fungus related diseases are being identified in Dehradun, Rishikesh, Chakrata areas etc. in collaboration with Pathology Division of the institute. The study will cover all districts of the Herbal state Uttarakhand by March 2009.

Project 13: Identification and evaluation of disease resistance in different genotypes of poplar [FRI 353/Path-21/2006-2011]

Status: Survey of nurseries and plantations of different age class poplars for disease assessment was done in Udham Singh Nagar and nearby areas (Baghwala, Chandain and Pawan farms, Inderpur nursery) of Uttarakhand. *Alternaria, Phoma, Bipolaris*, etc. Diseases were identified on different genetic materials. Their symptoms were recorded. Isolation of these pathogens was made and studies of their biology are underway. Data was recorded on growth performance and intensity of different foliar diseases on clones of *Populus deltoides.*

Project 14: Enhancing the longevity of acorns of *Quercus dilatata* and *Q. leucotrichophora* [FRI-355/Silva-32/2006-2009]

Status: Literature was consulted on distribution, acorn collection and storage of the two species of oak. Field surveys were conducted in Dhanaulti, Mussoorie and Nainital Forest Divisions to assess the crop of the two species. Acorns of *Q. leucotrichophora,* collected from Dhanaulti and Mussoorie Forest areas were cleaned, desiccated to three moisture levels using Silica gel, to study their desiccation tolerance. Then acorns were stored in four containers at 5°, 5°, and 15° C and at ambient temperature and subjected to monthly germination tests to assess their viability.

Project 15: Evaluation of seed orchards of *Dalbergia sissoo* for seed quality [FRI-354/Silva-33/2006-2009]

Status: Seeds/pods have been collected from seedling and clonal seed orchards of *Dalbergia sissoo* from Bithmara and Hissar in Haryana and also from general populations for comparison. The pod and seed characteristics of different progenies and clones have been recorded and significant variations observed in the studied traits. The germination and storage trials of the seeds collected are in progress.

Project 16: Econometric analysis of potential and constraints for farm forestry development in Eastern UP [FRI-356/Stat-2/2006-2010]

Status: The sites were visited and a questionnaire has been developed. The data from Western UP has been collected.

PROJECTS COMPLETED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Utilization of economic potential of *Parthenium* [FRI-262/Chem-13/External/2004-2007]

Sub-project (i): Preparation of composites

Findings: Phenol formaldehyde resin was prepared and analysed using commercial grade phenol and formaldehyde. It was observed that the particle boards prepared at 24 kg/cm^2 pressure level using 14 % resin meet the IS specifications.

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

Findings: *Parthenium* contains 78 % holocellulose and 17.8 % lignin indicating that the plant is suitable raw material for cellulose extraction. The plant contains short fibre and fibre length lies between

0.55 mm to1.32 mm and fibre diameter 14.94µ. Alpha cellulose (90.82%) was isolated under optimized conditions with brightness 80% and average DP 661.5. Handmade paper was developed with *Parthenium* alone with an admixture of long fibre.

Project 2: Alkaline peroxide mechanical pulping/bleaching [FRI-331/C&P-17/External/2005-2007]

Findings: Conditions optimized to produce APMP pulp from sarkanda. The technology was demonstrated at 2 kg batch level to the Executives, M/s ABC Paper (Punjab).

Project 3: Development of ecorestoration model for Iron Ore Mines of Bihar and Orissa [FRI- 179/Eco-9/External/2001-2007]

Findings: Over burden dumps, mined benches as well as degraded site (Village) have been completely stabilized and there is a distinct improvement in the soil after restoration intervention**.**

Steel Authority of India Limited (SAIL) appreciated the work, as restoration trials have directly cut the cost of debris removal from the colony areas of SAIL.

Project 4: Efficacy testing of the insecticide-Actara 25 WSG (Thiamethoxam) against termites [FRI-266/FED-18/External/2004-2007]

Findings: ***Laboratory Testing:*** Laboratory testing of the insecticide Actara-25 WSG in comparison with two more insecticides, Endosulfan 35EC and Chlorpyriphos 20EC (@ 0.0125%, 0.0187%, 0.025% and 0.05%) against termites completed. Endosulfan gave comparatively better results whereas effect of Actara and Chlorpyriphos was at par statistically. Final Report of the laboratory studies of the insecticide Actara- 25 WSG has been sent to the Syngenta India Ltd., Mumbai.

Field Trial: Comparative efficacy of the insecticide Actara-25 WSG is also being tested in the field. Monthly observations were taken on the mortality of poplar and *Eucalyptus* plants due to termites, *Odontotermes obesus* (Rambur) and *Microtermes obesi* Holmgren.

Project 5: Utilization of Sisal fibre for making Composites and Handmade paper [FRI-268/FPD-49/External/2004-2006]

Findings: Fibre board prepared from *Parthenium* at different pressure and varying additives, meets most of the IS specifications. Handmade paper was developed with 100% Sisal cooked fibre and blended with waste paper.

Project 6: Micropropagation of chirpine (*Pinus roxburghii*) and shisham (*Dalbergia sissoo*) [FRI- 222/ G&TP -13/ External/2002-2006]

Findings: Embryogenic callus was established through immature zygotic embryos. Effect of phytohormones was studied for embryogenic callus proliferation. *In-vitro* shoots of Chirpine and *Dalbergia sissoo* were multiplied on MS medium supplemented with different concentration of cytokinin.

Project 7: Preparation and publication of a souvenir to mark the Centenary of FRI [FRI-342/Path-20/External/2006-2007]

Findings: Uttaranchal Council of Science and Technology (UCOST) financed the project. A publication viz., FRI: Glimpses of a Century was published which gives details of 100 years of creative scientific history of FRI.

Project 8: Technology transfer and development of a model village by skill up-gradation and capacity building of rural communities for socio-economic upliftment, SRTT funded project [FRI-297/PLO-2/External/2005-2007]

Subtitle: Integrated Utilisation of *Lantana*

Findings: Training programme was undertaken and 10 participants took part in integrated utilisation of *Lantana*. The participants were imparted training to obtain dye from the leaves and the board from *Lantana* wood through trees support of Forest Products Division of FRI during November 2006. A Demonstration-cum-Display centre depicting the articles made from *Lantana* was formally inaugurated in the newly declared Shatabadi Van Vigyan Kendra of FRI, Dehradun. Through this Kendra (erstwhile Rangers College) the artisans/farmers can draw benefits by selling the products and multiplying the planting material by using mist chamber etc.

Project 9: 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]

Findings: The main results achieved from the project have been development of methodology by combining the "Multidisciplinary Landscape Assessment" developed by CIFOR with typology of ecosystem functions as provided by De Groot (2005). Developing a model NETFOP in OSIRIS framework for the purposes of spatial data management and knowledge enquiry; review of silvicultural tools to enhance ecosystem goods and services from planted forests; assessment of ecosystem goods and services from forests in India, Netherlands and Germany; development of database for educational courses on ecosystem goods and services and studies on community participation in plantation planning and management. Principally six activities were planned for execution during the project.

Project 10: 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]

Findings: Interim report has been submitted to funding agency.

Project 11: Studies on interrelationship between production level and marketing of important forestry species in Punjab [FRI-174/RSM-9/ External/2000-2007]

Findings: Assessment of production potential of agro-forestry species viz. poplar, *Eucalyptus*, drake and khair in seventeen districts of Punjab for the next ten years in intensive and extensive plantations was carried out. Total production predictions were made from 2004-05 to 2014-15 using time series analysis method of forecasting. Market mechanism and demand and supply status of wood in Punjab was studied in 103 markets spread out in 17 districts of Punjab. Inter-market comparison and price spread analysis in the market of Ludhiana, Hoshiarpur and Patiala were also carried out. Besides market mechanism of adjoining markets of Punjab viz. Sriganganagar (Rajasthan) and Yamunanagar in Haryana were also studied. The factors leading to the price fall of poplar wood were also identified and enumerated.

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

Sub-project 1: Seed Technology

Findings: Significant variations were observed for collar diameter, plant height, apical bud breaking time, number of buds, total length of buds, length of open and close buds, type of bud cluster, number of leaders, number of main branches, length of needles, etc. in different provenances of *Pinus roxburghii.* Variations were also observed in cone and seed characters of different seed sources of *P. wallichiana, P. roxburghii* and *P. gerardiana.* The study showed that the observed characters are under both genotypic and environmental control.

Sub-project 2: Nursery and planting technology

Findings: Developed a technique for rapid extraction of seeds of *Pinus roxburghii*. The technique resulted in seed extraction within 4 days in Dehradun conditions as compared to three weeks time required in the conventional technique of drying the cones in the sun. Cone fresh weight, dry weight, length and 100-seed weight in *P. roxburghii* show high repeatability suggesting that the traits are strongly inherited. Much of the variation in these characters occurred within the provenance rather than across provenances. Containerized seedling technology gave better survival and growth in field trials. Use of bare root technology was not recommended for large-scale planting of *P. roxburghii*. Seedling emergence in *Pinus wallichiana* was significantly enhanced by stratification. The final report has been submitted to USDA.

Sub-project 3: Plant physiology

Findings: In USDA Pine Project, physiological studies of selected genotypes and provenances of pines adapted to stress sites were conducted.

Seeds of pines collected from the entire range of distribution from Jammu and Kashmir to Arunachal Pradesh were studied to determine the nature and extent of variation in natural populations and to select the best provenance adapted to site.

Seeds of 56 parameters of chirpine were raised at three altitudes viz., FRI 600 m, Jarmola (1600 m.) and Sandra (1200 m.). The maximum height increment and collar dia. was observed at FRI. Sixty sources of Chir Pine were screened for photosynthetic efficiency at three altitudes. Augustmuni, Kedarnath seed was photosynthetically most efficient (Fv/Fm = 0.77).

Twenty seed sources of *Pinus wallichiana* were screened on the basis of cone, seed, seedling and early growth performance of the seedlings. Tutu, Jubbal and Bharmaur were found to be best in almost all traits studied.

UPGMA clustering of populations on the basis of four isoenzymes into 5 clusters revealed Sewai and Tutu to be divergent populations and hence could be used for future breeding programmes.

Allozyme variation in 20 populations of *Pinus wallichiana* with 16 loci revealed Trehta and Khambi Kuper with highest genetic diversity, hence be kept as biogenetic resources for conservation. Whereas, populations of Shimla and Saranan were found with different architecture. Thus could be used for future breeding strategies and improvement.

Project 13: Sample surey to update rates and ratios of Minor Forest Products and Timber in India [FRI-294/Stat-2 /External/2005-2006]

Findings: The data as required for the project has been collected and submitted for further analysis.

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Development of tissue culture technique for protocol development of *Bambusa balcooa* and *Melocanna bambusoides* [FRI-258/Bot-37/External/2004-2007]

Status: Axillary bud break was achieved in *Bambusa balcooa* and *Melocanna bambusoides.* Different media formulation was tested for axillary bud break and *in-vitro* shoot multiplication.

In *Bambusa balcooa* various media like MS, B5 and WPM were studied for axillary bud proliferation and shoot multiplication. MS medium was found to be the best. In *Melocanna bambusoides* effect of different concentration of BAP (1-6 mg/l) alone and in combination with NAA (0.5 mg/l) were studied for *in-vitro* shoot multiplication. Effect of MS, B5 and WPM medium, Sucrose (1-5%) and pH (2.8-7.8) were studied for *in-vitro* shoot proliferation.

Project 2: Network program for establishment of demonstrations of bamboo plantations in Uttaranchal [FRI -257/Bot-36/External/2004-2007]

Status: *In-vitro* shoots of *Dendrocalamus asper* were multiplied on large scale. 15-16 fold shoot multiplication was obtained on MS medium supplemented with 2.5 mg/l BAP. *In-vitro* rooting was standardized. 95% *in-vitro* rooting was standardized on MS supplemented with 10.0 mg/l IBA and 3.0 mg/l NAA. Tissue culture raised plants were hardened and acclimatized in mist chamber and shade house. Two thousand tissue culture raised plants were supplied to Uttarakhand Forest Department for field plantation.

Project 3: Micropropagation of promising interspecific F_1 hybrids of *Eucalyptus* and field plantations [FRI-220/ G&TP- 11 / External/2002-2007]

Status: Tissue culture plants of *Eucalyptus* hybrids FRI 5 and FRI 14 were multiplied and planted at seven agroclimatic regions. Field data were collected from all the seven sites of field trials with respect to plant height, collar diameter, clear bole length, no. of branches. Attempts were made for protocol development of *Eucalyptus* hybrids FRI 6, 10, 13 and 15. Aseptic cultures were established in all the four hybrids and *in-vitro* shoots were successfully multiplied on medium formulated. As a result of large number of experimentations a suitable media was also formulated for *in vitro* rooting of FRI 6, 10 and 15. Tissue culture plants were hardened and acclimatized in Mist chamber and Shade house.

Project 4: Development of micro-propagation protocol for clonal multiplication and germplasm conservation of *Swertia chirata* Buch. Ham. [FRI-332/Bot-46/External/ 2005-2006]

Status: Sterilization technique was standardized for nodal explant. Standardization of media was done for establishment and multiplication of cultures through axillary bud. Multiplication and elongation of shoots were obtained through root culture. Effect of different cytokinins was studied on multiplication of cultures.

Project 5: Development of suitable propagation technology of three *Terminalia* species [FRI-261/Bot-40/External/2003-2006]

Status: Rooting response of hardwood cuttings of *Terminalia* as influenced by different rooting

hormones in different concentrations was studied. The seedling growth behaviour and dry matter production were analysed. Analysis of data for publication and preparation of Final Technical Report was done.

Project 6: Creation of germplasm bank of medicinally important tree species of Punjab [FRI-336/Bot-50/External/2006-2009]

Status: Planting of *Terminalia bellirica*, *Emblica officinalis* and *Moringa oleifera* is completed at Kharkan, Hoshiarpur. Planting material of *Aegle marmelos* was developed for transportation to Punjab from F.R.I., Dehradun. Seeds of 50 trees of *T. chebula* were collected and the seed characteristics study was carried out. The seeds were sown in polybags for growing seedlings.

Project 7: 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: List of 20 species of medicinal plants has been prepared. The wood of these species is used in medicines. The microstructure studies of 15 species were completed.

Project 8: Expert system for Indian woods - their microstructure, identification, properties and uses [FRI-277/Bot-42/External/2005-2008]

Status: Microstructure data of about 30 species have been taken. Qualitative and quantitative characters of 30 species were stored in the software.

Project 9: *Ex-situ* conservation of some rare and endangered plants of Uttarakhand [FRI-277/Bot-42/External/2005-2008]

Status: List of rare and threatened plant species of Uttarakhand has been prepared. Nine RET species so far not represented in the FRI Botanical Garden have been collected and introduced in the Garden. Few species viz. *Trachycarpus takil, Angelica glauca, Eremostachys superba, Sophora mollis, Valeriana wallichii* and *Acorus calamus* have been propagated and reintroduced in their natural areas of occurrence.

Eramostachys superba in pot in FRI Botanical Garden

Project 10: Development of Live Red Data Book [FRI-277/Bot-42/External/2006-2009]

Status: List of rare and threatened plants of India has been prepared. *Diploknema butyracea, Jasminum arborescens, Rhus punjabensis* and *Itea nutans* have been introduced in the Botanical Garden of FRI.

Project 11: Identification, development and utilization of natural dyes from the forest plants of Uttaranchal [FRI-249/Chem-12/External/2003-2007] Extended upto December 2007

Status: Several trials were performed to develop the process for the isolation of natural dyes from *Cassia tora* seeds on pilot plant scale. Dyeing trials were done using the isolated dye and

colourfastness properties and CIELAB values of dyed fabrics were determined. Physicochemical properties of the dye were also determined. Pilot plant trials for isolation of dye from *Lantana camara* (leaves) and *Populus deltoides* (bark) were completed. Determination of CIELAB of various dyed fabric was completed. The technical report of the project was prepared and submitted to the DSIR. The PRC found the progress of the project to be excellent and recommended an extension of one year (upto 31st December 2007) with no additional budget.

Project 12: 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: The roots of Berberis *aristata* were collected from different places of two districts of Himachal Pradesh. Roots were shade dried, powdered and extracted with methanol in a soxhlet apparatus. The extracts were concentrated on a water bath to small volumes and yield of the extracts on moisture free basis was determined. HPLC analysis of extracts was carried out and yield of berberine (alkaloid) was determined. The root sample collected from Narkanda (Shimla) in winter season was found to have maximum yield of berberine.

Project 13: Ecorestoration studies in Uranium mines [FRI-265/Eco-14/ External/2005-2009]

Status: Species have been identified and ethnonobotanical studies completed. Tailings have been analysed for physico-chemical parameters and field experiments have been laid out on tailings.

Project 14: Forest fire monitoring and management [FRI-295/Eco-17/External/2005-2007]

Status: Pre-fire vegetation survey for fuel load determination and Fuel Moisture have been carried out in pine and sal forests under Nainital Forest Division, Nainital. Representative plots of 5m x 5m size were laid out in each forest area for collection of litter (fuel load) and analysis of shrub vegetation and estimation of understorey biomass. Field data such as soil temperature, soil moisture, and vegetation were also collected. Vegetation data were collected for ground, understorey and tree components. Similarly height and diameter of all tree encountered in the sample plot were also measured. Representative samples were brought to the laboratory for oven dry weight and other analysis. Other field data such as soil temperature, soil moisture, and vegetation were also collected. Organic carbon in all the soil samples was estimated.

Project 15: 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: Field visits to Pindari and Roopkund have been conducted. Vegetation studies, enlisting rare and endangered species, collection of soil samples and their analysis for nutrients and other attributes, socio-economic surveys along the trek route were carried out. Compiled relevant references for discussions of the results obtained. Attended National /International seminars and presented papers.

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

Status: Off-campus training was imparted to the women of different villages like Rajawala, Telpura, Phoolsaini, Kandoli etc. for taking up vermicomposting of solid waste as a means to generate additional income. Vermicompost from solid waste was prepared in the FRI campus and distributed to the rural women of Phoolsaini village for applying it in their field.

Project 17: Restoration of biodiversity in the hills of Kujapuri following Badrivan Restoration Approach [FRI-264/Eco-15/External/2004-2007]

Status: Species having commercial value viz. *Dendrocalamus strictus* and biofuel yielding *Jatropha curcas* were planted in the degraded forest and village community lands adjoining Kujapuri Temple. A number of ornamental species have also been planted in the area. The planted species were monitored for their growth and survival. Awareness campaigns were organized to sensitize the villagers about the functional role of planting trees and conservation of biodiversity in the Siddhapeeth area.

Project 18: Garden of the Great Arc [FRI-263/Eco-12/External/ 2004-2008]

Status: Garden is located in the Hathibarkala Estate of Survey of India, Dehradun. The terrain of southern aspect of the park (measuring 55 acres) is characterized by a nallah, running in north south direction, eroded undulating slopes and gullies in the east, and habitation on the southern part of estate. Commensurate to Great Arc that traverses the entire length of the country from north to south, FRI has attempted to create patches of different natural forest types of India in this park. Further a site for visually handicapped was developed to facilitate their appreciation of great floral diversity of India. Besides these, different theme gardens have been developed.

Plantation of nearly all the forest types viz., sub tropical pine forest, tropical dry deciduous forest, tropical moist deciduous forest, tropical evergreen forest and avenue plantations have been completed. Tree grooves, Nakshatra Vatica, Buddha Vatica and development of picnic garden, Rose garden, Foliage garden and a special garden for visually handicapped has been completed alongwith slope stabilization works.

Project 19: Biotechnological approaches for improvement of plant species with special reference to pulp and paper [FRI-267/FPD-48/External/2004 2006]

Status: Multi-institutional project has been funded by CSIR. The aim of the project is to screen suitable material of subabul with low lignin and higher fibre content for pulp and paper. Nearly 1100 samples collected by participating institutes across India were characterized for physical, chemical and anatomical parameters. Based on the results, samples have been short listed for further work.

Component: Chemical screening of subabul

Status: Dust of 1200 samples (mesh size 40-60) of *Lucaena* sp. was made for proximate analysis (with bark and with-out bark) and sent for NIR spectroscopy analysis to Forest Products Division of the institute. Extractive percentage (Alc-benz. Solubility) varies from 0.5% to 4%. Holocellulose percentage varies from 65% to 75%. Lignin percentage varies from 19% to 31%. Ash percentage varies from 0.5% to 2.3%. Pentosan percentage varies from 10.9% to 17%. Lignin, Holocellulose, Pentosan, Extractives and Ash percentage in case of subabul (*Lucaena* sp.) collected from different geographical regions showed wide variation. Compilation of raw data generated on the basis of locality, age, girth and diameter is in progress.

Project 20: Deployment of the promising F1 hybrids of *Eucalyptus citriodora* and *Eucalyptus torelliana* for establishment of vegetative multiplication garden and their field trials [FR-338/G&TP-17/External/2006-2009]

Status: Open pollinated seeds of *Eucalyptus citriodora* and *E. torelliana* species were collected from field of FRI campus and their progenies have been raised. Hybrids of *E. citriodora* x *E. torelliana* and *E. torelliana* x *E. citriodora* have been selected at nursery stages based on morpho-genetic parameters. Two field trials of *Eucalyptus* hybrids have been laid out at Hoshiarpur, Punjab and New Forest campus (Uttarakhand).

Project 21: Follow up-project on advance genetic improvement in SPA, SO and Progeny trials of different forest tree species in Punjab [FRI-339/G&TP 18/External/2006-2009]

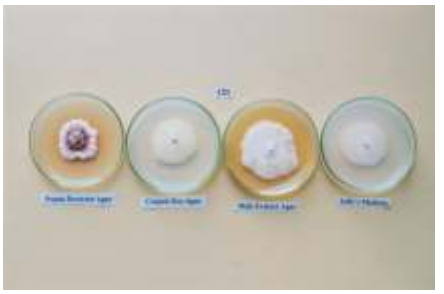
Status: A SPA of 5 ha of *Acacia catechu* was measured and analyzed. A report was prepared and submitted to the State Forest Department to carryout the culling operation. The operation has been completed in CSO of Pindori Mindo Mind, Hoshiarpur in Punjab. The SSO and CSO of *Dalbergia sissoo* at Ludhiana was measured and analysed for culling and a report submitted to the CF (R&T).

Project 22: Genetic improvement of *Asparagus racemosus* (Wilf) to enhance root production and saponin content [FRI-340/G&TP-19/External/2005-2008]

Status: Literature regarding *Asparagus racemosus* plant type, cultivation methodology and its different seed sources has been collected. Seeds and roots were collected from different geographical regions of Punjab, Haryana, Jammu and Kashmir, Himachal Pradesh, Rajasthan, Madhya Pradesh, Uttarakhand and Tamil Nadu. A total of 25 seed sources of *Asparagus racemosus* have been collected for evaluation. Seedlings were raised and a field trial of 20 different seed sources established at FRI campus in RBD design.

Project 23: Study on pathogenic and molecular variability in *Fusarium solani* causing shisham (*Dalbergia sissoo*) wilt. [FRI-272/Path-17/External/2004-2007]

Status: Out of 129 isolates of *Fusarium solani* collected from the high infection zones, a total of 53 isolates were selected for various studies. Nutritional studies using four nutrient media viz. Potato Dextrose Agar, Czapek Dox Yeast Extract Agar, Malt Extract agar and Joff's medium were conducted for variation in growth, sporulation and development of pigmentation. First two media encouraged only microconidal production. Macroconidia developed in Joff's medium profusely and in Malt Extract Agar sparsely. Effect of 9 pH ranges and fungicidal sensitivity using four fungicides namely Bavistin, Bayleton, Propiconazole and Topsin-M was conducted taking three concentrations for all 53 isolates. Bavistin and Propiconazole were most effective while Bayleton and Topsin-M were least effective in all concentrations.



Cultural Variability of *Fusarium solani* on different nutrient media

Project 24: Researches on natural decay resistance of juvenile timbers like poplars [FRI- 283/Path-18/External/2005-2008]

Status: Decay fungi identified in stored logs of poplar at Star Paper Mills, Saharanpur and FDC Depot, Lalkua as *Bjerkandera adusta, Coriolopsis telfarii, Daldinia concentrica, Ealiella scabrosa, Flavodon flavus, Lenzites acuta, Schizophyllum commune* and *Trametes cingulata*.

New clones being tested at WIMCO Seedlings Ltd., Rudrapur (WIMCO A26, S7C4, L 49, WIMCO 81, WIMCO 39) did not show resistance against test decay fungi.

Project 25: Collection and dissemination of market information on commercially important medicinal plants of Uttaranchal [FRI-282/RSM-16/External/2005-2008]

Status: Market price of commercially important medicinal plants was collected from Ramnagar, Tanakpur, Saharanpur and Delhi. Data were compiled and tabulated for publication of quarterly newsletters. Besides, the price data, relevant information on medicinal plants and policy decisions of Uttarakhand Government were also collected and incorporated in newsletters for the benefit of the growers. Quarterly newsletters were published and disseminated to various stakeholders throughout the country covering as many as about 50 commercially important medicinal plant species.

Project 26: Preparation of local volume tables of khair, sal, shisham and teak for UP Forest Development Corporation, Lucknow [FRI-255/RSM-15/ External/ 2003-2008]

Status: Local volume tables of khair, sal and shisham were prepared and submitted to the C.M.D., U.P. Forest Development Corporation, Lucknow. Field data on teak have been collected and being analysed for preparation of volume table.

Project 27: Preparation of Management Plan of Sukhna Wildlife Sanctuary and Working Plan of Chandigarh Forest Division [FRI-273/RSM-15/ External/ 2004-2008]

Status: The first ever Management Plan of Sukhna Wildlife Sanctuary was submitted to the funding agency for the period from 2006-07 to 2015-16. About 3 Zone Plans and 7 Theme Plans have been proposed as management interventions for scientific management of the sanctuary. Field work for the preparation of Working Plan of Chandigarh has been completed. The draft Final Working Plan (W.P.) for the period of 10 years from 2007-08 to 2016-17 has been written and submitted wherein 3 Working Circles viz. Protection W.C., Urban Forestry W.C. and Rejuvenation of Lake and Water Bodies W.C. have been proposed. The comments of the funding agency on the draft W.P. are awaited for the publication of the final report.

Project 28: Preparation of Working Plan for Dadra and Nagar Haveli Forest Division [FRI-328/NWFP-20/External/2005-2008]

Status: Field tours for enumeration and collection of data were undertaken and data compiled. The earlier Working Plan was reviewed and the First Preliminary Working Plan Report submitted to the funding agency. Socio-economic survey was conducted and results tabulated. The fund of 1st installment of Rs.4.83 lacs was utilized and the 2nd installment of Rs. 2.41 lacs has been received in March 2007. Writing of Working Plan for the period from 2008-09 to 2017-18 is in progress with 8 Chapters completed as per Working Plan Code.

Project 29: Technology transfer and development of a model village by skill upgradation and capacity building of rural communities for socio-economic upliftment [FRI-287/PLO-1/External/2005-2008]

Status: Survey in the villages Sherpur, Badonwala, Harbajwala, Malhan, Kalyanpur and Mehuwala Mafi was undertaken on Dehradun-Shimla road. Awareness was created regarding the importance of

medicinal plants and other forestry tree species by individual and group meetings with villagers. Multiplication of planting material was done by stem cuttings and also by seed sowing in the nursery beds and transferred in the polybags for distribution to the cultivators. The distribution of the *Coleus* seedlings was done during July-August 2006. Before the distribution of the medicinal plants to the cultivators meetings were held about the weeding, planting technique, caring, manuring, control of insects, pests and fungal attack. Nearly thirty cultivators in the village Badonwala, Harbajwala, Buddhi and in Pattion have started the cultivation of medicinal plants on small scale.

A demonstration-cum-display of the modern nursery has been established in the Shatabdi Van Vigyan Kendra (Rangers College) where the villagers could easily get information regarding the important medicinal plants. Training programme was organized and the identified villagers were motivated to grow seedlings in their village land. During the training in November 2006 villagers raised medicinal plants in the Shatabdi Van Vigyan Kendra, and their performance is appreciable. Modern nursery has been established from DST funded project.

Project 30: Farm forestry extension and its marketing and economic linkages [FRI-367/RSM-18/External/2005-2008]

Status: Inception report has been discussed with nodal officer of the project in June 2006. For study, markets and tree species grown under farm forestry in Punjab was finalized. Market Price data were collected in structured formats, compiled, tabulated and published in the form of Quarterly Newsletter "Market Prices of farm-grown agro-forestry wood in Punjab". First issue October-December 2006 was published and January-March 2007 issue is under preparation. A training programme on "Marketing of Farm Forestry Produce and Extension" was organized in July 2006 at Ludhiana in which 41 officials of Punjab FD participated. Development of a website was initiated with the co-ordination of the IT Cell, of FRI, Dehradun.

Project 31: Development of genetically superior planting material and cultivation technology for increasing productivity of *Jatropha curcas* [FRI-286/Silva-23/External/2005-2008]

Status: Selected 149 CPTs of *Jatropha curcas* in Uttarakhand. Identified 27 accessions, which have been rated as high oil yielders (>35% oil content on seed weight basis) by the Department of Biotechnology, Govt. of India. Three stands in Uttarakhand with high oil content are being converted into Seed Production Areas (SPAs). Nursery stock of high oil yielding germplasm has been raised for establishing Clonal Seed Orchards (CSOs), Seedling Seed Orchards (SSOs), Vegetative Multiplication Gardens (VMGs), progeny trials and clonal trials at three sites in Uttarakhand. Laid out field trials to standardise spacing, pruning, fertilizer, irrigation and type of planting stock for raising plantations of this species at three sites in Uttarakhand.

Sub-Project: Seed Technology

Status: Seeds of *Jatropha curcas* were collected from different places of Uttarakhand. The shade dried, decorticated and crushed seeds were extracted with petroleum ether and stored in twelve different containers at different environmental conditions (viz. Damp room, aerated room, 5°C, 15°C, room temperature and at freezing temperature). Seeds were taken out at particular intervals for estimating the fatty oil percentage of all the containers. At the end of the year seeds stored in the polybag at low temperature with low moisture content, were found best suited among rest of the containers.

Project 32: Genetic improvement of *Jatropha curcas* for adaptability and oil yield [FRI-293/Silva-24/External/2005-2010]

Status: Collected germplasm and made 40 accessions of *Jatropha curcas* from Punjab, Haryana, Himanchal Pradesh, Uttar Pradesh and West Bengal. The material was multiplied clonally and provided to five collaborating institutions, on exchange basis in different parts of India. With the accessions exchanged laid out field trial of 206 accessions at Etah, Uttar Pradesh to standardise spacing, pruning, fertilizer, irrigation and type of planting stock for raising plantations of the species in Uttar Pradesh.

Project 33: Development of silvicultural practices for promoting cultivation of *Taxus baccata*, *Rhododendron arboreum* and *Phyllanthus amarus* [FRI-294/Silva-25/External/2005-2008]

Status: Cuttings of *Taxus baccata* (collected from Chakrata, Uttarakhand) were treated with different IBA concentration and Bavistin (0.02%) and planted in poly-house for rooting. 100 ppm IBA resulted in best rooting in *T. baccata.* 100 wildlings of *Rhododendron* were planted at Chakrata nursery for undertaking budding experiments. Seed maturity studies on *Phyllanthus amarus* Sch. & Th. showed that germination of freshly harvested seeds was slower than older. Seeds from the first capsules to dehisce after harvest (dark green seeds) had higher germination percentage than those from dehiscing later (light tan seeds). Experiment on different spacing regimes, sowing methods, sowing time etc on *P. amarus* are in progress.

Project 34: Development of technological package for the production and quality evaluation of seeds of important medicinal plant species under National Medicinal Plant Board [FRI-285/Silva-22/External/2004 2007]

Status: Seeds of 30 species of medicinal plants were collected from different parts of Uttarakhand and seed morphological parameters in respect to seed length, width, shape, colour, 1000 seed weight, number of seeds in a single fruit and number of seeds in 1 kg have been measured. Seeds were given pretreatment of GA_3 - 0.1%, KNO_3 - 2%, H_2O_2 - 0.1% for enhancing the germination along with experiments in controlled condition and in germinator (25/30°C) at monthly intervals. Hard coated seeds like those of *Myrica esculenta (*Syn*. M. nagi), Rauvolfia serpentina, Rauvolfia canescens, Wrightia arborea (*Syn. *W. tomentosa)* and *Heracleum candicans* were soaked in water to obtain good germination by overcoming their dormancy. Seeds of *Zanthoxylum alatum*, *Rauvolfia serpentina* and *Rauvolfia canesens* were scarified with sulphuric acid and stratified. Germination record of one year of earlier collected 30 species was compiled for publishing as a seed booklet.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Planting stock improvement of some indigenous fuelwood and fodder tree species for higher biomass production in relevance to the hilly regions of Garhwal Himalaya [FRI-337/Bot-51/External/2006-2009]

Status: Seeds of *Grewia optiva, Melia composita, Kydia calycina, Terminalia tomentosa, Albizia lebbeck, Quercus leuchotricophora* and *Terminalia chebula* were sown in nursery.

Sites for three nurseries for Tropical, Sub-tropical and Temperate species were identified at Fatehgram (Tropical), Chowki Gholtir (Sub-tropical) and Jarmola (Temperate). Nursery development activities like preparation of nursery beds, preparation of sand, soil and farm yard manure mixture and filling of polybags have been done. The quality planting stock of *Grewia optiva, Melia azedarach, Ficus recemosa (*Syn*. F. glomerata), bamboos, Bauhinia variegata, Bauhinia purpurea* and *Terminalia chebula* has been prepared.

Project 2: Wood anatomy of important commercial timber of Assam with notes on their properties and uses [FRI-292/Bot-43/External/2006-2008]

Status: The data and write up of 10 species has been completed.

Project 3: Improvement and development of Bambusetum of FRI, Dehradun [FRI-335/Bot-49/External/2006-2007]

Status: Bambusetum has been established with state of art innovative lay-out explanatory displays. Surveyed the southern parts of country for collection of 12 bamboo species. Fifteen species duly studied in field in different parts of Arunachal Pradesh and adjoining tracts were collected for introduction. Seven species of bamboo, typical of hills of Kumaon region of Uttarakhand were introduced in the FRI Bambusetum. Irrigation channels were laid out. Fencing work on the southeastern and southern boundaries of bambusetum was completed**.** An inaugural-cum-field workshop was held in the Bambusetum during the Centenary Year of FRI to emphasize on the botanical research on bamboos being carried out by FRI.

Project 4: Development of improved chemical formulation and equipment for efficient treatment of bamboo for long term preservation and fire retardance [FRI-FPD]

Status: Installation of Boucherie equipment for treatment of 24 green bamboos was completed. Treatment of *Bambusa arundinacea, D. strictus* and *B. balcooa* with CCB was done. Three green bamboo species viz *D. Strictus*, *B. tulda* and *B. arundinacea* was treated with ten combinations of fire retardants and preservatives in split form. Performance evaluation against fire as per BIS: 5509 was carried out. It was found that some combinations performed satisfactorily and trials on further reproducibility of results are under progress. Equipment of flame penetration test is modified and upgraded compared to the earlier equipment.

Project 5: DNA fingerprinting of shisham (*Dalbergia sissoo*) clones planted in Punjab [FRI-364/G&TP-21/External/2006-2008]

Status: 53 clones of shisham were collected from Punjab. DNA isolation technique has been standardized and perfected. DNA has been extracted from 53 different clones. PCR-RAPD conditions standardized for shisham. Screening of 10 polymorphic RAPD primers has been completed and clonal material characterized with primers. Six clones (C174, S179, SDB, C361, C86 and C235) were clearly resolved showing maximum variation. Smaller cluster comprised of 8 clones and remaining were clustered together with least genetic variation between them. It was observed that there is no indication of clustering of clones based on area.

Project 6: Development of non-destructive harvesting methods for medicinal plants [FRI-341/NWFP-21/ External/2006-2009]

Status: Development and maintenance works continued at nursery sites in Chakrata and FRI Dehradun. Experiments on Project species at NWFP nursery, Chakrata and Dehradun have been conducted. Seeds of *Picrorhiza* sp. and *Rheum* sp. were collected from available sources and propagated in NWFP production nursery. The germination percentage and seedlings survival were found better in *Rheum* seeds as compared to *Picrorhiza*. The seedlings of these species transplanted in Chakrata nursery for further studies on survival and growth. Sites were selected for laying out the harvesting field trials in natural conditions.

Project 7: Exploration, conservation and propagation of important medicinal climbers of Garwhal Himalayas [FRI-365/NWFP-24/External/2006-2009]

Status: Collection of germ plasm, preparation of nursery beds and propagation of some climbers has been done. Review of literature on climbers of target species of the project was continued. Appointment of JRF and procurement of equipments mentioned in the Project has been done.

Project 8: Biological control of root diseases of some medicinal plants using selected antagonistic fungi [FRI-411/Path-26/External/ 2007-2009]

Status: The project was started in January 2007. The equipments for the project were procured and process for appointment of a SRF was initiated.

Project 9: Status of wood based industries in Kumaon, Uttaranchal [FRI-366/RSM-17/External-2006-2008]

Status: Inventorization of wood based industry in Udhamsingh Nagar, Uttarakhand was carried out. Demand and supply status of raw materials were studied, collected data was compiled and the interim report is under preparation for submission to funding agency.

Project 10: Inventorization and replacement plan for the trees planted by NDMC [FRI-405/RSM-19/External-2006-2008]

Status: Inventorization of trees, diseased trees and replacement plan for trees at Central Vista has been prepared and submitted. List of trees in Nehru Park and Talkatora Garden was prepared and submitted. Field demonstration of disease control techniques to NDMC officials at New Delhi was given. Layout Plan for the bio-aesthetic landscaping of Rajpath and C-Hexagon with choice of plant species along the Central Vista, New Delhi prepared and submitted.

Project 11: 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: Two villages have been selected in Uttarakhand under the project. Information about species preferred by the growers has been recorded. The choice of species in village in Chakrata block is dominated by fuel and fodder species while species that provide monetary returns are preferred by people in the village located in Chamba block. Planting material of the selected species is being raised.

Project 12: Study on the impact of riverbed material collection on ecology, silviculture and environment in Uttaranchal [FRI-407/Silva-38/External/ 2006-2008]

Status: Conducted surveys in river bed extracted sites and catchments of river Yamuna and Amlawa river and selected 3 sites for collection of field data covering a distance between 15-20 km. Field data were collected on ecology, change of successions, change of river course, water flow, biotic pressures, river environment and socio-economic conditions of people living near the extracted sites. The data are being compiled and analysed.

Abstract: No. of Projects

	No. of projects completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	9	37	16
External Projects	13	34	12
Total	**22**	**71**	**28**

TECHNOLOGY ASSESSED AND TRANSFERRED

Field demonstration of techniques of disease management in nursery and plantations was given to the officers and staff of New Delhi Municipal Council by Dr. N.S.K. Harsh.

EDUCATION AND TRAINING

Visits

1. Dr. Vineet Kumar made a visit as a Visiting Scientist to Polytechnic University, New York and worked on 'Chemo-enzymatic modification of hyaluronic acid' and also supervised a student on 'Chemical modification of oligopeptides synthesized using reverse equilibrium catalysis'. He completed the research work by filing one US Patent on modification of Hyaluronic Acid.

2. Dr. Pradeep Sharma visited Department of Primary Industries and Fisheries (DPI and F) Brisbane, Australia as a Visiting Scientist (Period 22nd November 2006 to 11th April 2007). AT DPI and F, he worked on the chemical analysis of *Callitris glaucophylla* sawdust oil by fractionation and Gas chromatography Mass spectroscopy.

Training imparted

1. One month training was given to Mr. Mohamad Yusaf Khan, M. Pharma, Jamia Hamdard University, New Delhi on the topic 'Chemical modification of alpha Cellulose to prepare Cyanoethyl Cellulose (CS) and Cellulose sulfate'.

2. One month training was given to. Ms. Maria Khan, M. Pharma, Jamia Hamdard University, New Delhi on the topic 'Phytochemical analysis of *Berberis aristata*'.

3. Training imparted to villagers and member of HESCO on natural dye and compost under the project "Integrated Utilization of Lantana" sponsored by Sir Ratan Tata.

4. Dr. Sas Biswas organized a training programme on Biodiversity and Environment for School and College Teachers of Uttarakhand on 10th and 11th August 2006.

5. Two programmes of two days each on "Biodiversity: Nurturing Nature for our future" were organised for school children and teachers of KVs of Dehradun by FRI.

6. Three training courses organized for Deputy Director level Horticulture Officers of New Delhi Municipal Council at FRI, Dehradun for disease control techniques by Dr. N. S. K. Harsh.

7. Two training courses organized on "Integrated Utilization of Lantana" at Shatabdi Van Vigyan Kendra (SVVK), Rangers College, Dehradun by FRI.

8. Training course on Medicinal plants at Shatabdi Van Vigyan Kendra (SVVK), Rangers College, Dehradun was organized from 6th to 10th November 2006 by FRI.

9. A training programme on "Marketing of Farm Forestry Produce and Extension" was organized by FRI in July 2006 in Ludhiana in which 41 officials of Punjab Forest Department participated.

10. Training was conducted for Forest Rangers and Foresters of Punjab Forest Department on 10th and 11th March 2007.

The following Short Term Training Courses were organized for officials of Government of India, State Forest Departments, Public Sector Undertakings, NGOs and representatives from various Industries:

1. Management of Forest Herbarium and Arboreta.
2. Development of Green Belts.
3. Afforestation and its management.
4. Exposure to identification of timbers through field and lab orientation.
5. Plywood Manufacture.
6. Wood Seasoning.
7. Classification and Grading of Timber.
8. Nursery and Plantation Technology.
9. Hi-tech Nursery and Plantation Technology.
10. Low cost Nursery and Plantation Management.
11. Low cost Seed Technology.
12. Low cost training on Bamboo Utilisation, Medicinal Plants, Vermicomposting and Soil testing.

Training received

1. Under ISO programme, three scientists of Chemistry Division, namely Shri Rakesh Kumar, Dr. Rashmi and Dr. V.K. Varshney acquired four days (26th to 29th March 2007) training in advanced instrumentations techniques-HPLC, GC-MS and HPTLC for their skill upgradation at Indian Institute of Chemical Technology (IICT), Hyderabad.

2. Dr. Santan Barthwal, Scientist C, attended 21 days, Department of Biotechnology, GoI (DBT) sponsored training programme on "Plant Tissue Culture, Genetic Transformation and Genome Analysis with Molecular Markers and PCR walking" at the Tata Energy and Resources Institute (TERI), Lodhi Road, N. Delhi from 4th to 23rd December 2006.

LINKAGES AND COLLABORATION

1. National Institute of Technology, Jalandhar and Sports Forum, Jalandhar for a consultancy project on identification of technology gaps in Sports Goods manufacturing.

2. Linkages were developed with Forest Deptartment Jaipur, Forest Deptartment Bundi, Forest Deptartment Hanumangarh, Forest Deptartment Haldwani, Forest Deptartment Roorkee, Forest Deptartment Haridwar, Forest Deptartment Ranikhet and Forest Deptartment Narendranagar Division.

3. Linkages with various wood and wood products manufacturers and user industries, important among them are NTPC, Talchair; BIS, New Delhi; Northern Coal Fields Ltd., Singrauli; Delhi Development Authority; Ashahi Glass Ltd., Mumbai; Reliance Industries Ltd., Gujarat; Garhwal Mandal Flush Door Factory, Kotdwar etc.

4. With IHBT, Palampur for giving training to local artisans on bamboo processing and utilization.

5. An agreement on the project titled "Identification, development and utilization of natural dyes from forest plants/weeds and agriculture waste" was signed on 18th August 2006 between Sikkim Khadi Village Industry Board, Gangtok (Sikkim), Forest Research Institute, Dehradun, Department of Scientific and Industrial Research, New Delhi and National Research Development Corporation, New Delhi.

6. NWFP Division carried out monitoring and evaluation of NMPB sponsored projects implemented by various States.

7. State Forest Departments.

8. Department of Biotechnology (DBT).

9. Space Application Centre (ISRO).

10. Department of Atomic Energy, Govt. of India, Mumbai.

11. Damodar Valley Corporation (DVC).

12. GB Pant Institute of Himalayan Environment and Development.

13. Linkages with organization like Railway, Defence, Bureau of Indian Standards, NTPC, Telecommunications, C.P.W.D., Punjab Police Housing Corporation, ONGC etc for wood related properties.

14. Creation of germplasm bank of medicinally important tree species of Punjab is running in Plant Physiology Discipline with the collaboration of Punjab Forest Department.

PUBLICATIONS

Books

1. S.S. Negi, R.K. Srivastava and S. Nautiyal (2006). Studies on Himalayan Pines. Edited Book FRI.

2. Singh, Y.P.; Kumar, D.; Nautiyal, R.; Thapliyal, M. and A.S. Chauhan, Eds. 2006. Hundred Years of FRI. Forest Research Institute, Dehradun. 112p.

3. Singh, Y.P.; Kumar, D.; Nautiyal, R.; Thapliyal, M. and A.S. Chauhan, Eds. 2006.FRI: Glimpses of a Century. Forest Research Institute, Dehradun. 80p.

Brochure

1. A brochure on "Research Highlights in Chemistry of Forest Products" during the last 100 years.

2. Published a booklet entitled 'Lantana Key Ekikrit Upyog' (in Hindi).

Proceedings

Proceedings of the XII Silvicultural Conference. (Eds.) S.S. Negi, R.K. Srivastava, Manisha Thapliyal and Ombir Singh, Forest Research Institute, Dehradun.

CONSULTANCIES

Long-term consultancies

1) **Title:** Installation of a 250cft solar kiln at Agra

Organization: M/s Shashee Industries, Sikandra, Agra

Amount: Rs. 0.84 Lakhs

Status: The Kiln has been installed and handed over to the client after successful trial and training of their staff.

2) **Title:** Installation of a solar kiln at Jallandhar

Organization: M/s Process cum Product Development Center (PPDC), Meerut

Amount: Rs. 4.26 Lakh

Status: The Kiln is in final stage of installation.

3) **Title:** Identification of technological gaps and possible remedial measures in wood based sports goods cluster at Jalandhar**.**

Organisation: Dr. B.R. Ambedkar National Institute of Technology, Jalandhar.

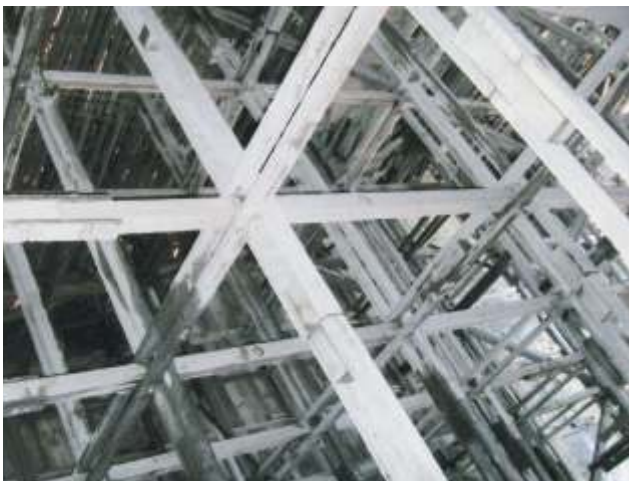
Amount: Rs.3.03 Lakhs

Status: A questionnaire regarding the problems faced by the Industry about the performance of cricket bats, hockey sticks and carom coins has been prepared for distribution among the industries through NIT, Jalandhar.

4) **Title:** Inspection of cooling tower timbers for Reliance Industries, Surat

Amount: Rs.1.9 Lakhs

Status: Scientists and staff of the Forest Products Division visited the cooling tower of RIL, Surat, Gujarat and completed inspection and sample collection under the consultancy.



Timber structure inside the cooling tower

Test sample placed in the cooling tower

5) **Title:** Preparation of Working Plan of Chandigarh Forest Division and Management Plan of Sukhna Wild life Sanctuary.

Period: 2004-2008

Organization: Chandigarh administration

Amount: 8,57,000/-

6) **Title:** Preparation of Working Plan/Management Plan for Dadra and Nagar Haveli Forest Division.

Period: 2005-2008

Organization: Dadra and Nagar Haveli Forest Department

Amount: 9,67,000/-

7) **Title:** Inventorization and Replacement Plan for the trees planted by NDMC

Period: 2006-2008

Orgnization: NDMC, New Delhi

Amount: 6,88,000/-

Short-term consultancies

1. Developing Optimal Afforestation Plan for DVC command area.

2. M/S Faridabad Gurgaon Minerals for ecological rehabilitation of stone mines.

3. Forest Department of Uttarakhand for Biostabilization of Varunavat landslide.

4. From Uttarakhand Bamboo Fibre Board Development for "Softening of Bhang (industrial hemp), Bichhu Ghaas Himalayan Nettle, Bhimal for textile".

5. Uttaranchal Bamboo Fibre Board Development awarded the job on "Softening of Bhang (industrial Hemp), Bichhu Ghaas Himalayan Nettle, Bhimal for textile". Rs. 70,000/- (Seventy thousands only) was charged for the job.

6. Women's Development organization, Dehradun awarded the job on "Softening of sisal fibre" at a cost of Rs. 2000/- (Two thousand only).

7. Handmade paper was made from herbal waste. The job was assigned by Himalayan Drug, Dehradun. Rs 5000/- was charged for the work.

8. Paper samples were tested on charged basis supplied by Defence Organisation, Dehradun.

9. About 239 wood samples have been examined and identified and revenue for about Rs.10,85,000/- earned.

10. Revenue earned through various consultancies, testing and other services above Rs. 15.5 Lakhs.

PATENTS

1. R. Gross and Vineet Kumar filed PCT application no. PCT/US07/63671 dated 9th March 2007 on 'Acrylation of Hyaluronic acid' to USPTO.

2. Director, Forest Research Institute, Dehradun. A process for the preparation of Katha from Gambier Extract, Patent No 125863 A, 30th August 2006 (Malaysia).

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. International conference was organised on "Ecosystem Goods and Services from Planted Forests" from 3rd to 7th October 2006 at Bilbao, Spain and "Planted Forests: Ecosystem Goods and Services" at FRI, Dehradun, India from 13th to 15th December 2006.

2. Organized 10 seminars and symposia during the Centenary celebration of the institute. Organized the Vaniki Mela in Forestry at the Shatabdi Van Vigyan Kendra (SVVK) erstwhile Northern Forest Rangers College, campus of FRI, Dehradun. In the event Forest Departments of U.P., Uttarakhand, Punjab and Haryana participated. Sir Brandis Walking Trail and a Nursery were laid out in the premises of SVVK.

3. A Vermi mela was organized in the Shatabdi Van Vigyan Kendra during Vaniki Mela Programme on 24th and 25th November 2006. Vermicompost prepared from organic solid waste and leaf litter in the FRI campus was analysed for micronutrients (Organic carbon, Nitrogen, Phosphorus, Potassium, Sodium, pH, etc).

4. Asia Pacific Forestry commission meeting at FRI Dehradun was organized from 17th to 21st April 2006.

5. National Workshop on "Role of Forestry in Employment" on 29th and 30th August 2006 organised at FRI Dehradun.

6. National Symposium on "Plant Biotechnology and 28th Plant Tissue Culture Association Meeting" from 12th to 14th October 2006 organised at FRI Dehradun.

7. Three days International seminar on "Planted Forest Eco system Goods and Services" was organized from 13th to 15th December 2006 at F R I Dehradun.

8. National Workshop on "Role of Forestry in Employment Generation and Rural Development" was organised on 29th and 30th August 2006, by FRI, Dehradun.

9. A National conference entitled "Natural Products and Biodiversity: Chemistry and Utilization" was organized on 2nd and 3rd November 2006.

10. Organized IUFRO-ISTS-FRI "International Symposium on Breeding and Improvement of Asian Conifers during 20th Century" at FRI, Dehradun from 11th to 13th September 2006.

11. National Technology Day at FRI, Dehradun on 11th May 2006.

12. FRI Centenary celebration on 5th and 6th June 2006.

13. Hindi Advisory committee at FRI Dehradun on 9th June 2006.

14. Van Mohostsava at FRI Dehradun on 21st July 2006.

15. Hindi Saptaha at FRI, Dehradun from 18th to 22nd September 2006.

16. Vigilance Awareness week at FRI, Dehradun from 6th to 10th November 2006.

17. "Kauthik Mela" at Shatabdi Van Vigyan Kendra (Rangers College) ground, Dehradun from 15th to 21st November 2006.

18. "Vaniki Mela" was organized on 24th and 25th November 2006 at Shatabdi Van Vigyan Kendra (Rangers College), Dehradun.

Vaniki Mela at FRI, Dehradun

19. Closing ceremony of the centenary celebration of Forest Research Institute, Dehradun was organised on 15th December 2006.

20. World Forestry Day was celebrated on 21st March 2007 at FRI, Dehradun.

Participated

National

1. Dr. N.S. Bisht and H.P. Singh attended the National Seminar on "Trees outside Forests" in Chandigarh on 25th and 26th April 2006.

2. Dr. (Mrs.) Prafulla Soni, Dr. H.B. Vasistha, Dr. Mridula Negi and Research Scholars attended the National Conference on "Eco-Restoration of Derelict Mined Lands" jointly organised by Department of Botany, Dhempe College of Arts and Science, Goa and FRI in Goa on 1st and 2nd March 2007. Dr. Soni delivered key note address on "Ecological Restoration of Mined Lands: Problems and Prospects". Dr. H.B. Vasistha, Dr. Mridula Negi and Research Scholars also presented papers separately.

3. Dr. Vineet Kumar, Scientist-D, delivered an invited Talk at XXI Carbohydrate Conference CARBO XXI organized by Delhi University, Delhi and Association of Carbohydrate Chemists and Technologists (India) on "Chemo-enzymatic modification of Hyaluronic Acid" from 26th to 29th November 2006 at Delhi University, Delhi.

4. Dr. Rameshwar Dayal, P.C. Dobhal, Rakesh Kumar, Praveen Onial and Raj Dev Rawat. Standardization of process for isolation of Natural Dyes. Poster presented in International symposium on Natural Dyes held at Hyderabad from 6th to 12th November 2006.

5. Dr. Rameshwar Dayal, Head, Chemistry Division, Dehradun delivered an invited talk on topic entitled "Forests: A Treasure of Chemicals" at Sardar Bhagwan Singh Institute of Biomedical Sciences and Research, Balawala, Dehradun on 10th March 2007.

6. Dr. V.K. Varshney and Dr. Vineet Kumar participated in a "Technology and Innovation Finding Workshop" organized by Confederation of Indian Industry (CII) and Technology Development Board (TDB) of Ministry of Science and Technology at Dehradun on 9th February 2007. A presentation entitled "Value added products from forests" was made by Dr. V.K. Varshney.

7. Dr Vineet Kumar attended XXI Carbohydrate Conference at Delhi University, Delhi from 26th to 29th November 2006 and following lecture was presented: An invited lecture on "Chemo-enzyme modification of Hyalouronic acid" by Dr Vineet Kumar.

8. Neetu Bhatt, P. K. Gupta and S. Naithani presented a paper on "*Lantanta camara,* a potential weed for preparing alpha cellulose and its cellulose sulfate derivative" in Carbohydrate conference at Delhi University, Delhi from 26th to 29th November 2006.

9. Dr. V.K. Varshney participated in the ICS-UNIDOSEA Regional workshop on "Extraction Technologies for Medicinal and Aromatic Plants (MAPs)" held at CIMAP, Lucknow from 29th November to 1st December 2006 and presented a country presentation on status of MAPs.

10. Dr. A.N. Shukla participated in Brain Storming Workshop on "Aerosols and its impact on climate with special reference to Indo-Gangetic plains", on 10th and 11th November 2006, Indian Institute of Technology, Kanpur.

11. Amit Pandey, N. S. K. Harsh, Meenakshi Khalkho and Suresh Chandra, attended National Seminar on Trees Outside Forests; Potential for Socio-economic and Ecological Development, Department of Forest and Wildlife Preservation, Govt. of Punjab, Chandigarh, April 2006.

12. Dr. S. Nauityal attended International Conference and Expo on "Botanical Products", held at Rajasthan University, Jaipur from 25th to 27th March 2007.

13. Dr. S. Nautiyal attended the Research Advisory Committee Meeting of HNB Garhwal University, Srinagar as an Expert Member held at HAPPRC, Srinagar (Garhwal) on 11th and 12th May 2006.

14. Dr. S. Nautiyal attended the Meeting on "Constitution of Sub-Groups Sectors and Suggest a Policy Framework/Strategy for Development of the Textile Sector during next five years" held under the Chairmanship of Joint Secretary, Ministry of Textile, Central Silk Board, Bangalore and represented ICFRE/FRI as a Member on 17th July 2006.

15. Dr. S. Nautiyal and Monika Tyagi attended International Seminar on "Forests, Forest Products and Services: Research, Development and Challenges Ahead", held at Department of Forestry, HNB Garhwal University, Srinagar from 1st to 3rd November 2006.

16. Dr. S. Nautiyal attended Uttranchal First Science Congress held at Dehradun Institute of Technology, Dehradun on 10th and 11th November 2006.

17. Dr. S. Nautiyal attended the meeting of Task Force on "Nutrient Management in Plantation and other Cash Crops", held at KFRI Peechi, on 10th August 2006.

18. Dr. Veena Chandra participated in GEF Project Development session on Biodiversity.

19. Dr. Sas Biswas, Dr. Veena Chandra and Shri Anup Chandra participated in Expert Committee Meeting on Plants and Workshop on "Revision of Species in Schedules of the Wildlife (Protection) Act".

20. Dr. Veena Chandra participated in National Symposium on Plant Biotechnology.

21. Dr. Veena Chandra participated and presented a paper in Workshop on Optimum Afforestation Plan

22. Dr. Veena Chandra participated in Project Conference on Planted Forests (Ecosystem Goods and Services).

23. Dr. H.S.Ginwal and Dr. Ashok Kumar attended the "National Seminar on Trees Outside Forests" on 25th and 26th April 2006 sponsored by Punjab Forest Department, Chandigarh.

24. Dr. H.S.Ginwal attended "National Biotechnology Conference 2006: Current trends and future perspectives" held on 2nd and 3rd September 2006 at Indian Institute of Technology, Roorkee (Uttarakhand).

25. Dr. H.B. Vasistha participated in the International Seminar on Soil and Forest Degradation in the Himalayan Region, organized by Norwegain University of Life Science (UMB), Aas, Norway in Shimla on 5th and 6th April 2006.

26. Deepak Kholiya, JRF attended International Conference on "Cutting Edge Research in Tourism Emerging Issues and Challenges", organized by Himachal Pradesh University, Summer Hill, Shimla on 17th and 18th March 2007 and presented paper.

International

Dr. S.S. Negi, Dr. A.K. Hooda, Dr. N.S. Bisht, Mr. D. Khanna, Dr. Rajeev Srivastva and Mr. Rajiv Pandey attended a workshop on the 'Ecosystem Goods and Services' from 3rd to 7th October 2006 at Bilbao, Spain.

AWARDS

1. Dr. S. Nautiyal has been awarded the Rajiv Gandhi Excellence Award by Economic Growth and National Integration Council, New Delhi on 31st August 2006.

2. Mr. Jagdish Pant received the Best Paper Award for research paper "Determination of Berberine in Berberis aristata by HPTLC" in Conference 'Phytochemical and Ayurveda potential and prospects' by Universities' Journal of Phytochemistry and Ayurvedic heights, Dehradun on 3rd December 2006.

3. Paper entitled "Amelioration of Neem leaves and Oil for wood protection" by Swati Dhyani and Sadhna Tripathi was presented in First Uttaranchal Science Congress on 10th and 11th November 2006. It was considered best paper in Environmental Sciences and Forestry Section and Ist Prize of Rs. 5000/- was awarded.

4. Junior Young Scientist Award 2007 for Best Paper presentation, won by Ruma Bisht (Project Associate), in "National Seminar on Medicinal Plants: Conservation, Cultivation and Utilization" at Gurukul Kangri University, Haridwar, Uttarakhand.

DISTINGUISHED VISITORS

1. Shri V.L.Chopra. Member, Planning Commission, visited FRI on 18th May 2006.

2. Shri Charnjit Singh Atwal, Deputy speaker of Lok Sabha visited FRI on 3rd July 2006.

3. Shri Digamber V. Kamat, Minister for Power, Mines, Art and Culture, Govt. of Goa Panaji-Goa, visited FRI on 18th October 2006.

Shri Digamber V. Kamat, Minister
for Power, Mines, Art and Culture, Govt. of Goa

4. Lt. Gen. R.K.Rampal, Commandant, I.M.A., Dehradun, made a visit to FRI on 8th February 2007.

5. Grandson of Mr. Brandis from Germany visited FRI on 12th March 2007.

6. Dr. J.S. Yadav, Director, IICT, Hyderabad, visited FRI on 2nd November 2006.

7. Prof. Akito Nagatsu, College of Pharmacy, Kinjogakuin University, Omori, Moriyama, Nagoya 463-8521, Japan, visited FRI on 2nd November 2006.

8. Prof. Deepak Pental, Vice Chancellor, Delhi University visited FRI on 13th October 2006.

9. A delegation of 29 (twenty nine) Civil Servants of Afganistan visited FRI on 29th August 2006.

10. Members of ITTO consisting Mr. J.R. Palmer and others visited FRI on 25th September 2006.

11. Dr. Prodipto Ghosh, Secretary, Ministry of Environment and Forest visited different disciplines of the FRI and went through various research activities on 8th March 2007.

Visit of Dr. Prodipto Ghosh, Secretary,
MoEF, New Delhi

12. Prof. Gajendra Singh, Vice Chancellor, Doon University, Dehradun, made a visit to FRI on 22nd November 2006.

MISCELLANEOUS

1. A special cover to mark the Centenary Celebration was released by Mrs. Amrita Rai, Director, Postal Service Uttarakhand.

2. Dr. A.N. Shukla delivered a radio talk in Hindi on the mortality of shisham in India and its control from All India Radio, Nazibabad, U.P.

3. Dr. N.S.K. Harsh gave a talk about the diseases of poplars and their management for All India Radio, Nazibabad.

4. Dr. Sas Biswas provided significance of monumental trees growing in Shatabdi Van Vigyan Kendra, City Campus of FRI in Bhoomi programme of Delhi Doordarshan.

NATIONAL FOREST LIBRARY AND INFORMATION CENTRE

The National Forest Library and Information Centre (NFLIC) of the institute is richest in document collection in South and South-east Asia. NFLIC provides various 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 27,204 books were loaned to the users for outside reading. Besides, 58,936 documents were consulted.

The document collection was enriched by the addition of 1018 documents, out of which 654 books were purchased at a cost of Rs.11.64 lakhs and 364 books received as gratis.

NFLIC subscribed to Indian and foreign periodical titles at a cost of about Rs. 53 lakhs. It also received about 335 periodical titles as gratis. Besides, back issues of 12 periodical titles were acquired at a cost of Rs. 6.20 lakhs.

The binding of loose periodicals is an essential library activity. During the year, 400 sets of periodicals were bound.

The NFLIC has been selling ICFRE publications through its Book Depot. During the year 509 books and 19 VCDs were sold to the State Forest Departments, Universities etc.

The NFLIC extended its expertise in library and documentation work by holding a Training Course on Library and Documentation for the officials of the Institute of Forestry, Tribhuvan University, Nepal from 3rd to 18th July 2006. Four officials attended the course.

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,* poplars, Forests and Environment, Current Forestry Literature. Besides, the content pages of journals, forest cover of India, state wise and then district wise, announcements of forthcoming National and International conferences, seminars, symposia, training courses were also put up on the website. The ENVIS Centre on Forest published issues of ENVIS News Digest and an issue of ENVIS Forestry Bulletin during the year.

FOREST RESEARCH INSTITUTE UNIVERSITY

Forest Research Institute, Dehradun was conferred the status of 'Deemed University' by the Ministry of Human Resource Development, Government of India, New Delhi vide Notification No. F-9-25/89 U-3 dated 6th December 1991. After the conferment of 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 meaningful and productive way. Besides turning out students having formal academic and practical education of University standard in specialized areas of study newly introduced in the country, such as, Forestry, Wood Science and Technology, Environment Management, Plantation Technology, Non-Wood Forest Products, Natural Resource Management, wood based industries and Plantation activities. The university has been fostering pioneering research in specialized areas under Ph.D. Programmes.

ACADEMIC COURSES AND ADMISSION

The FRI University has been offering the following academic courses on a regular basis: -

M.Sc. Forestry (Economics and Management)

M.Sc. Wood Science and Technology

M.Sc. Environment Management

Post Graduate Diploma in Natural Resource Management

Post Graduate Diploma in Management of Non Wood Forest Products

Six months Certificate Course in Pulp and Paper Technology.

The M.Sc. courses are of two years duration, whereas the Post Graduation Diploma Courses are of one year duration. 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 months Certificate course in Pulp and Paper Technology.

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

During the year 95 students were admitted in all the above mentioned six courses.

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

Besides, regular lectures/programs and dissertation/Project work on specific topic relevant to course, students were sent to one month's industrial attachment to different industries/ organizations. Local excursions, short and long study tours and training programmes were organized during the academic session.

During the year 2006-08, 95 (ninety five) students were admitted. The course 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 Natural Resource Management	- 11
5.	P.G. Diploma in Management of Non wood Forests Product	- 9
6.	Certificate courses in Pulp and Paper Technology	- 9
	TOTAL	**- 95**

EXTRA CURRICULAR ACTIVITIES

Students of FRI University (FRIU) participated in a workshop on “Forestry Education in India” organized by FRIU.

Annual Sports Meet of FRIU was held from 23rd to 26th February 2007 at IGNFA playground which was actively participated by students.

A cultural program "Srijan 2007" was organized on 31st March 2007 by the students and research scholars of the FRI University.

STUDENTS WELFARE ACTIVITIES

1. FRI University provides medical facility 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. FRI University students participated in the Centenary Year celebration of FRI on 15th December and helped the students of different schools from Uttarakhand in the cloth presenting ceremony, where cloth was signed by lakhs of students from different educational institutions of Uttarakhand.
2. Dr. Prodipto Ghosh, IAS, Secretary, Ministry of Environment and Forests visited the FRI University on 8th March 2007 and addressed the students of the FRI University and discussed various issues related to them.
3. Mr. Michael Vetha Siromany, IAS delivered a lecture to the PG Students of the FRI University on the topic "Human Rights in Relation to Forest Management", on 11th August 2006.
4. Mr. Mudit Kumar Singh, IFS, Chhattisgarh delivered a lecture to M.Sc. Students of 3rd Semester on the topic "Project Formulation" on 14th August 2006.
5. Mr. S.K. Sinha, IFS, Haryana delivered a talk on green areas around Panipat Oil Refinery and Afforestation on 14th August 2006.
6. Ms. Yuka Makino, Natural Resource Management Specialist, South East Region, World Bank, Washington delivered a lecture to the students of PG Diploma in NRM and NWFP on the topic "Global Learning development network on NRM" on 25th August 2006.
7. Mr. B.D. Suyal, IFS delivered a lecture to M.Sc. students of the FRI University on RTI Act on 25th September 2006.
8. Mr. Rakesh Taneja, Director, Ministry of Commerce delivered a talk to M.Sc. Environment Management and NRM students on 16th October 2006.
9. A Blood donation camp was organized by Indian Medical Association on 8th February 2007.

Ph.D. PROGRAMME

Research is an essential function of a National Institute like the Forest Research Institute 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 front 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 of the insitutes and established Research Centers, the research activities under Ph.D. Programmes 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 were awarded Ph.D. Degree.

Institute of Forest Genetics and Tree Breeding Coimbatore

The Institute of Forest Genetics and Tree Breeding (IFGTB) is a national Institute established in April 1988 under the Indian Council of Forestry Research and Education (ICFRE). It was formed by up-gradation of the erstwhile Forest Research Centre (FRC), Coimbatore under the Forest Research Institute and Colleges, existing since 15th December 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. The Institute conducts national level research on the subjects of Genetics and Tree Breeding of important forest species. In addition, it also attends to the local problems of the States of Tamil Nadu and Kerala and the Union Territories of Andaman and Nicobar Islands, Lakshadweep and Pondicherry.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: Estimation of gene diversity and enhancing seed production in seedling seed orchards of *Eucalyptus, Casuarina, Acacia* and Teak [IFGTB/RP-31/2003-2008]

Findings: The fertility was registered for each tree at the age of eight and nine years in seedling seed orchards of *Eucalyptus tereticornis* and *E. camaldulensis* established at two sites (one moist and one dry) in southern India. The effect of different treatments on tree growth and fertility was studied in one unpedigreed Seedling Seed Orchard (SSO) each of *E. camaldulensis* and *E. tereticornis* in an arid location (Pudukkottai) in southern India. Compared to untreated control, only hormone application showed significant increase in proportion of fertile trees in both species for four successive years. The number of fruits produced per tree also increased significantly with hormone application, though the difference was comparatively less in the fourth year.

Two seedling seed orchards each of *Casuarina equisetifolia* and *C. junghuhniana* established by thinning provenance trials in coastal (Pondicherry) and inland locations (Karunya and Panampally) in South India were evaluated for sex expression and fertility variation. Orchards established in coastal environment had less fertility variation and hence maintained higher diversity in both species. Coastal site had more trees contributing effectively to seed production than inland locations.

Fertility differences between clones were estimated in a 25 years old Clonal Seed Orchard (CSO) of teak at Walayar in Kerala State. There were great differences in fertility between two seedling seed orchards of *Acacia auriculiformis* established in two locations. Thus fertility variation is directly correlated with the location and the climatic conditions each year.

Project 2: Isolation of Somaclonal Variants of *Casuarina equisetifolia* for Salinity Tolerance [IFGTB/ RP-8/2002-2007]

Findings: Successful induction of callus and regeneration of shoots was achieved using juvenile cotyledon explants. The species was found to be recalcitrant to regeneration through tissue culture

evident by low shoot regeneration of the callus cultures. Biochemical studies indicated slight increase in the total proteins and proline and decrease in the total amino acids in callus tissues after 24 hours of salt stress. Screening of salt tolerant callus was done. The isolated tolerant callus could not regenerate into plantlets due to recalcitrant nature of callus for regeneration.

Project 3: Identification, isolation, evaluation and mass production of native fungi for the management of teak and *Casuarina* stem borers [IFGTB/ RP-21/2002-2007]

Findings: The seven potential isolates of entomopathogenic fungi selected out of fifteen were mass multiplied in media like vegetable waste, rice powder, coffee husk, and sorghum grain media to determine the suitable media for mass production. The fungus grew better on sorghum grain and on coffee husk.

Replicated field experiments at different locations were conducted at one year old teak plantation at Moondamuzhy, Kerala and at a private *Casuarina* plantation at Ulunthurpettai, Tamil Nadu to test the effectiveness of the seven potential isolates of entomopathogenic fungi on the pests *Sahydrassus malabaricus* and *Indarbela quardrinotata,* respectively. Three different concentrations were used in the experiments and effective concentration was determined for controlling the pests. Two commercially available entomopathogenic fungi products (*Beauveraia bassiana* and *Metarhizium anisopliae*) were tested against the targeted pests *Sahyadrassus malabaricus* and *Indarbela quadrinotata* (*Casuarina* stem borer) under lab conditions and it was found that both the products were not effective in controlling the pest S*. malabaricus* and less effective in the case of *I. quadrinotata as* compared to the native isolates.

Project 4: 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/RP-22/2002-2007]

Findings: *A. nilotica* leaves, flowers, fresh pods, seeds and twigs were extracted and their biopesticidal properties were tested and identified in terms of antifeedancy, ovicidal activity, pupal and larval mortality against teak defoliators. Results indicated the adverse effects of methanol and hexane extracts of *A. nilotica* flowers, pods and seeds on the tested insects, whereas these effects were not expressed by the extracts of twigs.

Individual secondary metabolites such as phenols, phenolics and polyphenols were also isolated and identified from different tissues of *A. nilotica*. The biological properties of these metabolites were evaluated on the teak defoliators, *H. puera* and *E. machaeralis*. Some of the bioactivities expressed by these metabolites include reduction in food consumption index, extended larval duration and high mortality.

Project 5: Testing and evaluation of selected existing control methods for key diseases of *Casuarina* spp. with reference to blister bark and root-rot [IFGTB/RP-24/2002-2007]

Findings: Application of fungicide solution (Bavistin/ Indofil M-45) to the trees of *Casuarina equisetifolia* and *C. junghuhniana* in the field trails was done at periodical intervals. Roots and rhizosphere soil samples collected from the trials were assessed for mycorrhizal colonization of both Ecto- (ECM) and Arbuscular (AM) mycorrhizal fungi. The samples exhibited higher percentage colonization of AM fungi as compared to ECM fungi. The AM fungal genera viz., *Acaulospora* and *Glomus* were found dominant in most of the soil samples analyzed.

Pure culture of the blister bark disease pathogen, *Trichosporium vesiculosum* was raised in the laboratory and subsequently artificially introduced in the soil at the root zone of the trees in the experimental trail site at Panampally, Kerala. After a period of inoculation, few trees of *C. equisetifolia* in various treatments expressed the symptom of blister bark disease. Maximum percent of infection of blister bark disease was recorded on T1 (control) plants and minimum percent infection was observed on T2 (Fungicide treatment). There was no infection/symptom of blister bark diseases in the trees treated with biofertilizers and biocontrol agents during the period of observation.

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Genetic improvement of *Eucalyptus tereticornis* through control hybridization and molecular characterization [IFGTB/RP-3/2002-2005] (Extended upto 2008)

Status: Controlled pollination was carried out in Helenvale, Garnet and Orobay provenances of *Eucalyptus tereticornis* with *E. alba, E. pellita, E. camaldulensis* and *E. globulus* as pollen. About twenty full sib family combinations were performed. Fruit and seed set have been recorded in all the said crosses.

Project 2: Enhancing productivity in *Casuarina* species through inter-provenance and inter-specific hybridization [IFGTB/RP-30/2003-2008]

Status: Pollination experiments were conducted between the two *Casuarina* species, *C. equisetifolia* and *C. junghuhniana,* forty full-sib families were harvested and characterised for morphological traits using image analyzer. Full-sib families were sown in the nursery along with orchard seeds of the two species as control. About 2500 seedlings have been produced and these plants will be tested in two locations to assess their growth performance. Seventy clones of the two species assembled from different locations were planted in a clone bank cum multiplication garden in the Forest Campus for future needs. Outstanding putative hybrid individuals identified in the progeny trial were felled for coppicing.

Control pollinated fruits maturing in a potted *Casuarina equisetifolia* plant.

Project 3: Status and floristic diversity of sacred groves- The only remnants of natural forests in Alappuzha District, Kerala [IFGTB/ RP-35/2005-2008]

Status: Alappuzha is the only district in Kerala State without natural forests. The sacred groves of the district attract utmost attention as they are the only remnants of natural forests once present**.** Visited Cherthala, Ambalappuzha, Karthikappally, Mavelikkara, Chengannur and Kuttanad Taluks in Alappuzha district and enumerated 1127 sacred groves, covering 91 villages and detailed floristic studies were undertaken in selected and permitted groves.

Project 4: Genetic improvement of *Acacia auriculiformis* through half-sib progeny selection [IFGTB/RP-39/2005-2010]

Status: A nursery of half-sib progenies of single tree collections of 133 superior trees selected in first generation orchards based on stem form, branching habit and growth was raised and evaluated for seedling growth. Two progeny trials of these selected trees, one at Panampally and another at Pondicherry were raised.

Two months old progeny trial of
A. auriculiformis at Panampally (Kerala)

Project 5: Phenotypic selection, reproduction and propagation in *Ailanthus excelsa*: Perspectives for safety matches industry and farmers in Tamil Nadu [IFGTB/RP- 40/2005-2009]

Status: Standardization of vegetative propagation was made and considerable seasonal effect was observed. Over 2000 seedlings have been raised with seeds collected from four different locations of the country for establishing the germplasm bank in Tamil Nadu. Seeds are being collected from the identified phenotypically superior trees in different agroclimatic zones of Tamil Nadu. Highly damaging plant parasite *Helicanthes elastica* (Desr.) Dans. has been identified in *Ailanthus* plantation in southern part of Tamil Nadu.

Project 6: Genetic transformation of *Eucalyptus* and *Casuarina* to enhance salinity tolerance [IFGTB/ PBT/ RP- 6/2002-2005] (extended upto March 2008)

Status: Parameters determining efficient co-cultivation conditions in *Eucalyptus* were assessed. *Agrobacterium* concentration standardised for the survival of co-cultivated explants when compared to *Agrobacterium* concentration at 297,600 CFU/ml. Sonication conditions were optimized. A few regenerants from co-cultivated explants have been obtained in kanamycin selection medium for Osmotin and AtNHX gene constructs. Experiments conducted to study *in vitro* regeneration responses, needle explants from mature trees of *Allocasuarina huegeliana* and *A. littoralis* showed better callusing frequency than the needles of *Casuarina glauca and C. junghuhniana.*

Project 7: Studies on the population structure and reproduction of *Pterocarpus marsupium* in Tamil Nadu and Kerala [IFGTB/RP-37/2005-2008]

Status: Based on reconnaissance survey, populations of *Pterocarpus marsupium* for long term phenological and reproductive studies were identified. From the identified populations, 28 individual trees have been marked for periodical phenological observations. As per the forest map of South India

prepared by the French Institute of Pondicherry, *Anogeissus latifolia, Pterocarpus marsupium* and *Terminalia* species in the forest type (>600 m above MSL) dry deciduous forests was identified and on the basis of physical barriers separating the distribution of *P. marsupium,* 19 distinct populations on the western aspect of Western Ghats in Tamil Nadu and Kerala have been short listed for further studies.

Project 8: Evolving silvicultural practices for *Casuarina junghuhniana* ssp. *timorensis* [IFGTB/RP-33/2005-2009]

Status: Seed parameters of *Casuarina junghuhniana* ssp. *timorensis* seeds from identified trees at Panampally, Sadivayal and Puducherry were recorded. Nursery trials to study effect of various potting media and container types and sizes on seedling growth performance of *C. junghuhniana* were carried out. Field evaluation trials to understand the silvicultural requirements of the species were established at 2 locations in Puducherry (Forest department land and in a farmers land) and at a location each in Veeravanallur, Kayalpattinam and Vedaranyam. Trial at sites located both at the coast and inland conditions as well as at different latitudes were carried out to understand the silvicultural requirement of the species.

Project 9: 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 genes conferring salt tolerance was carried out for potassium transporters, sodium transporters, calcium transporters, proton transporters and transcription factors. Conserved sequences and primers sets were deduced for the above genes using ClustalW and PriFi software. A prototype database named “TIGBAST” (The *In Silico* Gene Bank for Abiotic Stress Tolerance), which is now able to retrieve information for Sodium antiporter genes, has been developed using the WAMP environment.

Project 10: Studies on seed handling and storage behaviour of important NTFP species [IFGTB/RP-34/2005-2008]

Status: Studies indicated that yellow-green stage of fruit maturity after removing the testa, favoured germination without any pretreatment requirement for *Calophyllum inophyllum*. Mature seeds were found sensitive to moisture reduction. Storing seeds at specific temperature for one month proved promising for prolonging storage in comparison with ambient storage. Seed storage and biochemical basis of *Calophyllum* seed deterioration were studied.

Germination on paper medium or by roll towel method was found suitable indicating the need for ventilation. The sprouted seeds were transplanted to root trainers and found to establish well.

Seed extraction and drying methods were standardized for mature fruits of *Garcinia gummigutta*. Seeds stored at different temperatures were tested for germination and analyzed for biochemical parameters at different storage intervals.

Standardised seeds extraction and processing method for *Sapindus emarginatus*.

Project 11: Natural regeneration studies on important trees in Silent Valley National Park, Kerala [IFGTB/RP-32/2004-2009]

Status: In Silent Valley National Park, the regeneration status of important trees has been studied and the species have been enumerated to assess the natural regeneration status. Laying out of sample

plots and regeneration studies in Poochapara area is in progress.

Project 12: Studies on the diversity of bee fauna of the Nilgiris [IFGTB/RP-36/2005 2008]

Status: Survey was conducted in 9 forest types and in 4 plantations sites in the study areas in Nilgiris. The association of bee species, *Apis cerana, A. indica* and *Trigona* sp. on flowers of *Bidens biternata*, was observed. The carpenter bee, *Xylocopa* sp. was also found to visit the flowers of *Grewia* sp., for pollen.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Assessment on carbon pool potential of important tree species at different ages, sites and management regimes [IFGTB/RP- 41/2006-2011]

Status: Identified 70 plantations of *Casuarina*, *Eucalyptus* and Teak for carbon sequestration studies and growth parameters were made in selected plantations. Soil samples from these selected plantations were analyzed mainly for carbon and other major nutrients.

Project 2: Assessment of insect pest problems of selected fast growing indigenous tree species in Tamil Nadu and Kerala [IFGTB/RP- 42/2006-2009]

Status: Pest surveys at nurseries, plantations and in natural forest eco-system were carried out in Tamil Nadu and Kerala.

Insect pest species damaging *Dalbergia sissoo*, *Ailanthus excelsa*, *Gmelina arborea*, *Melia dubi*, *Bombax cieba* and *Morus alba* were collected and identified. Necessary data on intensity of attack of the pest, nature of damage caused and abiotic factors was also collected and documented.

Project 3: Origin, distribution and genetic diversity of *Jatropha curcas* in India [IFGTB/RP- 43/2006-2009]

Status: Local provenances were surveyed in Tamil Nadu and identified for assemblage for isozyme studies. Standardised extraction procedures for isozymes and staining procedures for eight isozymes. Seeds and vegetative material were collected from Kerala and maintained in the nursery. Vegetative material obtained from TFRI, Jabalpur and IWST, Bangalore was rooted in the nursery for isozyme studies. Six populations each comprising 30 individuals from the state of Tamil Nadu and two populations from the state of Kerala have been screened for the genetic diversity.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

(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*

Findings: Five seedling seed orchards of *Eucalyptus* and four orchards of *Casuarina* established

according to breeding programmes in South India were investigated for breeding efficiency and genetic gain before resorting to large-scale seed supply. In *Eucalyptus*, two unpedigreed seedling seed orchards each of *Eucalyptus camaldulensis* and *E. tereticornis* and a provenance - progeny trial of *E. tereticornis* established in different locations in South India were studied for tree growth and seed orchard functions at age four.

Two provenance trials each of *Casuarina equisetifolia* and *Casuarina junghuhniana* were converted to seedling seed orchards after early evaluation and thinning to remove inferior provenances and trees within provenances were included in the study. One of the provenance trials of *C. equisetifolia* located at Sadivayal in Tamil Nadu was established to maintain pedigree information, as provenance progeny trial.

Two genetic gain trials were established for each genus in different locations to test the performance of seeds collected from the seedling seed orchards. A commercially planted *Eucalyptus* clone was also used as a control in one site. The trials were evaluated for first year growth. Survival of this seedlot was also low in both test sites.

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-RP-6/2003-2006]

Findings: Studies aimed at monitoring variation in fertility among trees and clones for different forest species viz. teak, sandal, neem and tamarind situated in Southern India were observed for fertility variations. Fertility variation was generally higher in a natural stand compared to the Seed Production Areas (SPA) in teak even though majority of the trees were fertile in two adjacent years. In teak SPAs there was a positive year to year correlation in fertility parameters like proportion of fertile trees, flowers and fruits produced per tree. The female fertility variation and the fruit set percentage in two successive years were negatively correlated implying that there is a tendency for alternate bearing in the trees in a population.

Selection for tree DBH was observed to reduce the fertility variation as DBH was positively correlated to reproductive output in teak. Fertility variation was found to be low in ten years old Sandal plantations compared to those of Neem and Tamarind.

Project 3: Evaluation of reproductive success in seed orchards of teak in India (Funding Agency: International Foundation for Science, Sweden) [IFGTB/EF-RP-8/2003-2006]

Findings: Fertility variation was studied in two 30 years old Clonal Seed Orchards (CSO) of teak in four consecutive years (2003-2006). CSO I is located in Topslip (Tamil Nadu State) with 15 clones and CSO II in Walayar (Kerala State) with 20 clones. Thirteen clones are common to both the orchards. Flowering was low in all years in both the orchards. Clones differed significantly in reproductive output, a few contributing a major share of flowers and fruits while some did not flower in all four years. Broad sense heritability was moderate for flower and fruit production per tree. A strong positive correlation was found between flower and fruit production assessed in successive years. Diameter showed positive correlation with reproductive traits but clear bole height and height to clear bole ratio were negatively correlated with flowering and fruiting. Fertility variation and group coancestry were higher in poor flowering years than good years as indicated by sibling coefficient values. Between the two orchards CSO II showed about 3 times more fertility variation and group coancestry than CSO I in poor flowering years.

X-radiograph of teak fruit shows variation in seed filling (number of filled seeds in each fruit is given)

Insects visiting teak inflorescence were studied in two clonal seed orchards of teak. Bees, flies and wasps were among the most frequently observed insects in teak Pollen load and a visitation rate of each species differed significantly. Honeybees were found to be the key pollinators of teak. Nectarivorous birds like sunbirds were also found to effect pollination in one of the orchards. Fruit dimensions and weight correlated positively with seed filling. But germination and seed filling were not strongly correlated. Germination of Walayar orchard seeds was poor compared to Nilambur SPA which showed significant germination. These findings indicate that reproductive success in teak seed orchards is limited by several factors. Genetic and silvicultural interventions are essential to promote flowering and fruiting in teak orchards.

Project 4: Full sib production in selected high yielding tamarind clones of Tamil Nadu (Funding Agency: Tamil Nadu Forest Department) [IFGTB/ EF-RP-14/2003-2006]

Findings: Tamil Nadu Forest Department addressed a specific need of control pollinating red and other high yielding tamarind varieties for full sib production. Accordingly full sib families were produced by control pollinating red tamarind clones TNRJ-402, TNRJ-403 and TNRN-401 as pollen parents with other high yielding clones. About six full sib families have been transferred to a field trial in State Forest Research Institute, Kolapakkam. About 40 families have been developed as a trial in Forest Campus, Coimbatore for further experimentation.

Project 5: Characterization of tropical and temperate forest seeds with reference to seed storage behavior (Funding Agency: SIDA, Sweden) [IFGTB/ EF-RP-10/2003-2006]

Findings: Seed storage behaviour of *Azadirachta indica, Persea macrantha, Bambusa arundinacea, Artocarpus heterophyllus, Myristica dactyloides, Strychnos nux-vomica, Vateria indica, Hopea parviflora, Embelia ribes, Garcinea gumigutta, Myristica fragrance, Pithcellobium dulce, Hydnocarpus alpine* and *Smilax zeylanica* was studied. The germination and storage methods were developed for these species. The seeds were characterized for physical and biochemical traits. The relationship between the seed characters and the ecological characters was studied.

Project 6: Evaluation of superior planting stock of *Acacia mangium* in agroforestry systems at different eco-climatic zones of Kerala and Tamil Nadu [IFGTB/EF-RP11/2003-2006]

Findings: Experimental plots of 2 ha in Tamil Nadu and 2 acres in Kerala have been laid out with seedlings raised using the seeds collected from identified superior trees of *Acacia mangium* (Mangium) in Panampalli, Kerala as well as from Theni, Tamil Nadu along with ramets of superior trees of Mangium were procured from Mysore Paper Mills. Growth data was recorded during the first year. Studies on intercropping of fodder sorghum under one-year-old Mangium based agroforestry system revealed

that on per plant basis there was no difference in height growth as well as dry matter production of fodder sorghum under open field and under mangium based agroforestry system. However, yield of fodder sorghum was slightly higher under open field than under mangium owing to the difference in the total number of plants under open and mangium plot. Among different agricultural crops intercropped with mangium, blackgram, horsegram, fodder sorghum and beans were found to be compatible and onion was observed to be less compatible. Since the biomass and productivity studies of the tree component and economics of cultivation can be estimated only at half the rotation of *Acacia mangium*, i.e., 3 years; extension has been sought from the funding agency.

Project 7: Establishment of agroforestry plantations with medicinal plants and trees for conservation, propagation and utilization [IFGTB/EF-RP-16/2003-2006]

Findings: Established about 4 ha of amla based agroforestry models in 10 farmers' fields with medicinal plants (*Withania somnifera*) and other agricultural crops like red gram, black gram, horse gram, tomato etc. In the amla based agroforestry models, economics of cultivation for various agricultural crops has been worked out and black gram model gives higher economic return to the farmers.

Withania was intercropped under different agroforestry systems and the results showed amla-based agroforestry system registered maximum tuber yield. Effect of different spacing of *Withania* was assessed and the results showed variation in tuber yield under different spacing. 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.

Enhanced intercropping opportunity through canopy management under five years old neem based agroforestry system

Also, established 2 ha of pungam and neem based agroforestry plots with quality planting material of identified superior parent trees. The effect of pruning on agricultural crop yield under neem based agroforestry has been carried out in five year old neem plot which showed that 100 per cent pruning increased the annual crop yield by 40% compared to shade.

Project 8: 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]

Findings: Identified and standardized integrated pest management measures to develop management package for forest nursery insect pests of some economically important tree species.

First report in India about the incidence of an invasive insect pest *Leptocybe invasa* Fisher and La Salle (Hymenoptera: Eulophidae) in *Eucalyptus* plantations and nurseries in southern India was made besides assessing the nature and extent of damage in *Eucalyptus* clones in plantations.

Project 9: Exploitation of Mycorrhizal systems in the Nilgiri biosphere reserve areas in India [IFGT/EF-RP-15/2004-2007]

Findings: Different ECM and AM fungi collected from different forest ecosystems were identified to genus and species level. Species richness and species dominance of AM fungi in association with the rhizosphere of different host plants was also assessed and recorded. Mass production of different ECM fungi was done for screening experiments in glass house and nursery.

Mass culturing of dominant AM fungi with different host cover crops like Bajra, Maize, Ragi, Sorghum, Wheat and other leguminous plants in a glass house condition revealed that Maize was the most suitable host cover crop.

Screened the efficacy of both ECM and AM fungi on growth enhancement of shola and commercially important plantation species such as *Acacia mearnsii, A. melanoxylon, Eucalyptus globulus, E. grandis, E. tereticornis, Cupressus macrocarpa*,*Casuarina equisetifolia* and *C. junghuhniana* in nursery condition and the experiment revealed that the seedlings inoculated with mycorrhizal fungi had better growth performance over control.

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Germplasm collection and production of improved planting stocks of *Terminalia chebula* Retz and *Terminalia bellerica* [IFGTB/EF-RP-25/2005-2008]

Status: Vegetative propagation in *Terminalia chebula* and *T. bellerica* was attempted through rooting of branch cuttings, *in situ* air layering, grafting (wedge grafting) and budding. Seedlings of both the species were raised in nursery and used as root stock for grafting. Effect of biofertilizers on seedling growth in nursery has been studied. Selection criteria for plus tree selection for fruit yields and quality have been standardized. Methods for estimation of medicinally active major biochemical compounds have been standardized.

Wedge grafted plants of *Terminalia bellerica*

Project 2: Reproduction and Population Structure in *Bruguiera* and *Ceriops*: Implication on Conservation [IFGTB/EF-RP-26/2005-2008]

Status: Studies on reproductive aspects have been initiated in two sites namely Pitchavaram and Rameswaram in Tamil Nadu.

Project 3: Genome evaluation and characterization in *Casuarinas* and *Eucalyptus* for improving productivity and conservation [BT/PR2981/Agr/ 16/223/2002; DBT funded/ 2003 2007]

Status: The project is aimed at developing specific markers for species and traits in *Eucalyptus* and *Casuarina*. Developed three species specific SCAR markers in *C. equisetifolia* and *C. junghuhniana*. In

E. tereticornis, the putative non adventitious root specific SSR marker was validated in provenances and its high correlation with non-rooting trait was ascertained. Further, allelic diversity of CCR gene (involved in the lignin biosynthetic pathway) was determined in the populations of *E. tereticornis* to identify high cellulose specific markers.

Project 4: Identification of broad spectrum antifungal proteins from elite medicinal plants for control of plant pathogens [BT/PR/3444/AGR/16/ 282/2002; DBT funded/ 2003 2007]

Status: An antifungal peroxidase was purified from leaf tissues of *Withania somnifera* by gel filtration, ion exchange and lectin affinity chromatography. The purified protein inhibited the hyphal extension of *Trichosporium vesiculosum*. The effect of the protein on hyphal cell wall was elucidated in SEM studies.

Project 5: Refinement of *in vitro* multiplication protocol for *Bambusa nutans* and *Dendrocalamus giganteus* [IFGTB/EF-RP-17/2004-2007]

Status: Multishoot cultures for two clones of *D. giganteus* and two clones of *Bambusa* nutans were established and high frequency continuous shoot multiplication through axillary bud proliferation was obtained. *In vitro* rooting procedures were refined to obtain high percentage of rooting and acclimatization in *B. nutans*. Indirect organogenesis was obtained in *D. giganteus* for continuous shoot production. Biochemcical studies to identify the cause of shoot necrosis were conducted.

Project 6: Field Performance of Micro and Macro-Propagated planting stock of selected five commercially important Bamboo Species [IFGTB/EF-RP 18/2004-2007]

Status: Field demonstration trials were established in an area of 4.0 ha using micropropagated and conventionally raised plants of three species namely *D. strictus, D. stocksii* and *B. bambos.* The survival rates were observed. Two years old tissue culture raised plants were tested for shoot production and growth rates.

Project 7: 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: Rooting of branch cuttings of *Tinospora cordifolia* was carried out. Phytochemical analysis of the genotype from forest campus completed. Identification of alkaloids, flavanoids and saponins completed. Identification of carbohydrates, proteins, phenols, steroids and tannins etc. was completed. Rooting trials of *Terminallia bellerica* were carried out.

Project 8: Germplasm conservation and establishment of seed stands for production of quality seeds and seedlings [IFGTB/EF-RP-9/2003-2007]

Status: The accessions of 10 medicinal plants assembled and seed stand established under the project are being maintained in the nursery.

Estimation of active principles in *Gymnema sylvestre*, the biochemical screening of secondary metabolites from the gene bank was investigated. The main component in the accessions namely gymnemic acid content was estimated. Significant variations were observed.

Project 9: 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: To stabilize the vulnerable coastline and to provide employment opportunities to the Tsunami victims and the villagers, the Department of Biotechnology sponsored the project with a target of planting 60 ha area with *Casuarina equisetifolia* in Andaman Group of Islands. The research input is provided in the establishment of nurseries and for the improvement of *Casuarina* seedlings. This year 24.7 ha area is planted in different islands of North Andaman, Middle Andaman and South Andaman. In total so far 31.2 ha has been covered under *Casuarina* plantation. Training imparted to the staff of Forest Department of Andaman Nicobar Islands for production of improved seedlings of *Casuarina*. Employment was generated through various activities.

Casuarina Plantations along the coast at Casuarina Bay (North Andaman)

Plantation near the residential area on the coast at Long Island (Middle Andaman)

Embankment Plantation at Sippighat (South Andaman)

Disbursing wages to the beneficiaries at Casuarina Bay (North Andaman)

Project 10: Establishment of bamboo model plantation in different agro climatic regions of Tamil Nadu using quality planting stock (Funding Agency: Department of Biotechnology, Government of India) [IFGTB/EF-RP- 21/2005-2008]

Status: Quality planting stock in the form of seedlings, macro propagated and tissue culture raised plants of 7 bamboo species viz., *Bambusa balcooa, B. vulgaris, B. bambos, B. nutans, B. tulda,*

Dendrocalamus strictus and *D. stocksii* are maintained from various sources. Land offered by farmers for raising of bamboo plantations based on advertisement in local dailies was undertaken for 20 ha in four districts of Tamil Nadu namely Coimbatore, Karur, Cuddalore and Salem apart from the land offered by the Forest Department in Puducherry. After completing field preparatory works including application of farmyard manure and vermicompost, etc., planting was carried out. Tenders have been floated for supply of TC plants for all seven bamboo species and seedlings of *Bambusa bambos* and *Dendrocalamus strictus* are being raised for 2007-2008 planting.

Project 11: Development of yield assessment methods for *Eucalyptus* species and *Anacardium occidentale* using Image analyzer (Funding agency: Tamil Nadu Forest Plantation Corporation-TAFCORN) [IFGTB/EF-RP- 22/2005-2007]

Status: Digital camera was used to estimate basal area of *Eucalyptus* pulpwood plantations. Image of the plantations were taken with flash after sunset. The image profiles were analyzed for RGB values at breast height. The relationship between the light reflectance and the ground distance was analysed. The light reflectance spectrum was analysed as peak values and curve structure. Preliminary studies showed that the basal area could be estimated with an average of 5% deviation from the actual basal area.

Image of *Eucalyptus* plantation taken using SLR digital camera for estimation of basal area measurement

Project 12: 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: Multilocational trials involving 8 species of bamboos viz., *Bambusa bambos, B. balcooa, B. nutans, B. tulda, B. vulgaris, Dendrocalamus asper, D. hamiltonii* and *Guadua angustifoli*a, and trials on micro and macro propagated plants, on nutrient management and on organic v/s inorganic farming methods were carried out. The survival rate and the growth performance of different bamboo species at 3 months and 6 months after planting was collected and documented.

Project 13: Development of post harvest techniques for seed production in *Jatropha curcas* [IFGTB/EF-RP24/2005-2008]

Status: Flowering and fruiting phenology studies indicated that *Jatropha curcas* has high reproductive efficiency with reference to the selected locality, Anaikatti. Fruits at yellow stage gave significant germination indicating the attainment of physiological maturity. Studies on effect of fruit colour (maturity) oil content and quality showed that the colour of the fruits processed for oil extraction had

considerable effect on oil characteristics. The results indicate that fruits need to be harvested at yellow stage or when turning black and is safer to avoid collecting fruits at dry stage. Studies on effect of drying method on *Jatropha* oil showed that sun drying proved best for oil recovery and black pulpy fruits responded well for this method of drying. Both Iodine No. and Peroxide value were significantly high in oven drying method indicating detrimental effect on oil and tendency towards rapid rancidification. It is safer to adopt sun and shade drying methods where the oil characteristics are not affected by drying methods. To understand the efficacy of seed coat removal the oil content in shell, kernel and seed as a whole were determined. Studies revealed that shell has very negligible quantity of oil and it is the kernel that contributes the maximum oil content.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Differential analysis of transcript expression in *Casuarina: Trichosporium* interaction to isolate defense related genes (Funding Agency: DBT/2006-2009) [BT/PR/5943/AGR/16/531/2005]

Status: Differential display of mRNA was conducted on pathogen elicitor treated and untreated calli of C. *equisetifolia* to identify transcripts specifically expressed during pathogenesis. Sequencing of specific fragments showed the expression of transcripts like Resistance (R) gene, Phenylalanine Ammonia Lyase (PAL) and arabinogalactan protein genes during pathogenesis.

Project 2: Infrastructure development of the Botanical Garden of the Institute of Forest Genetics and Tree Breeding and *ex*-situ conservation of selected Rare and Threatened species (Funding Agency: MoEF 2007)

Status: Infrastructure development activities are being initiated and 20 individuals of endemic and threatened species, *Phyllanthus narayanaswami* were collected from Ananthagiri Range of Visakhapatnam district and planted in botanical garden for the study of its performance.

Project 3: Bioproduction of secondary metabolites from *Aegle marmelos* (Funding Agency: NMPB) [2006-2009]

Status: Studies on callus induction from various explants were initiated. In the process, different explants of juvenile tissues namely leaf, hypocotyls, root, shoot were tested for callus induction. The explants were inoculated in media containing varying concentrations of different plant growth regulators. Mature leaf tissue collected from standing trees were also tried for callus induction. For qualitative and quantitative assessment of the biomolecules, preliminary screening of alkaloids, flavanoids, anthraquinones, tannins and phenolics were carried out in the leaf and root tissues.

Project 4: Establishment of seed production systems for NTFPs of Attapady Hills (Funding Agency: AHADS) [2006-2008]

Status: Discussions were held with the officials of AHADS regarding the land for planting and for establishment of the SPS. Seeds of *Caesalpinia sappan, Oroxylum indicum* and *Saraca asoca* were collected from Kerala and germination studies are in progress.

Project 5: Developing strategies for describing, testing and registering varieties of

forest tree species in India (Funding Agency: Protection of Plant Varieties and Farmers' Rights Authority) [2006-2008]

Status: Selected trial plots of *Eucalyptus camaldulensis, E. tereticornis, Casuarina equisetifolia* and *C. junghuhniana* were visited in the State of Tamil Nadu. Probable characters which can be used as descriptors for these species were identified. These characters include both vegetative and reproductive characters. The Leica QWin Version 1.0 software for Image analysis was upgraded into Lecia QWin Version 3.0 for handling images up to 12 mega pixel size and to measure morphological traits and to digitally store the phenotypes for later reference.

Abstract: No. of Projects

	No. of projects completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	5	12	3
External Projects	9	13	5
Total	**14**	**35**	**8**

EDUCATION AND TRAINING

Training Organized

1. Dr. B. Nagarajan and A. Nicodemus provided training on tree improvement to field staff of Tamil Nadu Forest Department on 8th and 9th January 2007.
2. Conducted five awareness programmes for farmers on 'Cultivation of medicinal plants under farm land conditions' in various villages in Theni district of Tamil Nadu state. About 200 farmers participated in the awareness programme and various resource persons from IFGTB delivered

Awareness programme to farmers and women self help groups on 'Importance of medicinal plants cultivation' under NMPB funded project

lectures on their respective fields related to medicinal plants cultivation under the National Medicinal Plants Board funded project.

3. Shri S. Saravanan, Scientist C delivered lecture on Tree Crop Interactions and Promising Agroforestry Models for Higher Returns Under Farmland, in the training programme organized for farmers from Pondicherry on 12th and 13th November 2006 at IFGTB.
4. Dr. C. Buvaneswaran, Scientist C delivered lecture on 'Agroforestry practices in coastal areas' on 24th November 2006 during the training to farmers organized by Pondicherry Forest Department in Pondicherry.
5. Dr. C. Buvaneswaran, Scientist C delivered lecture on "Agroforestry Systems for Sustainability" in the training programme on 'Tree Improvement and Productivity Enhancement' organized for officials of Tamil Nadu State Forest Department at IFGTB from 8th to 12th January 2007.
6. Shri M. Maria Dominic Savio, Scientist C conducted training programme on "Nursery Management" for the frontline staff of the Department of Environment and Forest, Andaman and Nicobar Islands at Long Island, Mayabunder, Diglipur and Hut Bay during April 2006.
7. Practical demonstration on "Nursery techniques and vegetative propagation" was organized for the Forest Ranger trainees of Tamil Nadu Forest Academy, Coimbatore during May 2006.
8. A training programme on "Nursery and plantation techniques for forest trees" was organized on 5th June 2006 as part of World Environment Day celebrations for the farmers from in and around Coimbatore in which 35 farmers participated.
9. A two day training programme on "Improved nursery practices and plant protection measures "was organized on 15th and 16th June 2006 for the officials of Andhra Pradesh Forest Department.
10. Nursery activities including vegetative propagation techniques was explained to the IFS probationers of 2005-2007 batch during their visit to IFGTB, Coimbatore during September 2006.
11. Shri M. Maria Dominic Savio, Scientist-C delivered a lecture on "Improved nursery techniques" to the staff of Puducherry Forest Department at Coimbatore on 13th November, 2006. Shri C.K. Jayachandran RA Gr. I (SG) and Shri G. Ponraj, Gr. I (SG) gave practical demonstration on nursery techniques and vegetative propagation the staff of Puducherry Forest Department at Coimbatore on 14th November 2006.
12. Shri M. Maria Dominic Savio, Scientist-C delivered a lecture on "Improved nursery techniques" to the farmers of Puducherry at Puducherry on 22nd November 2006.
13. Shri M. Maria Dominic Savio, Scientist-C delivered a lecture on "Selection of non mangrove species for bioshield programme" to the elected representatives of Panchayats of Nagapattinam and Karaikal on 28th November 2006 at Karaikal in a training programme organized by the M.S. Swaminathan Research Foundation, Chennai.
14. Shri K. Ravichandran, Assistant Silviculturist (General) gave a lecture on "Plantation Management" to the Forest Rangers of Tamil Nadu Forest Department, in the training programme on Tree Improvement and Productivity enhancement held from 8th to 12th January 2007.
15. Dr. C. Kunhikannan, Scientist-D delivered a lecture on `Biodiversity of rain forest with special reference to Silent valley National Park" in Refresher course for Forest officials at State Forest Service College, Coimbatore on 11th July 2006.
16. Dr. B. Gurudev Singh, Scientist-E and Smt. R. Anandalakshmi, Scientist-C served as resource persons in the two day training programme at the farmers of Pondicherry held at IFGTB on 1st and 2nd August 2006 and presented the papers on Production of quality seeds and Seed collection, processing and storage of selected agroforestry species respectively.

17. Dr. B. Gurudev Singh was invited by TERI, New Delhi as resource person for training on "Neem selection, seed handling and propagation"on 5th and 6th July 2006.
18. Shri N.P. Mahadevan, Research Officer delivered a lecture on Seed collection, processing, germination and storage of selected medicinal species at the Office of the Conservator of Forests, Genetics Division, Tamil Nadu Forest Department, Bharathi Park Road, Coimbatore 641 043 on 6th February 2007 in the Medicinal Plants and Tree Growers' Meeting.
19. The Institute arranged the following training programmes for 6 college students from Tamil Nadu and Kerala states:

"Phytochemical aspects and instrumentation methods" during May and June 2006.

- "Age correlated bioactivity of yellow oleander *Thevetia perviana* yellow oleander" August to
- November 2006.
  "Chemical profiles of *Cassia auriculata*: bioefficacy against pest and diseases" December to
- March 2007.
  "Antogonistic Activity of seeds of *Pongamia pinnata, Ricinus communis, Datura alba* and
- their fatty acids" December to March 2007
  "Essential oil of *Coleus forskohlii* roots: sentinels of plant defense" January to March 2007.
- Analyzing the selected textile fibers for their chemical constituents and microscopical
- appearance from 23rd to 30th March 2006.

20. Conducted Project Trainings for 5 college students from Tamil Nadu on "Mycorrhizal Biofertilizers Techniques i.e. Isolation, Identification, Multiplication and Application".

Training received

1. Dr. A. Balu, Scientist-E attended a training on Negotiating Strategies in Work Environment for Scientist organized by the Administrative Staff College of India (ASCI), Hyderabad, A. P., from 23rd October to 3rd November 2006.
2. Dr. V. Mohan, Scientist E attended training on "Intellectual Property Rights and World Trade Organization Related Issues" organized by the Administrative Staff College of India (ASCI), Hyderabad, A. P., from 30th October to 3rd November 2006.
3. Dr. A. Karthikeyan, Scientist C attended a training on Molecular Taxonomy of Fungi at Thapar University, Patiala, Punjab during 19th to 24th March 2007.
4. Dr. B. Gurudev Singh participated in the programme on "Negotiating Strategies in Work Environment for Scientists", sponsored by DST, Govt. of India at ASCI, Hyderabad, from 23rd October to 3rd November 2006.
5. Smt. R. Anandalakshmi, Scientist C participated and presented a note on "Quality seed production for oil yield in *Jatropha curcas*" in the experts group discussion on Non-edible grade vegetable oils as a source of decentralized power production conducted by the Ministry of Non-Conventional Energy Sources at Rajaji Bhavan, Chennai on 24th April 2006.

PUBLICATION

Books

Sivakumar, V. B., Gurudev Singh, R. Anandalakshmi and K. Vanangamudi (2006): Seed pelleting for aerial seeding. In: K. Vanangamudi, N. Natarajan, A. Bharathi, R. Umarani, K. Natarajan and T. Saravanan (eds.). Advances in Seed Science and Technology, Vol.1. Recent Trends in Seed Technology and Management, Agrobios (India), Jodhpur, pp.241-245.

News Articles

1. Nicodemus, A. 2006. High yielding and drought tolerant casuarina. Science and Technology Supplement, *The Hindu* dated 31st August 2006.

2. Cost effective way to tackle mine spoils' published in Indian Express (Coimbatore Ed.) dated 16th December 2006.

CONSULTANCIES

1. Dr. C. Kunhikannan rendered his services as a team member for preparation of Catchment Area Treatment Plan for proposed bauxite mining areas in Arakku valley (Chitamgondi, Galikonda and Raktakonda) Vishakhapatnam district, Andhra Pradesh for APMDC under ICFRE consultancy.
2. Dr. C. Kunhikannan rendered his services as a team member for conducting Environmental Impact Assessment (EIA) of proposed bauxite mining areas in Arakku valley (Chitamgondi, Galikonda and Raktakonda), Vishakhapatnam district, Andhra Pradesh for APMDC under ICFRE consultancy.

3. Consultancy services were rendered to the MoEF to carry out mid term evaluation of the centrally sponsored scheme “National Afforestation Programme (NAP)” being implemented under the decentralized system of Forest Development Agency in Tamil Nadu and Kerala.

PATENTS

Patent titled “A process for *in vitro* plantlet production of the bamboo, *Oxytenanthera stocksii*” with the financial assistance from National Research Development Corporation, New Delhi was granted to the Institute of Forest Genetics and Tree Breeding, Coimbatore on 31st August 2006 for a term of 20 years.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Participation

National

1. Dr. A. Nicodemus participated in the Interactive Seminar on Technology Improvement on 12th and 13th December 2006 held at Biotechnology Research Centre, Tirupati (AP).
2. Dr. B. Nagarajan and Dr. V. Sivakumar participated in the Interactive Seminar on Technology Improvement on 21st and 22nd December 2006 held at Regional Forest Research Centre, Rajahmundry (AP).
3. Dr. B. Nagarajan, Dr. A. Nicodemus and Shri D.R.S. Sekar participated in the Seminar on ”Increasing Forest Productivity: Genetic and Breeding Options” from 21st to 23rd February 2007 held at TFRI, Jabalpur.
4. Dr. A. Nicodemus, V. Sivakumar, M.T. Hegde, Kannan C.S. Warrier and A. Mayavel participated in the National level consultative meeting on DUS testing of forest trees on 27th and 28th February 2007 held at Tamil Nadu Agricultural University, Coimbatore.
5. Dr. N.V. Mathish and Dr. Modhumita Dasgupta attended “Safety Assessment and Regulations of GM Crops with a special focus on Cartagena Protocol on Biosafety" held on 2nd and 3rd August

2006 at TNAU, Coimbatore.

6. Dr. Modhumita Dasgupta attended "Safety Assessment and Regulations of GM Crops" held on 27th March 2007 at TNAU, Coimbatore.

7. Dr. N.V. Mathish and Dr. Modhumita Dasgupta attended National Seminar on "Patenting in Biotechnology" organized by Department of Biotechnology and NRDC, New Delhi on 26th October 2006 at Hyderabad.

8. Dr. Rekha R. Warrier participated as a resource person and delivered a lecture in the Indo-Korean Joint Seminar on "Secondary Metabolites Sources and Production Process" by Dept. of Biochem. and Biotechnology, Avinashilingam University and Department of Oriental Medicinal Material and Process, Kyunghee University, South Korea organized at the Avinashilingam University Coimbatore on 14th February 2007.

9. Dr. Rekha R. Warrier attended a conference on " Nutraceuticals and the Future of Medical Science" organized by Dept. of Biochemistry, Kongunadu Arts and Science College, Indian Pharmacological Society of Biological Chemist, Nutrition Society of India at Kongunadu Arts and Science College, Coimbatore on 22nd and 23rd February 2007.

10. Dr. Modhumita Dasgupta delivered lecture on "Biotechnological tools for identification of desired traits for commercial application and genetic improvement" in compulsory training course for IFS officer on "Biotechnology for Forest Conservation" held at IWST, Bangalore from 15th to 19th January 2007.

11. S. Saravanan, Scientist 'C' participated and presented a paper on 'Economic Evaluation of Teak and Casuarina based agroforestry systems in western agro-climatic zone of Tamil Nadu' in the National symposium on 'Agroforestry for livelihood security, environment protection and bio-fuel production' held at National Research Centre for Agroforestry, Jhansi from 16th to 18th December 2006.

12. Dr. C. Buvaneswaran, Scientist 'C' attended and presented a paper on 'Superior Planting Stock Production in Pungam (*Pongamia pinnata* L. Pierre)' in the national level seminar on 'Tree improvement for sustained productivity' from 4th to 6th November 2006 at JNKVV, Jabalpur.

13. Dr. C. Buvaneswaran, Scientist 'C' attended and presented a paper on 'Tree improvement for carbon sequestration' in the regional conference on 'Production forestry and carbon sequestration' on 14th and 15th November 2006 organized by ATREE, Bangalore.

14. Shri. R.S.C. Jayaraj, IFS, Silviculturist, Dr. C. Bhuvaneswaran, Sc-C and Shri. S. Saravanan, Sc-C attended the 'National Workshop on Tree Cultivation on Private Lands' organized by the Tamil Nadu Forest Department on 24th and 25th February 2007 at Chennai.

15. Dr. A. Balu, Scientist E attended and acted as a resource person and delivered a lecture on "Insect Pest Problems of Plantation Forestry and Their Management" in the interactive seminar for senior level officers of AP Forest Department held at Rajahmundry on 22nd and 23rd December 2006.

16. Dr. A. Balu, Scientist E participated as a resource person and delivered a lecture on "Biological control of Forest Insect pests in the training Range Officers of Tamil Nadu Forest Department on Tree improvement and productivity enhancement organized by the Institute from 8th to 12th January 2007.

17. Dr. A. Balu, Scientist E attended and acted as a resource person and delivered a lecture on Procedural formalities for filing application conduct of inspection and lab analysis and issue of

PSC for export of plants and plant based products in the Seminar cum Discussion Meet on Export of Agricultural Commodities organized by the Tamil Nadu Agricultural University and Michigan State University, USA. on 26th March 2007.

18. Dr. S. Murugesan, Scientist E and Dr. K. Panneerselvam, Scientist-B attended the National seminar on "Convergence of Technologies for organic horticulture" on 20th and 21st July (two days), organized by South Indian Horticultural Association (SIHA) and Tamil Nadu Agricultural University, Coimbatore. Sponsored by National Centre for Organic Farming, Ghaziabad, National Horticultural Board, Guragon.

19. Dr. S. Murugesan, Scientist E attended the Seminar on "Agilent Technology Food Safety (Agilent Asia-Pacific-Food safety Seminar) held at Le Royal Meridian, Chennai on 23rd July 2006.

20. Dr. S. Murugesan, Scientist E attended the Seminar on "Preparation of Samples for HPLC" on 28th July 2006 held at Residency, Coimbatore.

21. Dr. S. Murugesan, Scientist E attended the VII Annual Discussion Meeting in Entomology on "Semiochemicals in Crop Protection: Ongoing Technologies" on 2nd December 2006, at Chennai, organized by Prof. T.N. Ananthakrishnan, Ex-Director of ZSI and Entomology Research Institute, Chennai. He presented a paper on "Exploiting Chemical Ecology for sustainable pest control against forest pests.

22. Dr .S. Murugesan, Scientist E delivered lecture on "Role of Chemical Ecology in HPR" for CAS training Course (20th January 2007) on "Recent advances in HPR to insects and mite Pests" from 3rd to 23rd January 2007 by Centre of Advanced Studies in Entomology, TNAU, Coimbatore.

23. Dr. S. Murugesan, Scientist E and Dr. K. Panneerselvam, Scientist-B attended Indo-Korean joint seminar on "Secondary Metabolites sources and production process" by Dept. of Biochem. and Biotechnology and Department of oriental Medicinal Material and process, Kyunghee University, South Korea on 14th February 2007.

24. Dr. S. Murugesan, Scientist E and Dr. K. Panneerselvam Scientist-B attended the National Conference on "Nutraceuticals and the future of Medical Science" organized by Dept. of Biochemistry, Kongunadu arts and Science College, Indian Pharmacological Society of Biological Chemist and Nutrition Society of India.

25. Dr. S. Murugesan, Scientist E and Dr. K. Pannerselvam, Scientist-B, attended the UGC sponsored National Symposium on " Need based Modern Trends in Ethno Medicine Research (Ayush Remedies-2007) organized by the PG and Research Dept of botany, Kongunadu arts and Science College, Coimbatore.

26. Dr. V. Mohan, Scientist E participated in "Task Force/ Brain storming session on Integrated Nutrient Management (INM) in and other crops" held at Kerala Forest Research Institute (KFRI), Peechi, Kerala on 10th August 2006.

27. Dr. V. Mohan, Scientist E participated and presented the highlights of the research work and the new project proposals in the RAG meeting held at IFGTB, Coimbatore during 22nd August 2006.

28. Dr. V. Mohan, Scientist E, participated and presented the paper on "Factors influencing resistance / susceptible to diseases" and conducted the Proceedings of the session in the National Conference on "Molecular Pathogenisis" organised by the Karpagam Arts and Science College, Coimbatore on 15th and 16th September 2006.

29. Dr. V. Mohan, Scientist E participated and delivered a Lead Lecture on "Disease problems and

their management in nursery and plantations of South India" in National Conference on "Recent Trends in Mycological Research" and "33rd Annual Meeting of the Mycological Society of India" held at JJ College of Arts and Science, Pudukkottai, Tamil Nadu on 28th and 29th December 2006.

30. Dr. V. Mohan, Scientist E, participated as a Resource Person and delivered a Lecture on "Identification and selection of research problem and preparation of thesis" in National Seminar on "Research Methods in Biological Sciences" held at Dr. G.R. Damodaran College of Science, Coimbatore, Tamil Nadu on 9th and 10th January 2007.

31. Dr. V. Mohan, Scientist E participated as a Resource Person and delivered a Lead Lecture on "Biodiversity of mycorrhizal flora in the Nilgiri Biosphre reserve area of South India" in Workshop on Perspectives of Biodiversity Conservation: Status of species richness in protected areas" sponsored by the Ministry of Environment and Forests, Govt. of India, held at Kongunadu Arts and Science College, Coimbatore-29, Tamil Nadu on 8th and 9th February 2007.

32. Dr. Prasanth Jacob, Scientist-D participated as a resource person and delivered a lecture on "Insect problems in nurseries and their control" in the Training Programme on Improved Nursery Technique/Plant protection measures in nursery to forest officials of Andhra Pradesh Forest Department conducted at IFGTB, Coimbatore. (June 2006).

33. Dr. Prasanth Jacob, Scientist-D participated as a resource person on and delivered a lecture on "Insect pests of forests and their management" in the one day Seminar on Animal Behaviour at Kongunadu Arts and Science College, Coimbatore (September 2006).

34. Dr. Prasanth Jacob, Scientist-D participated as a resource person and delivered a lecture on "Insect problems in nurseries and their control" in the Training Programme on Tree Improvement and Productivity Evaluations to forest officials of Tamil Nadu Forest Department conducted at IFGTB, Coimbatore (December 2006).

35. Dr. Prasanth Jacob, Scientist-D participated as a resource person and delivered a lecture on "Insect problems in nurseries and their control" in the Interactive Seminar for senior level Officers of Andhra Pradesh Forest Department conducted at Warrangal (December 2006).

36. Dr. K. Panneerselvam attended the Herbal conference held from 14th to 16th April 2007 at Tamil Universtiy, Tanjore.

37. Shri.R.Raja Rishi, R.O. participated in the exhibition conducted at TNAU on the occasion of 8th Agriculture Science Congress from 15th to 17th Feb.07.

38. Shri R.S.C. Jayaraj IFS, C.F. attended the training programme on Financial Management and Audit Sensitization at the National Academy of Audit and Accounts, Shimla from 17th to 21st July 2006.

39. Shri R.S.C. Jayaraj IFS, C.F. attended the workshop on Standardization of remote sensing and GIS techniques for reporting on the wildlife areas of South East Asian countries conducted by WWF India, at Ooty, Nilgiris on 31st August 2006.

40. Shri R.S.C. Jayaraj IFS, C.F participated in the training cum workshop on "Integrating conservation and development" conducted by WWF- India at New Delhi on 8th and 9th November 2006.

41. Shri. R.S.C. Jayaraj IFS, C.F and Shri. M. Maria Dominic Savio, Scientist C participated in the National Workshop on Bamboo Location Trials, Bambusetum and Propagation held at Kerala Forest Research Institute, Peechi held on 21st and 22nd December 2006.

42. Shri R.S.C. Jayaraj IFS, C.F attended the National workshop on "Tree culture outside forest" organized by the Tamil Nadu Forest Department at Chennai on 24th and 25th February 2007.

43. Smt. R. Anandalakshmi, Scientist-C participated and presented a note on Quality seed production for oil yield in *Jatropha curcas* in the experts group discussion on "Non-edible grade vegetable oils as a source of decentralized power production" conducted by the Ministry of Non-Conventional Energy Sources at Rajaji Bhavan, Chennai on 24th April 2006.

44. Dr. C. Kunhikannan, Scientist-D attended the National Seminar on Environmental Health: New Challenges in Human Rights held at N.S.S. College, Nenmara, Palakkad District, Kerala on 19th and 20th June 2006 and presented a paper "Solid waste management: status and strategies".

International

1. Dr. K. Palanisamy, Scientist E participated in an International Symposium on Tree Breeding at Korea Forest Research Institute, Suanbo, South Korea on 15th to 16th June 2006 and delivered special lecture on Tree Improvement in India.

2. Dr. S. Murugesan, Scientist E attended the International Conference on "3rd Nutraceutical Summit" from 15th to 17th November organized by CFTRI, Mysore with MM Activ-Sci-Tech Communication Co. and CSIR at Mumbai.

AWARDS

Dr. N.V. Mathish was awarded fellowship by the Department of Biotechnology, Ministry of Science and Technology, under the scheme "Specialized training of young scientists in niche areas of biotechnology" to pursue a project on "Development of post-transcriptional gene silencing approaches as a tool for the functional analysis of symbiotic genes in the tropical actinorhizal tree *Casuarina glauca"* at the Institute de Recherche pour le Development (IRD), Montpellier Cedex 5, France for one year.

DISTINGUISHED VISITORS

1. Shri M. Selvaraj, Hon'ble Minister of Forests, Govt. of Tamil Nadu inaugurated the Microscopic Laboratory in the Institute and also visited the Gass Forest Museum on 10th July 2006.
2. Shri Hans Raj Josan, Hon'ble Minister of Forests, Govt. of Punjab visited the Institute on 14th October 2006.
3. Dr. S. Nagarajan, Chairperson, PPV & PRA, New Delhi visited the Institute on 29th August 2006.
4. Shri G.K. Prasad, IFS, DG (Forests) and Special Secretary, Govt. of India visited the Institute on 19th January 2007.
5. Prof. V.L. Chopra and Shri B.N. Yugandhar, Members of Planning Commission, Govt. of India visited the Institute on 15th February 2007.

MISCELLANEOUS

Sports

Smt. V. Banumathy, LDC won Gold Medals both in womens classic and rapid chess events during XV All India Forest Sports Meet held at Jaipur, Rajasthan from 6th to 10th February 2007.

Service Rendered

Plants and plant products slated for export were examined and subjected to the appropriate quarantine measures. About 247 Phyto-sanitary Certificates were issued to various organizations and individuals.

Insect pest problem in casuarina plantation referred by the Andaman Forest Department was investigated and suitable management practices were suggested.

Maintenance of Seed Bank

1. Seeds of various important species viz. *Acacia auriculiformis, A. mangium, 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. About 55 kg seeds of the above species were supplied to other divisions of the Institute, SFDs, Paper mills and NGOs on request and on payment and revenue of about Rs.2.64 lakhs was earned for the Institute.
2. Seed testing for viability, seed count, and purity were conducted and provided the test results to various clients and researchers.

Institute of Wood Science and Technology Bangalore

The Institute of Wood Science and Technology (IWST), Bangalore established 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.

The vision of the Institute is to attain excellence in forestry and wood science research for generation of desired resource values, uses, products, services in a way that sustains diversity and productivity in an eco-friendly regime.

A Shore Laboratory at Visakhapatnam and a Forest Research Centre at Hyderabad have been established under IWST. It has field stations at Gottipura and Nallal near Bangalore, Yelawala near Mysore and Mulugu near Hyderabad.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: Wood-fibre plastic composite foams with improved cell morphology by continuous process [IWST/WSP/X-37/2004 2006]

Findings: Flexural modulus of the fibre filled PS showed an increase in the value upto 30% loading followed by a sharp decrease at 40%. In powder filled composites an increase in the flexural modulus was observed. Foaming experiments indicated 35% increase in stiffness as compared to normal WPC. There was no significant change in density with decreasing the die temperature from 180°C down to 135°C and the density 1050 kg/m^3. When the die temperature was suddenly reduced to less than 135°C, there was a decrease in density (910-950 kg/ m^3).

Project 2: Polymerization filled composites [IWST/WSP/2003-2006]

Findings: An efficient way to overcome problems of poor dispersion and interfacial adhesion is one-step synthesis of composites by using Polymerization-Filling Technique (PFT). Using this technique, ethylene was polymerized directly from the wood fiber surface, and this proved to be an efficient method to promote good filler dispersion and improvement in mechanical properties of the resulting composites. Studies on polymerization kinetics have contributed in optimizing the reactor. A novel technique of *in situ* generation of co-catalyst from co-catalyst precursor has resulted in higher rates of polymerization and very high catalyst activity. The study has successfully demonstrated that highly filled composites can be prepared by filler supported catalyst system using cellulosic materials as fillers in a slurry reactor.

Project 3: Evaluation of culm quality before, during and after flowering in bamboo (*Bambusa bambos* and *Dendrocalamus strictus*) species [IWST/WPU/X-14/2003-2007]

Findings: Starch content estimated by bio-chemical method in non-flowered, flowered, and after flowered culms of *Bambusa bambos* showed variation. Histo-anatomical studies on starch, lipids and proteins also showed variations. Histo-anatomical studies on starch, lipids and proteins were also made in non-flowered culms of *Dendrocalamus strictus.* Round bamboo showed higher values in compression parallel to grain in non-flowered culms while static bending values are higher in culms during flowering. Strength properties (MCS and static bending) were more in split bamboo culms after flowering (air-dry) than non-flowered and flowered culms (green). The percentage of damage (natural durability) in culms in flowering stage showed variation with reference to height.

Project 4: Assessment of wood quality of *Tectona grandis* (teak) clones from Thithimathi (Karnataka) and Andhra Pradesh [IWST/WPU/X-15/2003-2007]

Findings: Among the clones studied it was observed that Thithimathi clones have better strength values compared to Haliyal clones but their strength values were less than standard teak. The correlation between dynamic and static modulus of elasticity (MOE) is very useful in determining the stiffness of the material without destroying it. The growth rate rather remained more or less same for both sources. The data generated from 11 clones from Andhra Pradesh indicated that some of the wood quality parameters do not support the rating followed by the department for best, average and poor.

Project 5: Studies on fracture mechanics in solid wood and wood composites using acoustic emissions [IWST/WPU/X-16/2003-2007]

Findings: Timber exhibited more fracture toughness in longitudinal-tangential plane than in longitudinal-radial plane, which was based on Linear Elastic Fracture Mechanics (LEFM) model. Microscopic observations of the longitudinally compressed specimens revealed a characteristic fracture band of buckled fibres making S-like shape. Branching macroscopic failure lines were also observed. 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 6: Characterization and identification of imported timbers available in the timber markets and sea ports [IWST/WPU/X-43/2004-2007]

Findings: A booklet entitled "*A guide to some imported timbers in south Indian market*" was published. The information consists of 25 species of imported timbers collected from Bangalore timber market 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 with some information on mechanical properties, seasoning, durability, preservation and uses were given to help the public. Collection of quantitative data after the preparation of permanent slides followed by the characterization and development of card key features was carried out.

Project 7: Influence of pretreatment techniques on the treatability of hardwood species grown in Karnataka [IWST/WSP/X-33/2004-2007]

Findings: Study indicates that there is a considerable improvement in the absorption of chemicals in the ponded specimens than that of control specimens. Data also indicate upward trend of increase in absorption with increased diffusion period.

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]

Findings: Drying behaviour of plantation grown timbers namely silver oak, teak, shivane, *Acacia auriculiformis* and rubber wood was studied in the desiccant based dehumidifying wood drying system.

Drying rate in all the species was found to vary with the reduction in moisture content. Drying of teak, silver oak, rubber wood and *Acacia* at varying temperature as recommended for the dry bulbs in the conventional drying schedules has given satisfactory results. Species like silver oak exhibited some tendency to warp but it was more due to inherent wood quality variation. This system has an advantage in terms of operational ease and low maintenance over conventional kilns.

Total electrical energy consumed during drying of different species was evaluated. For teak the energy consumption required to remove one kg of water was estimated to be 0.86 kWh/kg, which is in close agreement with the reported values for dehumidification drying elsewhere.

Project 9: Development of colouring reagents based on enzyme - substrate reaction for differentiating oil yielders of sandal in field [IWST/CFP/ X-12/2002-2007]

Findings: A simple, less expensive, user friendly and field oriented colour reaction has been developed for identification of high oil yielders. Of the 12 substrates identified for colour reaction, only 2 substrates Benzidine and Guiaicol were found to be effective for distinguishing sandal plants into low and high oil yielders. The developed colour reaction using Benzidine and Guiaicol substrates was modified so as to distinguish sandal plants of varying oil content in the field. Results of the colour reaction have been verified in the field. Cost effectiveness of the study indicates that Benzidine is cheaper as compared to Guiaicol.

Verification of research findings
Kushalnagar forest range

Distinguishing sandal plants of varying oil content using field method

Project 10: Standardization of anti-leaching treatment for *Pterocarpus marsupium, Pterocarpus soyauxii* and *Intsia* species [IWST/CFP/X-51/2005-2007]

Findings: Appearance of discoloured patches on the wood surface due to leaching of water soluble extractives is quite common in the timbers of *Pterocarpus marsupium*, *P. soyauxii* and *Intsia* species. Samples of these species were treated with chromium trioxide, copper sulphate, potassium dichromate and stannous chloride to arrest extractive leaching. Chromium trioxide and stannous chloride were found to be effective and the treatment has been standardized. It has practical application and will be very useful for better acceptability of these timbers.

Project 11: Studies on the sucking pest complexes of Sandal and their management [IWST/WBD/X-13/2004-2007]

Findings: In this study 73 species of sucking pests breeding on sandal were authentically identified and documented. Out of these 14 species were reported for the first time out of which *Megapulvinaria maxima* (Coccidae), and *Nipaecoccus viridis* (Psuedococcidae) were found as potential pests of sandal. The study exposed the presence of an array of natural enemies of sucking pest on sandal. Many new insecticides including neem formulations were first time evaluated against *N. viridis* on sandal and Imidacloprid, Metasystox and Deltamethrin were found superior in containing this pest. Hence, these insecticides can be effectively used to manage the scales and mealy bugs infesting sandal on need basis.

Project 12: Role of Fungi biodeterioration of timber under marine conditions [IWST/WBD/X-35/2004-07]

Findings: From the marine infected wood samples 15 species of fungi were isolated. Microscopic and macroscopic characterizations were studied. Initially the fungal isolates were screened for the production of amylase and cellulase enzymes. Based on these activities, the isolates were classified as cellulolytic and non-cellulolytic fungi. Each isolate was subjected to weight loss study by exposing the rubber wood separately to each fungus by adopting accelerated laboratory evaluation as per IS 4873. Their decay pattern was recorded individually. Percentage of infection, type of fungus, seasonal occurrence of fungus were calculated.

Project 13: Impact of disturbance on canopy insect biodiversity: an assessment of forest health [IWST/WBD/2003-2007]

Findings: This is the first study in the country to quantify diversity in the forest canopies. The rich diversity of insects in the canopies paves way for a new dimension of research work on rainforest canopies. The work also represents the arthropod sample drawn in India using insecticide fogging method and also the first access of the forest canopy using single rope technique

Project 14: Ethnobotanical studies of Godavari valley in Andhra Pradesh [IWST/WBD-Marine/X-04/2002-2007]

Findings: Intensive field studies were conducted for collecting ethnobotanical data in the Rampachodavaram and Polavaram agency areas of East and West Godavari Districts, respectively of Godavari valley in Andhra Pradesh. Data on 426 plant species were collected from Konda Reddis, Konda Kammaras, Koyas and Valmikis and herbarium was made for all the species of ethnobotanical interest. Twenty-six lesser known potential plant species were collected for the first time from the tribes of Godavari valley and recommended for further studies. Collected for the first time a rare cane genetic

resource, *Calamus latifolius* Roxb. - from the study area, which forms a distributional record to southern India. Twenty-three rare, endangered and economic / wild plant genetic resources of ethnobotanical importance were collected from the tribal areas and introduced for *ex-situ* conservation in the office of the State Silviculturist, Regional Forest Research Centre, Rajahmundry. Recorded environmental

Globba marantina L.-tuberous rhizome used for eye diseases by Konda reddis of Godavari valley, Andhra Pradesh

relationship and utilization practices of plant resources. Documented traditional system of agricultural practices and their knowledge on preservation of primitive cultivars and wild genetic resources.

Project 15: Inventory of coastal plant communities of north Andhra region [IWST/WBD-Marine/X-25/2003-2007]

Findings: Intensive field surveys were undertaken along the coastal areas of Srikakulam, Vizianagaram, Visakhapatnam, East Godavari, West Godavari and Krishna Districts. In all, 2148 plant specimens were collected, made into herbarium and 1080 of them identified. Several mangroves, halophytes, hydrophytes, xerophytes, psammophytes and seaweeds were collected. *Acanthus ilicifolius* L., *Avicennia marina* (Forssk.) Vierh., *Hydrophylax maritima* L.f., *Sesuvium portulacastrum* (L.) L. and *Solanum trilobatum* L. were found as new distributional records to Srikakulam district. An excellent sand binder, *Pupalia lappacea* (L.) Juss. var. *orbiculata* (Heyne ex Wall.) Townsend was collected for the first time from the north coastal region of Andhra Pradesh. Recorded a rare and endemic plant namely, *Dimorphocalyx glabellus* Thw. from the coastal hilly area near Bangarammapalem, Visakhapatnam District. Recorded sixteen hitherto lesser-known mangrove wetlands from Srikakulam, Visakhapatnam, East Godavari, West Godavari and Krishna Districts.

Project 16: Studies on productivity and management of *t*eak (*Tectona grandis*) in agroforestry practices in Karnataka and Andhra Pradesh [IWST/TIP/X-38/2004-2007]

Findings: Growth stresses were low and within utilizable range for farm teak in line and in less intensively managed block plantations. Intensively managed block plantations had significantly higher growth stresses indicating possible loss in utilizable timber if harvested at 12 years. Mechanical and physical properties of farm teak in line and in less intensively managed block plantations were almost at par. Among the various teak based agroforestry models compared, teak on farm boundaries (line plantations) with annual arable crops and horticultural crops like mango appear to be financially viable.

Twelve years old farm teak in line plantations in Devanahally, Bangalore rural district.

Project 17: Seed studies of some of the economically important species of Western Ghats [IWST/TIP/2003-2007]

Findings: The study was conducted to understand the critical moisture content of seeds at different temperatures and its effect on viability. The species studied were *Garcinia gummigutta, Dysoxylum malabaricum, Myristica fragrans* and *Dipterocarpus indicus.* It was found that seeds of *G. gummigutta* are sensitive to temperature below 15°C and can be stored for 18 months at 15°C with seed moisture content between 34 to 43%. Viability of *Dysoxylum malabaricum* can be prolonged for six months when stored at 15°C with 48.5% moisture content. Seeds of *Myristica fragrans* are recalcitrant in nature and loose viability under all conditions of storage.

Project 18: Screening clonal propagation, ex-situ conservation and genetic improvement of *Pongamia pinnata* [IWST/TIP/X-36/2004-2007]

Findings: Collected seeds of plus trees from 4 silvicultural zones namely, Central, Southern, Eastern and Northern zones of Karnataka. Conducted variability studies on fruits, seeds and germination. Estimated oil content in seeds to screen the plus trees with higher oil content. Seeds of northern silvicultural zone recorded highest (29.7%) oil content followed by the central silvicultural zone and minimum (24.0%) in southern silvicultural zone. 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 tree sources and established progeny trial at Nallal field research station in 0.6 ha of land with 375 seedlings.

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Studies on the gas permeability of secondary species of timbers [IWST/WSP/2003-2008]

Status: Flow rates have been measured for *Acacia mangium* specimens (150 samples) in axial, radial tangential directions. *Eucalyptus tereticornis, Eucalyptus camaldulensis* and *Eucalyptus grandis* are being subjected to conditioning.

Project 2: Studies on the durability of treated and untreated timbers of selected species [IWST/WSP/X-34/2004-2009]

Status: Test yard specimens of *Lophopetalum wightianum, Lagerstroemia lanceolata, Artocarpus heterophyllus, Spondias pinnata, Melia azadirachta* and *Sterospermum personatum* were subjected to pressure treatment adopting the Full Cell process using 3 different preservatives viz. Copper Chrome Arsenic composition (CCA), Copper Chrome Boric composition (CCB) and Creosote and furnace oil 1:1 preservatives for 4 different levels of absorption. The specimens were exposed to the field tests in the Test yard at Nallal along with untreated control.

All the untreated specimens of the above mentioned species were attacked by termites except *Lagerstroemia lanceolata* after 21 months of exposure.

All the untreated specimens of *Lophopetalum wightianum* were destroyed by termites within a year of exposure while 30% of the treated specimens with CCB, (4 kg/m^3) were showing termite attack after 20 months of exposure. Loss of weight was more than 40%. This shows that 4 kg/m^3 retention of CCB in this species will not increase the durability for a longer period.

Treated specimens of remaining 5 species are in sound condition showing that preservative treatment even with very low retention of CCA and CCB (4 kg/m^3) improves the durability of non durable timbers.

Project 3: Analysis of active principles in *Gymnema sylvestre* and *Phyllanthus amarus* from the forest of southern India [IWST/CFP/X-46/ 2005-2008]

Status: Collection of plant material (*Gymnema* and *Phyllanthus)* from Tamil Nadu, selected place of Andhra Pradesh and selected part of Kerala is over. Collected plant material was processed and extracted with petroleum ether and 95 % ethanol to get gymnamic acid. Quantification of gymnamic acid has been initiated.

Project 4: Screening and evaluation of wild varieties of *Emblica officinalis* fruit in various Agro-climatic zones of Western Ghats [IWST/CFP/X-48/ 2005-2008]

Status: Fruits of *Emblica officinalis* were collected from Mudumalai and BRT Hills (Karnataka); Agastiar Malai, Peechi, Athirapallys, Parambikulam (Kerala) and Thenmalai, Kurtalam and Kanyakumari (Tamil Nadu). Collected fruits were processed for extraction of ascorbic acid. Estimation of Vitamin-C has been initiated.

Project 5: Extraction and separation of Chemical constituents of *Dysoxylum malabaricum* Bedd. wood [IWST/CFP/X-52/2005-2008]

Status: White cedar wood was distilled by hydro distillation method and the oil was analysed by GC-MS. The result showed that 28 important chemical compounds are present out of which 5 major compounds i.e., more than 3% in quantity. Extractives (<2%) were column chromatographed with different solvent mixtures and partial separation and purification was done.

Project 6: Investigations on the resistance of commercially available bamboo species in Karnataka against insect borer and termite [IWST/WBD/X-45/2004-2008]

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

Project 7: Studies on age related durability of plantation grown timbers [IWST/WBD/X-50/2005- 2009]

Status: Maintenance of wood rotters in virulent condition by repeated sub - culture technique is being done. Wood samples were prepared for both fungal and termite studies from all species and age groups. One set of samples was treated with ACA and exposed for termites in test yard. Monthly observation is being done for termite activity on the treated samples. *Acacia auriculiformis* and *A. mangium* of all age group were exposed to both wood rotters under accelerated laboratory studies. Treatment of CCA and CCB for fungal and termite exposure are being done.

Project 8: Clonal test trials on *Casuarina equisetifolia* L. in North coastal Andhra region [IWST/WBD-Marine/X-004/2003-2008]

Status: Observations on survival of different clones of *Casuarina equisetifolia* L. recorded. Growth in terms of height of five dominant clones was found to be 10.2 m in APVSYM-5M; 7.50 m in APVSYM-4F; 8.40 m in APVZVZ-1F; 9.70 m in CP4202-M and 7.8 m in CP0305-M. Basal stem diameter of the five clones was noted to be 40.5 cm in APVSYM-5M; 38.4 cm in CP0305-M; 41.0 cm in CP4202-M; 35.6 cm in APVZVZ-1F and 34.8 cm in APVSYM-4F.

Project 9: Periodical income generation for communities involved in coastal plantation (Old title: Community involvement in coastal forestry through periodical returns by value added produce) [IWST/WBD-Marine/X-24/2003-2008]

Status: Growth parameters of *Casuarina equisetifolia* L. were recorded. Herbage was collected from 3m x 3m plantations of *Eucalyptus citriodora*. Essential oil yield was at the rate of 620 ml/quintal and 581 ml/quintal, respectively from 500 kg and 430 kg of herbage. Assessment of quality of essential oil is under progress at IWST. Observations on the survival of NTFP species showed that the soil and weather conditions are not congenial for the species.

Project 10: Environmental impact of leachates from Copper Chrome Arsenic (CCA) wood preservative under marine condition [IWST/WBD-Marine/X-23/2003-2008]

Status: Prepared out of untreated and CCA treated mango test panels, 200 test ladders were secured sequentially to thick nylon ropes and exposed in the fishing harbour at Visakhapatnam. Test panel sets were retrieved periodically and observations on biodeteriogens recorded. Important environmental parameters were monitored. Boring samples were obtained from all the 375 panels retrieved and being processed for further analysis.

Project 11: Studies on recruitment and metamorphosis of marine woodborer larvae [IWST/WBD-Marine/X-22/2003-2008]

Status: Pure cultures of microorganisms separated from the primary film were maintained. Biochemical tests were conducted to identify the bacteria so cultured. The microbes so far identified are *Halomonas* species, *Actinobacillus* species, *Serratia ficaria, Haemophilus* species, *Vibrio* species and *Staphylococcus* species. Wooden wafers were coated with pure bacterial cultures and experiments conducted on their influence on the recruitment of teredinid wood borer larvae.

Project 12: Productivity and interaction studies in *Acacia hybrid* based agroforestry practices in Karnataka [IWST/TIP/X40/2004-2009]

Status: *Acacia* hybrid ramets were outsourced from MPM, Bhadravathi. Agroforestry trial plots were set up in farmers' fields in Kolar (in 2004) and in Doddaballapur (2005). Data on growth performance of *Acacia* hybrid was recorded at both sites. Analysis of soil samples for soil physico-chemical parameters were completed. Maintenance of trials is carried out on regular basis. Data on intercropped agricultural crop like ragi, maize and tomato was also recorded.

Project 13: Comprehensive tree improvement program for *Gmelina arborea in* Karnataka Phase I Progeny trial [IWST/TIP/X-41/2004-2009]

Status: Seeds were collected from 27 plus trees from Karnataka (17 plus trees) and Andhra Pradesh (10 plus trees) and were sown for germination at IWST, Rajamundry and Tittimathi. Although germination was not satisfactory at the IWST nursery but the seedlings were produced at the Rajamundry and Tittimathi nurseries.

Project 14: Assessment of seed quality in unimproved populations, seed production areas and seed orchards of *Tectona grandis* [IWST/TIP/X-48/2005-2007]

Status: Preliminary results indicate that seeds collected during February-March 2006 from SPA were of better quality in terms of seed morphological characters and germination compared to unimproved populations. Seeds were collected again during February-March 2007 from CSO, SSO, SPA and unimproved population for studies on seed variability, germination and growth performance.

Project 15: Studies on seed source variation, determination of age of the trees and establishment of germplasm bank of Sandal [IWST/TIP/X-47/ 2005-2008]

Status: Seed collection from Karnataka, Tamil Nadu and Kerala has been completed and the seedlings are being raised to establish germplasm bank. Seed variability study has been initiated.

Project 16: Carbonisation of selected fuelwood species [IWST-34/WE-1/ 2004- 2007]

Status: Variation in calorific value of *Casuarina equisetifolia* with age (1, 2, 3, 4, 5 and 7 years) was studied. No significant change in calorific value of different age groups of *C. equisetifolia* was found. Proximate analysis and Elemental analysis of *C. equisetifolia* with age and height was carried out. No significant changes in these parameters were observed. The carbonization of three wood species *Acacia auriculaeformis, Eucalyptus* hybrid and *C. equisetifolia* has been carried out at 300°, 400°, 500°, 600°, and 800° at 1 hour soaking time and three different heating rates of 4° C/min, 8° C/min, 12° C/min. The study shows that the yield of charcoal decreases with rise in temperature. Variation in the calorific values of the charcoals prepared under different experimental conditions was also evaluated. The study shows that with increase in temperature the fixed carbon increases and volatile content decreases. The ash content is more in case of *C. equisetifolia.*

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Processing and evaluation of plantation grown *Simarouba glauca* DC. from Orissa [IWST/WPU/X-59/2006-2009]

Status: Heartwood is yellowish grey in colour and is indistinguishable from sap wood. Average bark thickness was 8 mm and specific gravity was 0.647. Studies conducted on shrinkage behaviour showed average 3% radial shrinkage and 5% tangential shrinkage from green to oven dry.

Project 2: Detection of natural and biological defects in timbers by non-destructive testing techniques [IWST/WPU/X-63/2006-2010]

Status: Ultra Sonic Flaw Detector was installed along with transducers of various diameters and frequencies. Experiments were repeated using the equipment to standardize the testing procedure using samples of *Acacia mangium*.

Project 3: Study on utilization aspects of plantation grown *Acacia mangium* Willd. from Orissa [IWST/WPU/X-57/2006-2010]

Status: Heartwood and sapwood are distinct. Heartwood is dark brown and sapwood is whitish to yellow in colour. Heartwood and sapwood percentage varied from 92-94% and 6-8% respectively. Studies conducted on shrinkage behaviour showed average 2% radial shrinkage and 6% tangential shrinkage from green to oven dry.

Project 4: Study the variability in growth stresses in clones of *Eucalyptus* [IWST/WSP/X-56/2006-2008]

Status: Studies were carried out on 25 Clones of *Eucalyptus* raised by the institute at Nagaroor. Basic data such as DBH, pilodyn penetration, taper and height has been recorded for 8 clones. Out of 25 clones 15 have been selected for the final study. Based on initial studies, modification in the design of instrument was made.

Project 5: Effect of particle size on properties of wood filled polypropylene composites [IWST/WSP/ X-53/2006-2009]

Status: Injection moulding machine for moulding standard wood polymer composite specimens was procured and installed. Moulding parameters like injection pressure, temperature profile, hold up pressure and time, cooling rate and time for moulding WPC material were standardized.

Wood of *Hevea brasiliensis* (rubber wood) was chipped and pulverized. Wood flour was segregated into five different sieve sizes (-30/+40; -40/+52; -52/+60; -60/+80; and 80) using sieve shaker fitted with BSS standard meshes. Using optical microscopy, 50 measurements on each size class were made.

Composite specimens with polypropylene as matrix material were prepared using each of the above size class at 40% filler loading using twin screw extruder. The compounded material was palletized and moulded into ASTM type test specimens using injection moulding machine. Moulding parameters were standardized. The test specimens were evaluated for tensile strength, flexural strength and modulus of elasticity (MoE). A mathematical model based on shear lag theory was also developed for predicting elastic properties of wood filled composites.

Project 6: Analytic Studies on Woody Cell Wall Architecture [IWST/WSP/ 62/2006-2009]

Status: It has been found that rosettes are created in a hexagonal arrangement through which glucose from cell is drawn and is polymerized into cellulosic chains that are in turn packed into a microfibril that is extruded on the outer side of plasma membrane. Forces exerted by the growing microfibril are responsible for the motion of rosettes in the plasma membrane. Role of microtubules as the system guiding the movement of rosettes in a fluid plasma membrane has been explored.

Project 7: Studies on chemical modification of wood by vapour phase treatments [IWST/WSP/X-61/2006-2008]

Status: Glass reaction vessel for carrying out experiments on chemical modification of wood in vapour phase was designed and fabricated. Wood of *Hevea brasiliensis, Mangifera indica, Pinus radiata* and *Pinus roxhurghii* was procured. Defect free samples of size 2.0X2.0X2.0 cm and 2.0X2.0X0.5 cm from each species were prepared from sapwood after air seasoning to 8-10% moisture content. Studies on per cent extractives present in sapwood portion of each species using toluene, ethanol, acetone and mixture of toluene: ethanol: acetone::2:1:1 have been completed.

Project 8: Investigations on chemical composition and utility of AESP oil from exhausted sandalwood powder [IWST/CFP/X-60/2006-2009]

Status: Study between the ratio of exhausted sandalwood powder and water is being standardized. Exhausted sandalwood powder (two sets) is treated with different concentrations of acids (2.5 % to 10 %) for confirmation of results. The products obtained in above treatments were steam distilled. The steam distilled product was distilled again and AESP oil was estimated.

Project 9: Isolation and anti-fungal activities of the chemical compounds of *Baccaurea courtallensis* Muell.-Arg. - a wild edible plant of Western Ghats [IWST/CFP/X-64/2006-2009]

Status: Surveyed two locations in Karnataka and Tamil Nadu and located *Baccaurea courtallensis* in the natural forest of Western Ghats region. Collected plant materials. Powdered different plant parts. Extracted plant parts (wood and fruit rind) with different polarity solvents, quantified the extracts and separated and purified extracts by column chromatography.

Profuse fruiting of *Baccaurea courtallensis* at Makut, Karnataka

Fruits of *Baccaurea courtallensis* under process for phytochemical studies

Project 10: Laboratory testing for the assessment of the durability of timbers against powder post beetles standardization and evaluation [IWST /WBD/X-55/20062010]

Status: Culture of 2 species, *Lyctus africanus* and *Sinoxylon anale* has been established using Tapioca chips as feed material. Specimens from different age groups of plantation timbers (*Acacia auriculiformis, A. mangium, Eucalyptus tereticornis, Grevillea robusta* and *Melia dubia)* were procured from Hoskote and treated with ACA for laboratory testing. The contact toxicity and residual toxicity of bifenthrin was tested by adult release method.

Project 11: Database Development of IWST Xylarium [IWST/IT/X-58/ 2006-2009]

Status: Classification and arrangement, number and identification of specimens of IWST Xylarium is in progress. Visited Gass Forest Museum, IFGTB, Coimbatore to collect information and some specimen pictures.

PROJECTS COMPLETED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: 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]

Findings: Developed refined protocols for *in vitro* cloning of *Santalum album* through axillary shoot proliferation and somatic embryogenesis of mature trees and clones. Genotype/clones have shown significant effect on shoot initiation, multiplication and rooting. Five genotypes/clones tested viz; AP4, KL3, CPT6, T1 and T13 and shoot multiplication rate varied from 2.66-4.43 fold and rooting from 40.77-70.39%. Genotypes/clones have also shown variable response on embryogenic callus induction, multiplication, somatic embryo induction, maturation and germination. Five clones viz; KL3, AP4, T11, K31 and K36 tested for somatic embryogenesis. Somatic embryo induction varied from 60.31-89.65%. Germination percentage varied from 40.42-50.73% with genotypes. Developed process for direct adventitious shoot induction and plantlet development from leaf and internode tissues of mature and selected genotypes for rapid and mass production of planting material of sandal. Basic protocol also developed for *in vitro* cloning of red sanders.

Project 2: Biocomposites from engineered natural fibres (Funding Agency: Ministry of Environment and Forest (MoEF)) [2004-2006]

Finding: Natural fibres are increasingly being used as reinforcement in commercial thermoplastics due to their low cost, high specific properties and renewable nature. The effect of filler concentration on the mechanical properties of wood fibre filled composites, prepared by using *m*-TMI-g-PP as the compatibilizer, was investigated. Tensile strength of composites so prepared increased by almost 45%, whereas an 85% increase in flexural properties was observed. The addition of wood fibers resulted in a decrease in elongation at break and impact strength of the composites. Dynamic modulus of elasticity (MoE) and shear modulus of wood filled polypropylene composite at various filler contents ranging from 10% to 50% were determined from the vibration frequencies of disc shaped specimens. Between the two fillers, wood fibre filled composites exhibited slightly better properties. Halpin-Tsai model equation was used to describe the changes in the composite modulus with the increasing filler content. The continuous improvement in elastic properties of the composites with the increasing wood filler is attributed to the effective reinforcement of low modulus polypropylene matrix with the high modulus wood filler

Project 3: Revision of subfamily Ponerinae (Hymenoptera:Formicidae) in India with special emphasis to western ghats (Funding Agency: DST-Fast Track Scheme) [2004-2007]

Finding: Out of 64 species of Ponerinae ants known from India, 51 species occur in Western Ghats. One new genus and six new species of Ponerinae ants have been described from Western Ghats.

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Studies on the properties of coffee wood as indicators of white stem borer resistance (Funding Agency: Central Coffee Research Institute) [2005-2008]

Status: Specialized training in histo-anatomical features was imparted to the in-service officials of CCRI. Selections of coffee stems of healthy, susceptible and induced to borer attack nature were collected coinciding the phenology. Data on specific gravity and bark thickness was collected. Histo-anatomical studies for starch, proteins and lipids were made

In vitro cloning of *Santalum album*: Shoot multiplication cultures of clone KIL3

Project 2: 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)) [2004-2008]

Xylocarpus granatum Koen. a rare true mangrove found along the coast of Andhra Pradesh

Status: Surveyed 75 mangrove areas in the states of Karnataka, Goa and Andhra Pradesh. A total of 375 plant specimens were collected and documented. Samples of *Aegiceras corniculatum, Ceriops decandra, Sonneratia alba, Sonneratia apetala, Avicennia alba, Avicennia officinalis, Avicennia marina, Lumnitzera racemosa, Excoecaria agallocha, Bruguiera cylindrica, Bruguiera gymnorrhiza, Rhizophora apiculata. Rhizophora mucronata, Kandelia candel, Excoecaria agallocha, Avicennia marina* and *Avicennia officinalis* were collected. Bark and wood samples of *Rhizophora mucronata* and *Excoecaria agallocha* were processed separately for extraction of chemical constituents. Water and soil samples were also collected and analyzed.

Project 3: Establishment of Advanced Wood Working Training Centre at IWST (Funding Agency: Italian Trade Commission/ACIMALL) [2003-2008]

Status: Training was imparted to 31 batches consisting of 1788 students upto March 2007 as per module. Over 95 percent unemployed persons were benefited after the course. The salary earned by the trainees after their employment in various wood working companies in India ranging from Rs. 3000 to Rs. 15000 per month depending on their qualification, experience, etc.

Project 4: Community ecology of a detritus system. Insects and fungi associated with fallen trees in the Nilgiri Biosphere Reserve (Funding Agency: MoEF, Govt. of India) [2004-2007]

Status: Various sampling methods, including black light traps were used to collect insects from fallen logs. About 300 xylophagous insects were also recorded from fallen logs at Nagarhole National Park. From fungi inhabiting fallen logs, 20 species of fungi and 42 species of mycophagous insects were recorded. Chemical characterization of different stages of fallen logs of 10 species has been completed and is being correlated with the community structure of insects and fungi.

Project 5: Studies on the entomofaunal diversity and their interactions in selected provenances of sandal (Funding Agency: Ministry of Environment and Forest (MoEF)) [2004-2007]

Status: From the six selected sandal provenances 344 insect species belonging to 12 orders have been identified. Specimens are preserved as reference collection for future use. In terms of number of hopper *Nephotettix nigropictus* was found to be dominant and *Nephotettix nigropictus* and *Emposcanara* sp. were found to be active throughout the year.

Project 6: Insect-plant relationships with special reference to herbivory in the mangroves of South India [2005-2008]

Status: Surveyed West coast (Mangalore, Honnawar, Kundapur and Karwar) mangroves monthly and collected insects by light traps and other methods. Solar light traps were installed in the selected study sites inside the mangrove forests for collection and monitoring of the nocturnal insects. Frugivores and their parasites were collected and identified. Pollinators of 6 species of mangroves have been identified and studies on pollination biology and role of insects were conducted. Herbivory in 4 insect species of mangroves with reference to different areas and seasons was assessed.

Project 7: 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: Recruitment of *Mytilopsis sallei* was monitored at monthly intervals at Visakhapatnam and Kakinada ports. Water samples were collected and salinity, temperature and pH recorded and additional samples processed for heavy metal analyses. Animal tissue samples were also collected, processed and preserved for analyses. Gut micro flora from *M. sallei* was cultured, isolated and pure cultures maintained. Characterization of bacteria isolated from the gut of *M. sallei* completed. In all, eleven species of bacteria, viz., *Serratia* sp., *Bacillus subtilis, B. cereus, Staphylococcus aureus, Escherechia coli, Vibrio cholorae, V. parahaemolyticus, Aeromonas* sp., *Pseudomonas* sp., *Micrococcus* sp., and *Staphylococcus epidermi* were identified. Tests on copper tolerance by the bacteria were conducted and growth pattern of different bacteria under copper stress recorded. *Bacillus* sp. and *Staphylococcus aureus* were found to tolerate higher copper concentrations.

Project 8: Development of protocols for rapid and mass clonal propagation of *Bambusa pallida* Munro and *Phyllostachys bambusoides* Sieb. et Jucc. (Funding Agency: Department of Biotechnology) [2004-2007]

Status: Studies were conducted on effect of additives, sucrose concentrations and pH on shoot multiplication, media and auxins for *in vitro* rooting in *B. pallida.* Maximum 4.0 fold shoot multiplication

could be achieved on shoot multiplication medium with additives (ascorbic acid 50 mg/l + citric acid 25 mg/l + cysteine 25 mg/l) + sucrose 4.5% + NAA 0.25 mg/l + BAP 1.0 2.5 mg/l or TDZ 0.25 mg/l. Liquid medium proved better than agar gelled medium for shoot multiplication. Sub culturing within 2 weeks proved essential to maintain growth and vigour. Auxins (IAA, IBA, NAA and NOA) and media (MS, MS/2, MS/4 and B5) have significant effect on rooting. Low nutrient medium with NAA/IBA proved suitable for *in vitro* rooting in *B. pallida.*

Medium with NAA + BAP proved suitable for somatic embryo induction and germination in *B. pallida*. In *P. bambusoides* multiplication rate was poor (2 fold) and rooting was sporadic. High rate of rooting (> 70%) from leaf stem branch cutting in *P. bambusoides* achieved in 5 weeks period with auxins (IBA/NAA) treatment.

Project 9: Field performance of micro and macro propagated planting stock of selected five commercially important bamboo species (Collaborative project with KFRI and IFGTB) (Funding Agency: Department of Biotechnology) [2004-2007]

Status: Field trials of micro and macropropagated planting material of commercially important five bamboo species viz; *Bambusa bambos, B.balcooa, Dendrocalamus asper, D.strictus* and *Pseudoxytenanthera stocksii* established during July September 2005 in 16.7 ha area (Karnataka 13.0 ha and Andhra Pradesh 3.7 ha) had survival rate varying from 85-95 per cent after six months of planting and 65-90% after one year. Maximum survival rate (90%) was in *D. strictus* and minimum in *D. asper* (65%). Maximum height was observed in *B. balcooa* and minimum in *D. asper*. Whereas, maximum number of tillers were seen in *D. asper* and minimum in *B. balcooa.* In general micropropagated plants had more number of tillers as compared to seed and cutting raised plants. There was no significant difference in survival rate of seed base, cutting base and micropropagated plants of these bamboos.

Hardened micropropagated plants of *Dendrocalamus asper* for field trials

Project 10: Studies on assessing growth performance of *Guadua angustifolia* Kunth under different management schedules (Funding Agency: National Mission for Bamboo Application) [2005-2008]

Status: Raised the planting material of *G. angustifolia* for casuality replacement by macropropagation. Field trials established at two sites viz; Yelwala and Gottipura with each site trial having area of 1.3 ha. Assessed survival rate and growth performance of *G. angustifolia* at Gottipura and Yelwala. Soil analysis of study sites completed. Intercropping carried out with horse gram, red gram and cow pea in Yelwala. Litter studies were initiated.

Project 11: Bamboo Location Trials (Funding Agency: National Mission for Bamboo Application) [2005-2007]

Status: Eight bamboo species viz; *Bambusa bambos, B. tulda, B. nutans, B. balcooa, Dendrocalamus hamiltonii, D. asper, D. giganteus* and *Phyllostachys stocksii* trials at Nallal in Karnataka and FRC, Hyderabad (at FRC seven species are common and in place of *P. stocksii* and *Guadua angustifolia* was planted) revealed maximum height in *D. hamiltonii* and maximum number of tiller in *B. tulda.* Bushy growth was observed in *B. tulda* at Nallal (Karnataka). Survival rate in both these trials was > 80% after 18 months of planting.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Investigation on Tree ring analysis of certain species in Western Ghats to monitor climate changes and its relevance to wood quality (Funding Agency: MoEF) [2006-2009]

Status: Formalities regarding purchase of certain equipments and recruitment of JRFs have been initiated.

Project 2: Studies on acoustical behaviour of plantation timbers for musical instruments and wall paneling (Funding Agency: CSIR) [2006-2009]

Status: Purchased a system consisting of FFT analyzer, microphones, impedance tube and display and storage device. Procured logs of *Acacia auriculiformis, Artocarpus heterophyllus, Azadirachta indica, Eucalyptus* spp. and *Melia composita.* Surveyed the markets and obtained information on timber being used for making musical instruments.

Project 3: Development of bamboo fiber reinforced thermoplastic composites (Funding Agency: National Mission for Bamboo Application) [2006-2009]

Status: Universal testing machine, injection moulding die, palletizer, Hauloff system and Dryer, were procured and commissioned. Studies on standardization of extrusion parameters for preparation of bamboo fiber filled thermoplastic composites completed. Approximately 125 Kg of compounded material was supplied to industrial partner for industrial scale trials. The extrusion parameters and compounding formulations were modified according to feedback from industrial trials and requirements suggested by industries.

Project 4: Investigations on the fungi and insects associated with fruits and seeds of selected endemic trees of Western Ghats (Funding Agency: Ministry of Environment and Forests) [2006-2009]

Status: Different Western Ghat forest areas in Karnataka and Kerala were visited several times to collect fruits and seeds of selected endemic species. Infested and uninfested fruits and seeds were classified, percentage of infection was calculated and causal organisms were isolated and are being identified.

Project 5: Monitoring of biofouling at Visakhapatnam Port. (Funding Agency: Ministry of Shipping, Road Transport and Highways, Government of India through the National Institute of Oceanography, Goa) [2006-2009]

Status: Biofouling material collected through active sampling during Port Biological Baseline Survey carried out along with Scientists of National Institute of Oceanography, Goa was sorted out. Wooden test panels were prepared and immersed at three test stations, *viz.*, Slipway Complex, Ore Berth and Marine Foreman Jetty in Visakhapatnam Port for trapping biofouling and wood boring organisms. The panels were retrieved at monthly intervals and observations made on different aspects of fouling and wood boring.

Project 6: Need for conserving forest canopies: assessing the diversity of canopy insects in the Western Ghats. (Funding Agency: Ministry of Environment and Forests (MoEF) [October 2006 to September 2009]

Status: The project aims at developing methodologies for regular sampling of insects from the emergent rainforest canopies and evaluating them, and to develop a baseline data on seasonal variation in the diversity of canopy insects. Four traps were fabricated canopy pitfall trap, yellow pan trap, light trap and butterfly trap, which have been established in the canopies.

Project 7: Development, Augmentation of efficacy and improvement of dissemination systems of *Metarhizium* based mycoinsecticide for the management of major pests in forest plantations and nurseries (Funding Agency: Department of Biotechnology) [2007 2010]

Status: Survey of nurseries in South Canara, Mangalore (Karnataka), Tirupathi (Andhra Pradesh) was conducted and collection of insects and pathogens was made. Culture of fungal strains has been established in the laboratory.

Project 8: Bioecology, damage potential and management of Gall formers of *Pongamia pinnata* (L.) Pierre (Funding Agency: Department of Science and Technology) [20062009]

Status: Sanctioned equipments were procured and recruitment of JRF completed. Study sites were identified for the detailed studies.

Project 9: 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 *Pseudoxytenanthera stocksii* in Andhra Pradesh, Karnataka and Goa (Funding Agency: Department of Biotechnology) [2006-2009]

Status: Tissue culture plants of *Guadua angustifolia, Bambusa nutans, Dendrocalamus asper, Pseudoxytenanthera stocksii* have been produced at IWST lab. while tissue culture plants of *D. hamiltonii* and *B. balcooa* were obtained from IHBT, Palampur and Grow More Biotech, Hosur. Vegetative propagation plants of the above species are being produced for laying out the field trial.

Project 10: Conservation of Sandal (*Santalum album* L.) germplasm, production of quality planting stock and promotion of sandal cultivational practices (Funding Agency: National Medicinal Plant Board) [2006-2009]

Status: Collected about 100 kg seeds of sandal from Yelwala (Mysore), Nallal and Salem (Tamil Nadu) and processed for storage and germination. About 40 kg of seeds were sown in germination beds and around 65,000 seedlings have been raised so far of which around 38,000 are in root trainers and 27,000 in polybags. A stake holders training programme was conducted in Mehsana, Gujarat on "Sandal nursery technology and cultivation" in March 2007.

Project 11: Cultivation of *Guadua angustifolia* Kunth. and *Dendrocalamus asper* in Kerala and Karnataka (Funding Agency: National Mission for Bamboo Application) [2006-2009]

Status: Established the demonstration plantations (0.5 ha each) of *Guadua angustifolia* Kunth. and *Dendrocalamus asper* Backer in Thithimathi, Coorg, Karnataka and in two sites in Alwaye and Palakkad, Kerala.

Project 12: Commercial cultivation of bamboo in Kodagu District: Raising of Quality Planting Material (QPM), Establishment of demonstration plots and bamboo based value addition facilities (Funding Agency: National Mission for Bamboo Application) [2006-2008]

Status: Conducted entrepreneurs meet in July 2006. Around 10,000 TC plants of *Dendrocalamus asper* procured from Grow More Biotech planting in farmers' fields and coffee estates. For establishing demonstration plantation of *D. asper* in 25 ha 77 beneficiaries were identified and plants were supplied to them.

Project 13: Vegetative Propagation Centre (VPC) for the production of quality plants of *P. stocksii, D. brandsii* and *Guadua angustifolia* (Funding Agency: National Mission for Bamboo Application) [2006-2009]

Status: Agroshed net house was established (area 17 m x 17m) and misting system was installed. Production of plants by rooting of culm and branch cuttings of *Guadua angustifolia* and *Dendrocalamus stocksii* has been initiated.

Abstract: No. of Projects

	No. of projects completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	18	16	11
External Projects	3	11	13
Total	**21**	**27**	**24**

TECHNOLOGY ASSESSED AND TRANSFERRED

1. A Demonstration programme on 'Sap displacement, Boucherie, Seasoning and Ammonia fumigation techniques' was organized by the Andhra Pradesh Forest Department on 13th December 2006.

2. Demonstrated Sap displacement, Boucherie process, and delivered lecture on Wood Preservation to the participants of the training course on, "Training to Trainers and Master craft Persons" organized by the Govt of India, Ministry of Textiles, Bangalore on 23rd February 2007.

3. Demonstrations of the Institute activities were organized at Hyderabad, Tirupathi, Warangal and Rajamundry on 29th November 2006, 13th to 20th and 23rd December 2006, respectively.

EDUCATION AND TRAINING

Education

1. 332 students from different Universities visited the Institute from April 2005 to March 2006.

2. Students of Wood Science and Technology, FRI University were given lectures on wood quality.

3. Students of B.Sc. Forestry of Allahabad Agricultural Institute (Deemed University) did their project on documentation of standard wood testing methods under supervision of the Institute.

Trainings

Organized

1. Short term training course on "Wood biodegradation and preservation" was conducted. A total of 16 participants participated in the training programme representing different organizations like Asian Paints, Johnson fumigation, Rubber board, individual etc. from 17th to 21st July 2006.

2. Training programme was organized by IT cell of the Institute for the PhD students of FRI Deemed University on Computer Applications in July 2006.

3. Short term training on "Modern nursery practices of Sandalwood" was conducted from 21st to 25th August 2006.

4. Short term training course on Wood Bio-degradation and Preservation" was conducted from 16th to 20th October 2006. A total of 20 participants from different organizations participated.

5. Training course on "Field identification of important timbers" to the in-service officials of Tamil Nadu Forest Department from 30th October to 3rd November 2006.

6. Training course on "Timber Joinery" to the in-service officials of Andaman and Nicobar Forest Department, Port Blair from 27th November to 1st December 2006.

7. Three days training programme on "Classification of grading of timbers" from 4th to 6th December 2006, was organized. A total of 6 participants participated.

8. Training course on "Classification and grading of timbers" for the in-service officials of Ordinance Factory, Tiruchirapalli and M/s Moser Baer India Pvt. Ltd., Greater Noida, from 4th to 6th December 2006 was organized.

9. Compulsory Training Course for IFS officers on "Biotechnology for Forest Conservation" was organized from 15th to 19th January 2007. A total of 29 officers participated.

10. Specialized training to in-service official of CCRI in wood anatomy.

11. Two training programmes in modern seed and nursery practices for the farmers of Gujarat during 21st to 25th August 2006 and farmers of Maharashtra during 20th to 24th February 2007.

12. Training Course on "Extraction/purification techniques and instrumentation analysis" conducted by the Chemistry of Forest Products Division from 14th to 16th March 2007.

Attended

1. Dr. R.V. Rao, Scientist F attended 2 weeks training programme on "General Management for Senior Scientists" at ASCI, Hyderabad from 5th to 16th February 2007 conducted by Administrative Staff college of India, Hyderabad.

2. Dr. S.S. Chauhan participated as faculty in a 3 day training-cum-workshop on forest based crafts development organized by A.P. Forest Academy, Dulapally, Hyderabad from 29th to 31st May 2006.

3. Mr. Anil K. Sethy, Scientist B underwent a training on preparation and handling of increment core samples and tree ring analysis at Indian Institute of Tropical Metrology, Pune from 5th to 9th February 2007.

4. Dr. N. Rama Rao, Scientist E attended training on *General Management for Senior Scientists,* at Administrative Staff College of India (ASCI), Hyderabad from 4th to 15th September 2006.

5. Shri V. Soundararajan, Scientist B attended one week training programme on "Data Warehousing and Data Mining" at ASCI, Hyderabad from 19th to 23rd February 2007.

6. Dr. S. Viswanath, Scientist E attended National Workshop cum training on Bamboo Locational trial, Bambusetum and propagation from 14th to16th February 2006, conducted by NMBA at Bamboo co-ordinating center, GB Pant University of Agriculture and Tech, Pantnagar, Uttaranchal.

7. Dr. S. Viswanath, Scientist E attended training programme on "Intellectual Property Rights and WTO related issues" sponsored by Govt. of India at ASCI, Hyderabad from 31st July to 4th August 2006.

8. Dr. Geeta, Scientist D attended training programme on "Intellectual property rights and world trade organization related issues" from 30th October to 3rd November 2006 at Administrative Staff College of India, Hyderabad.

9. Dr. Geeta, Scientist D attended Third country training program, on "Improvement of tropical tree species", at Yogyakarta, Indonesia from 4th to17th March 2007.

10. Dr. M. Balaji and M. V. Rao, Scientists C attended the Training programme on disease free shrimp seed production, organized by the Ocean Atmospheric Science and Technology Cell, Ministry of Earth Sciences, Andhra University, Visakhapatnam on 11th March 2007.

Exhibition

1. Participated in Krishi Mela 2006 organised by University of Agricultural Sciences, Bangalore and exhibited Institute's technologies from 17th to 20th November 2006. Institute got best stall prize.

2. Participated in Krishimela at Suttur, Mysore organized by Jathra Mahotsava Committee, JSS Mahavidhyapeeta, Mysore from 16th to 20th January 2007.

Meeting

1. The scientists of the institute participated in the one day international seminar on "Diagnostic wood heritage: Fundamental tools for knowledge, restoration and conservation" (Indo-Italian seminar) at IWST, Bangalore on 1st December 2006.

Dr. K.S. Shashidhar, Director, IWST addressing the participants during the Joint Interactive Meeting of IWST and IPIRTI with stake holders on 28th March 2007

Joint Interactive Meeting of IWST and IPIRTI participants being explained about the tissue culture practices

2. The scientists of the institute participated in "Discussion meeting on Biotechnological interventions for the conservation and utilization of forestry resources organized and sponsored by DBT at IWST, Bangalore from 22nd to 23rd March 2007.

3. The scientists participated in the Joint interactive meeting of IWST-IPIRTI with stakeholders at IWST on 28th March 2007.

4. The scientists of the institute participated in the RAG meeting of the institute on 26th September 2006.

5. Dr. O.K. Remadevi attended the executive meeting of Indian Academy of Wood Science held at IPIRTI on 12th May 2006.

6. Dr. O.K. Remadevi participated in the interactive meeting on Improved forest technologies organized by APFD at Forest Academy, Tirupati on 29th November 2006.

7. Dr. R. Sundararaj participated in the interactive meeting on Tree forming for sustainable development organized by APFD at Warrangal on 20th December 2006.

8. Mrs. D. Venmalar, Scientist-B attended the Bureau of Indian standard meeting for Wood preservation on 27th September 2006 at BIS, Bangalore.

9. Dr. K.S. Shashidhar, Director; Shri Suresh Gairola, Group Co-ordinator (R); Dr. T.S. Rathore, Scientist-E; Dr. Shyam Vishwanath, Scientist-E and Shri Pankaj K. Aggarwal, Scientist-in-charge (Extension) participated in Entrepreneurs Meet on Bamboo on 24th July 2006 at

Ponnampet. Meeting was organized by Kodagu Model Forest Trust, College of Forestry, Ponnampet under NMBA Sponsored project. Technical support is being provided by IWST.

LINKAGES AND COLLABORATIONS

1. MoU signed between Central Coffee Research Institute (CCRI), Coffee Research Station, Chikkamaglur district and IWST, Bangalore. Wood Properties and Uses Division of IWST will collaborate with scientists of CCRI in carrying out Research studies on the properties of coffee wood as indicators of white borer for resistance.

2. Officials from Coconut Development Board visited the Institute, appreciated the work carried out on ammonia plasticization of coconut wood and reproduced published paper in their Journal Indian Coconut Journal for wider publicity.

3. Linkages were developed with State Forest Department, Karnataka, Andhra Pradesh Forest Department, Goa Forest Department, Bangalore University, Bangalore, University of Agricultural Sciences, Bangalore, University of Agricultural Sciences, Dharwad, Andhra Pradesh Fisheries Department; Andhra University, Visakhapatnam; Sri Venkateswara University, Tirupati; Central Institute of Fisheries Technology, Visakhapatnam; Central Marine Fisheries Research Institute, Visakhapatnam; National Institute of Oceanography, Goa and Visakhapatnam; Naval Materials Research Laboratory, Ambernath; State Institute of Fisheries Technology, Kakinada; Visakhapatnam Port Trust and Toy making industries and Indian Institute of Science, Bangalore.

4. One operational DBT project in collaboration with KFRI, Peechi and IFGTB, Coimbatore on "Field performance of micro and macro propagated planting stock of selected five commercially important bamboo species"

PUBLICATIONS

Project Completion Reports

1. Evaluation of wood quality parameters of plantation grown *Eucalyptus citriodora* for different end uses.

2. Assessment of wood quality of *Simarouba glauca* for its timber value.

3. Use of sonic and ultrasonic testing techniques to evaluate wood strength of plantation species - A non-destructive test method.

4. Evaluation of treatability of selected refractory species.

5. Analytic studies on visco-elastic behaviour of wood and tree biomechanics.

6. Studies on fiber formation in wood.

7. Performance and evaluation of selected bamboo species treated by modified Boucherie process.

8. Chemical induction of heartwood in Sandal.

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.

10. Studies on teak heartwood borer *Alcterogystia (cossus) cadambae* moore and its management.

11. Standardization of protocol for viability testing and prolonging the viability and vigour of *Santalum album* seeds in storage.

12. Genetic screening of *Jatropha curcas* an important biofuel species of dry areas.

13. Evaluation of genetic variability and mating system analysis of *Aegle marmelos Co*rr. and *Feronia elephantum* Corr. using isoenzyme markers.

Books

1. III Consolidated Report on Marine Work was published in March 2007.

2. Publication of Institute's profile of IWST Marine Centre, Vishakapatnam in December 2006.

3. Publication of "A guide to some important timbers in South Indian markets" in January 2007.

CONSULTANCIES

1. 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.
2. 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.
3. Testing services were rendered to different users from Industry, Government departments, Police, Vigilance, CBI, Defence, Railways, Construction industry, NGOs and Private sectors on timber identification, moisture content, strength property determination and bulk density and specific gravity.
4. The peeling off paint of french knitters made from *Wrighitia tinctoria* wood was investigated for an export-oriented company from Nilgiris as they were getting rejected by importing country. Laboratory conditions were simulated with high humidity and saline conditions. It was found out that physical damage during processing and handling were possible causes but not due to high saline conditions. An amount of Rs. 10,000 was charged for this.
5. Twenty seven wood samples received from end users were analyzed for their preservative content. Problems related to wood preservation were discussed and suitable advices were given based on their enquiries.
6. A one-day consultancy was provided to Karnataka State Handicraft Development Corporation on drying of wood in a desiccant based dehumidification wood drying system on 21st September 2006.
7. The wood preservative which was supplied by Moldrup System is being tested for the efficacy of their product against decay fungi.
8. Dr. O.K. Remadevi and Shri Raja Muthukrishnan visited the Bamboo Stocks of Ranga Rao and Sons, Mysore on 4th August 2006 to investigate the pest problems on stored bamboos.
9. Dr. O.K. Remadevi visited ITC, Bhadrachalam to study pest problems on the test yard from 11th to 13th November 2006.

10. Dr. R. Sundararaj and Smt. H.C. Nagaveni visited the plantation area at Chelur beat in Bagepalli range of Kolar district on 12th November 2006 to inspect the Eucalyptus plants for finding out the problems and suggesting remedies.

11. Enquiry regarding pathogen problems from cooling towers attended.

12. Requisition for carrying out the efficacy of treated samples against wood decay fungi has been received.

13. Test report on laboratory evaluation of wood preservative for its efficacy against borers was sent to by FMC India Private Limited, Bangalore.

14. Dr. O.K. Remadevi and Raja Muthukrishnan visited Channapatna and Mysore in connection with studies on timber pests in depots and wood handicrafts units on 13th March 2007.

15. 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.

16. Study of existing flora and fauna and assessment of impact of flora and fauna due to diversion of forestland, Singareni Collieries Company Limited, Kothagudem, Andhra Pradesh.

17. Study on Catchment Area Treatment Plan for Diversion of Forest land for bauxite mining in Visakhapatnam, Andhra Pradesh. Andhra Pradesh Mineral Development Corporation Limited, Hyderabad was the user agency.

18. EIA studies and ecological studies for exploitation of bauxite deposits in Visakhapatnam District, Andhra Pradesh Mineral Development Corporation Limited, Hyderabad.

19. Three bamboo species, *Bambusa bamboos* (80 Nos.) and *Dendrocalamus strictus* and *O. stocksii*, culms each 2 metre length (total 330 Nos.) were treated by Sap-Displacement method with CCB (Copper Chrome Boric) wood preservative, to protect against insects and fungi and to increase the durability to Treelands Development Services (P) Ltd. on 26th March 2007.

CONFERENCE/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. 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. A total of 63 delegates participated in the workshop. A total of 18 papers were presented in addition to 3 poster presentations. A session on experience sharing was also organized. Three technical sessions were organized. It was inaugurated by Dr. P.J. Dilip Kumar, IFS, PCCF (EWPRT), KFD. Shri G.K. Prasad, DG, ICFRE participated in the Workshop on 29th March 2006 and gave special address.

2. Supported a one day workshop on water restoration conducted by National Water Development Academy on 23rd June 2006.

3. Two days training workshop for IFS officers on “Field applicability of forests and wildlife research outputs: Issues and strategies” was conducted on 10th and 11th October 2006. A total of 12 officers participated.

Participants in the two days training workshop for IFS officers on "Field applicability of forests and wildlife research outputs: Issues and strategies" at IWST, Bangalore

4. One-day Indo-Italian seminar on "Diagnostic on wood heritage: Fundamental tools for knowledge, restoration and conservation" organized on 1st December 2006. The seminar was sponsored by ICE, Mumbai and Italian Embassy, New Delhi. The seminar was inaugurated by Dr. Sivaramakrishna, Prof. (Retd.), University of Agricultural Sciences. A total of 7 presentations were made (3 from Italian side and 4 from Indian side) in the seminar.

Attended

1. All the Scientists of the institute attended the one day Joint Interactive Meeting of IWST-IPIRTI with Stakeholders at IWST Bangalore on 28th March 2007.
2. All the scientists of the institute participated in the Orientation program on Hindi at IWST, Bangalore on 14th March 2007.
3. Mr. P. Kumar participated in the exhibition of the Institute organised by Jata Mahotsava Committee, JSS Mahavidhya Peeta, Mysore between 15th to 16th January 2007.
4. Dr. R.V. Rao, Scientist-F, participated in the seminar organized by Research Wing of Andhra Pradesh Forest Department at Rajahmundry to demonstrate the Institute's technologies on 22nd and 23rd December 2006.
5. Dr. R.V. Rao, Dr. S.K. Sharma and Mr. A.K. Sethy attended Interactive Seminar for Forest Officers - Tree Farming for Sustainable Development, organised by Andhra Pradesh Forest Department at Tirupathi, Hyderabad, Warangal and Rajamundry in December 2006.
6. All the scientists of the institute attended one day Seminar on "Diagnostic on wood heritage: Fundamental tools for knowledge, restoration and conservation" (Indo-Italian seminar) at IWST, Bangalore on 1st December 2006.
7. Dr. R.V. Rao, Scientist F and Mr. P. Kumar, Scientist-B participated in the State Level Marketing Workshop on "Handicrafts of Karnataka" held on 29th November 2006 organized by the O/o the Development Commissioner (Handicrafts), Bangalore and gave lecture on "Alternative wood species for wood based handicrafts such as Lacquerware, Wood carving".
8. Dr. R.V. Rao, Scientist F attended Academic Council Meeting of FRI Deemed University on 14th September 2006 in the capacity of Member at Dehradun.

9. Dr. O.K. Remadevi and Dr. R. Sundararaj attended the National Symposium on "Biological Control of sucking pests in India" conducted by Society for Biocontrol Advancement, Project Directorate of Biological Control, Bangalore from 26th and 27th May 2006.

10. Raja Muthukrishnan, Sarasija, P., Deepa, B, Latheef and Debajyoti, C. attended the "International Conference on Zoology INCOZ 2006 Central College Campus, Bangalore University, Bangalore from 19th to 22nd November 2006.

11. Dr. O.K. Remadevi attended the 8th Pacific Rim Bio-based Composites Symposium from 20th to 23rd November 2006 at Kuala Lumpur, Malaysia.

12. Raja Muthukrishnan participated in the Interactive seminar on Technology Improvement from 12th and 13th December 2006 for forest officials, carpenters etc. held at Biotechnology Research Centre, Tirupathi.

13. Smt. H.C. Nagaveni attended meeting and presented programmed work of MoEF project in Research seminar in B.R. Hills conducted by DCF, Wild Life, Chamarajanagar.

14. Dr. R. Sundararaj attended a seminar on "Medicinal Plants" at Chennai on 24th and 25th January 2007.

15. Dr. O.K. Remadevi and B. Deepa participated in the III National Symposium on "Plant Protection in Horticulture: Emerging trends and challenges at Indian Institute of Horticulture Research, Bangalore from 7th to 9th March 2007 and presented a paper and got 1st prize for poster presentation.

16. Dr. R. Sundararaj and B. Deepa attended the National Conference on Organic Waste Utilization and Eco-friendly Technologies for Crop Protection held at Plant Protection Association of India at Hyderabad from 15th to 17th March 2007.

17. Dr. N. Rama Rao, Scientist E attended the Meeting of the Expert Committee on Plants for revision of species of the Wildlife (Protection) Act 1972, Ministry of Environment and Forests, New Delhi on 26th April 2006 and ICFRE, Dehradun on 16th October 2006 as an expert member.

18. Dr. N. Rama Rao, Scientist E attended the brain storming session on the Indian coasts: Planning and management, Centre for Studies of Bay of Bengal, Andhra University, Visakhapatnam on 22nd and 23rd May 2006.

19. Dr. M. Balaji and M. V. Rao, Scientists-C attended the Investing in fisheries for food security, Forum of Fisheries Professionals, India and Central Institute of Fisheries Technology, Visakhapatnam on 16th October 2006.

20. Dr. M. Balaji, Scientist C attended the Interactive Seminar on Tree Farming for Sustainable Development organized by Regional Forest Research Centre, Andhra Pradesh Forest Department, Rajahmundry on 23rd December 2006.

21. Dr. N. Rama Rao, Scientist-E, Dr. M. Balaji and M. V. Rao, Scientists C attended the *Energy Conservation in Fisheries,* Central Institute of Fisheries Technology, Visakhapatnam on 14th February 2007.

22. Dr. M. Balaji and M. V. Rao, Scientists C attended the Training programme on disease free shrimp seed production, Ocean Atmospheric Science and Technology Cell, Ministry of Earth Sciences, Andhra University, Visakhapatnam on 11th March 2007.

23. Dr. T.S. Rathore, Scientist E attended and participated in National conference on emerging trends and future challenges in Biotechnology at Bangalore on 22nd and 23rd September 2006, organized by the PES Institute of Technology, Bangalore.

24. Dr. T.S. Rathore, Scientist E attended and participated in National symposium on Plant Biotechnology *In vitro* regeneration and cloning techniques at Dehradun from 12th to 14th October 2006, organized by the FRI, Dehradun.

25. Dr. S. Viswanath, Scientist E attended and participated in the National Symposium on " Tree Improvement for Sustainable Forestry" held at JNKVV, Jabalpur, Madhya Pradesh from 4th to 6th November 2006.

26. Dr. S. Viswanath, Scientist E attended and participated in the National Symposium on Agroforestry for livelihood Security, Environment Protection and Biofuel Production at National Research Centre for Agroforestry (NRCA), Jhansi from 23rd to 25th December 2006.

27. Dr. S. Viswanath, Scientist E attended the workshop on Bamboo organized by Bamboo Co-ordinating Centre (BCC), GB Pant University of Agriculture and Tech., Pantnagar, Uttarakhand under the aegis of NMBA held at KFRI, Peechi from 22nd to 24th December 2006.

28. Dr. S. Viswanath, Scientist E 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 and Tech., Pantnagar, Uttarakhand.

29. Dr. Arun Kumar, Scientist C participated in Regional Conference on "Scope of Production Forestry for Enhancing Carbon Mitigation in India" at National Institute of Advanced Studies, Bangalore on 14thand 15th December 2006.

30. Dr. Arun Kumar, Scientist C Participated in National Conference on "Increasing Forest Productivity: Genetic and Breeding Options" held at Jabalpur from 21st to 23rd February 2007.

31. Dr. Arun Kumar, Scientist C and Mr. Ashutosh Srivastava, Scientist C participated in National Conference on "Increasing Forest Productivity: Genetic and Breeding Options" held at Jabalpur from 21st to 23rd February 2007.

AWARDS

1. IWST got best stall prize in Krishi Mela 2006 organised by University of Agricultural Sciences, Bangalore which was held from 17th to 20th November 2006.

2. Dr. K.S. Shashidhar, IFS, Director, IWST was conferred "The Great Son of Karnataka" award on 28th May 2006. The award was given by All India Conference of Intellectuals during their Silver Jubilee Celebration.

3. Dr. R.V. Rao was conferred ICFRE Excellency Award in Forest Utilization.

DISTINGUISHED VISITORS

1. Shri B.S. Parsheera, IAS, Additional Secretary, MoEF visited the Institute on 6th May 2006.
2. His Holiness Sri Sri Sri Viswaprasanna Thirtha Swamiji of Pejawar Mutt, Udupi visited the institute on 13th June 2006.
3. Mr. Krishnamurthy, MD, Huber Chemical (India) visited the institute on 12th July 2006 to explore the possibilities of sponsored or collaborative project in the field of wood science.

4. Mr. Steen Moldrup, MD, Moldrup system, Singapore visited the institute to seek consultancy on testing wood preservative and collaboration work on 13th July 2006.

5. Mr. J.C. Kala, DG (Forests) and Special Secretary, MoEF, Government of India visited the Institute and addressed the scientists on 4th September 2006.

6. Ms. Minni Mathew, IAS, Chairman, Coconut Development Board visited the Institute regarding work on coconut wood and other related aspects on 5th September 2006.

7. Mr. R. Chandramohan, IAS, Joint Secretary, CC II, MoEF, Govt. of India visited the Institute on 19th September 2006.

MISCELLANEOUS

1. Environment day was celebrated on 5th June 2006. Dr. Syam Vishwanath, Scientist-D delivered a talk on “Poverty, Environment and Desertification”.

2. World Forestry Day was celebrated on 20th March 2007.

Tropical Forest Research Institute Jabalpur

Tropical Forest Research Institute (TFRI), Jabalpur an institution under the ICFRE, caters to the forestry research needs of four States of central 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 and demonstration of agroforestry models, planting stock improvement, developing tissue culture protocols for difficult species of central Indian forests and control of forest diseases and insect 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 and were also actively involved in extension activities. This has helped the Institute in imbibing its research programme, ideas and concepts from various user groups.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: 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]

Findings: A user-friendly package "PLANTPAK" has been developed and tested successfully to evaluate the climatic suitability of forestry species in central Indian region. The package can be used to store, retrieve and display information based on simple key strokes. The package provides query on texturual as well as map basis. The package is tested with 15 data records and all the features including data entry, information retrieval based on species name, location, climatic as well as edaphic fields are working properly. The package is successfully tested for providing map based retrieval of information of suitable species.

Project 2: Germplasm conservation and investigation on inheritance pattern of *Gmelina arborea* [040/TFRI-2002/Gen-1(6)/ 2002-2007]

Findings: As availability of germplasm is a building block for effecting genetic improvement of any species, a germplasm bank with 49 diverse clones was established. 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 CSO-cum-progeny trial comprising of 11 families was established in complete randomized block design.

Germplasm bank of 49 clones, production population with 36 clones and progeny trial comprising of 11 half-sib families were maintained. Growth data from progeny trial was collected and statistically analysed according to Zobal and Talbert (1962). Analysis of variance revealed significant differences among the families for both height (ranging from 47.77 to 76.11 cm) and collar girth (ranging from 3.77 to 6.01cm). Height showed 63 and 70 percent whereas collar girth exhibited 73 and 62 percent heritability at individual and family levels, respectively. Both the traits were also found to be associated with each other as revealed by their significant correlations. Families Zagadpur-5 ORBLG-

1, ATIA-39, ATIA-45 and ORBLG-5 outperformed other families as indicated by their positive general combining ability (gca) values.

Project 3: Screening populations of *Dalbergia sissoo* for tolerance to salt and water stress using physio-morphological and bio-chemical criteria [067/TFRI-2004/Gen-2(9)/ 2004-2007]

Findings: Experiment was conducted to test 4 regimes of salt stress in sand culture pots. Growth and biomass accumulation and various biochemical parameters were investigated for 8 weeks at weekly intervals. The 4 populations of *Dalbergia sissoo* exhibited variable response with respect to these parameters. In conclusion, *D. sissoo* populations had considerable salt tolerance. Beside half-sib seeds were collected from various populations from Maharashtra and Madhya Pradesh and seed germination was tested against high salt concentrations.

Project 4: Evaluation of non-wood forest waste material for use in bio-composites [106/TFRI/2006/NWFP-1(21)/ 2006-2007]

Findings: Different forest areas viz. Kajol Nadi, Jabbara, Dugli, Achankmarg in Chattisgarh and Amarkantak in M.P. were surveyed and NWFP waste materials (leaves of Nagarmotha; Kans waste not used for rope making; lemon grass left over after extraction of essential oil) were collected. All the samples were processed for the estimation of ligno-cellulosic contents in the leaves.

PROJECTS CONTINUED DURING THE YEAR 2006 -2007

Project 1: Study on plant diversity in Sal Teak ecotone zone as influenced by ecological and climatic changes [085/TFRI/2005/Biod-2 (5)/ 2005 2009]

Status: Two sites viz. Umariya (M.P.) and Jagadalpur (C.G.) have been selected for the study where sal and teak are growing together naturally. Maps and other details of the study area along with weather records from 1995-2005 have been collected. Microclimatic data for May, June 2006 inside and outside the forest was also recorded. Quadrats have been laid out at both the ecotone area for floristic study. Number of species occurring in a quadrate and girth of tree species along with phenological observations of major tree species from both the sites have been recorded. The Important Value Index (IVI) and Diversity Index of tree species observed in both the sites are being calculated. Surface soil samples are collected from 0-5 and 5-15 cm depth in the ecotone area of Jagadalpur for analysis of soil microflora and soil chemical properties. The pattern of exploitation of major forest produces have also been recorded.

Project 2: Documentation of traditional knowledge on ethno-medicinal information from traditional herbal healers (vaidyas, ojhas, guniyas) in central Madhya Pradesh [084/TFRI/2005/Biod-1 (4)/ 2005- 2008]

Status: Literature survey was conducted for recording of existing information on traditional knowledge. Different tribal pockets have been identified for survey work in Sehor, Hoshangabad and Seoni districts of Madhya Pradesh. Five tribal pockets in Sehor district viz. Irchawar, Budni, Astha, Rehti and Nasrullaganj; four tribal pockets in Hoshangabad district viz. Sohagpur, Bagra Tawa, Kesala and three tribal pockets in Seoni district viz. Banjari, Dhuma and Chhapara have been identified. Preparation of list of herbal healers is in progress for Hoshangabad, Sehore and Seoni districts. Field survey was

conducted to record information available with traditional healers in tribal pockets identified in Sehore, Hoshangabad and Seoni districts. The plant part used along with different formulations and dosages used in cure of ailments were recorded. The response of tribal community towards use of herbal medicines has been recorded. Awareness among tribal communities was created by organizing village meetings in tribal pockets and among end users during Van Mela organized at Bhopal and Jabalpur.

Project 3: Eco-rehabilitation of limestone mined areas in Madhya Pradesh [065/TFRI/2004/Ecol-1(6)/ 2004-2007]

Status: Vegetation survey was carried out in Jamori limestone mined area by *quadrate* method in the overburden dump. Significant improvement in soil quality and fertility status was observed in already existing plantations of Kuteshwar and Jamori limestone mined areas. *Jatropha curcas* (232.3) showed superioty over other 21 selected species regarding growth and biomass parameters followed by *Acacia nilotica* (185.2), *Gmelina arborea* (130.5), *Dalbergia sissoo* (129.6), and *Eucalyptus hybrid* (125.2). VAM+PSB+Rhizobium was found as the best biofertilizer treatment for the growth of *Albizia procera* followed by VAM+PSB and Rhizobium+PSB. Twenty five ppm single super phosphate and 100 ppm urea was observed as the best combination for higher biomass production of A*lbiza procera* followed by 100 ppm urea and 50 ppm single super phosphate. Ammonium nitrate was found as the best treatment for higher biomass production among 3 different nitrogenous fertilizers followed by ammonium sulphate and ammonium chloride. Leaf litter prevented moisture loss followed by husk and grass.

Project 4: 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)/ 2005-2008]

Status: Surveys were conducted in different localities of Jabalpur, Behrai, Kanjai, Bamandehi, Dindori, Shahdol, Sagar, Damoh, Guna, Shivpuri, Indore, Jhabua, Satna, Panna, Katni, Maihar, Rewa, Sirmore, Mandsaur, Neemuch, Itarsi, Hoshangabad and Harda of Madhya Pradesh for the collection of Braconids. Over all 328 samples of insect fauna were collected by sweeping method; out of which 303 Braconids were isolated and preserved. A total 197 samples of leaf miners and defoliators of forest tree species (*Ailanthus excelsa*, *Butea monosperma*, *Pongamia pinnata*, *Dalbergia sissoo, Syzygium cumini, Lagerstroemia parviflora* and *Ziziyphus jujuba*), teak leaf defoliator / skeletonizer: *Hyblaea puera* and *Eutectona machaeralis* and bamboo leaf roller: *Crypsiptya coclesalis* were collected from above localities of Madhya Pradesh. *Apanteles machaeralis* was emerged from the larvae of *Eutectona machaeralis*; *Apanteles* sp. near *malacosomae* was reared from the larvae of *Atteva fabriciella*. Twelve Braconids (*Apanteles machaeralis, Apanteles* sp. near *malacosomae, Adialytus salicaphis, Cassidobracon indicus, Chelonus deogiri, Chelonus narayani, Microchelonus nigripes, Eutropobracon granulatus, Cassidobracon sumodani, Opius* species*, Parahormius stom* and *Mirax* sp. were identified up to species level. Other available Braconids are belonging to subfamilies: Microgasterinae, Miracinae; Opiinae, Cheloninae, Aphidiinae, Euphorinae, Dirrhopinae, Alysiinae, Cardiochilinae and Adeliinae.

Project 5: Effect of microbial inoculants on Safed Musli (*Chlorophytum borivillianum*) [082/TFRI-2005/Path-1(11)/2005-2007]

Status: Survey was conducted for germplasm collection of safed musli from Chhindwara, Saunser and Seoni. Safed Musli was raised in nursery beds by collected propagating material. *Fusarium* and one

fluorescent bacterium were isolated and purified from rhizopsphere of safed musli seedlings. A nursery experiment was conducted in RBD design to enhance the production of safed musli. VAM, PSB, *Azospirillum, Azotobacter* individually and in combination were used for experimentation. It was observed that application of VAM + *Azospirillum* + PSB has given maximum yield of safed musli. Saponin contents in different treatments were also analyzed.

Project 6: Studies on bacterial and viral diseases of teak, *Gmelina* and *Albizia* and their management [066/TFRI/2004/Patho-1(8)/ 2004-2008]

Status: Six isolates of bacteria were identified as a cause of collar rot and seedling wilt of *Tectona grandis* and *Gmelina arborea* in forest nurseries of Madhya Pradesh and Chhattisgarh. Out of 6 bacterial isolates 3 each were gram-positive and gram-negative. Further work on field management with application of broad spectrum antibiotics and modification in cultural practices is in progress. Assessment of damage caused by *Pseudomonas* in three FDCM teak nurseries (Ram Dongari, MS; Kanchangaon, MP and Chulband nursery, Gondia, MS) was done. Incidence of bacterial collar rot and wilt in six months' old seedlings of teak was assessed to be <5%. Leaf curl and stunting in one year old hi-tech teak plantation in Panna Forest Division was recorded. *Xanthomonas* was isolated from the affected leaf region.

Project 7: Studies on the role of Actinomycetes in controlling root diseases of *Tectona grandis, Albizia procera, Albizia lebbek* and *Acacia nilotica* in nurseries [072/TFRI-2004/Patho-2(9)/ 2004-2007]

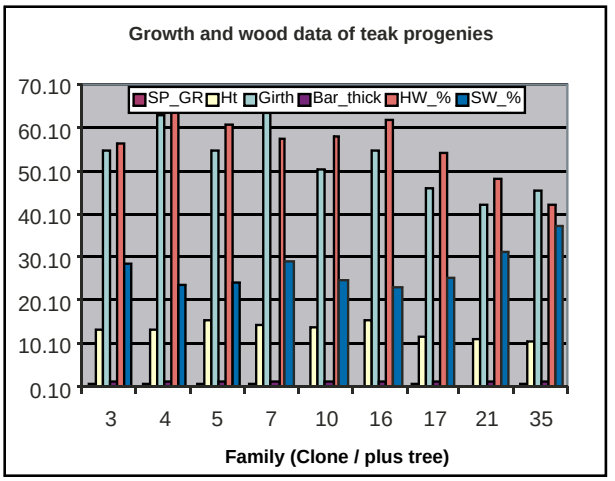
Status: Soil samples were collected from different parts of M.P. and C.G. (Katni, Mandla, Sagar, Badwani, Balaghat, Raipur, Bilaspur, Kundam) for isolation of actinomycetes and antagonistic bacteria. Three actinomycetes and 4 bacteria were isolated from the collected samples. Interaction of antagonistic actinomycetes and bacteria was tested against *Trichoderma viride, Bacillus subtilis, Fusarium oxysporum, Macrophomina phaseolina, Alternaria alternata* and *Ganoderma lucidum.* Crude extract of *Streptomyces* sp. was analyzed for mass spectra and NMR from CDRI Lucknow. The efficacy was also tested in nursery beds against wilt and root rot of *Albizia procera, Dalbergia sissoo, Albizia lebbek* and *Acacia nilotica* caused by *Fusarium solani*. Culture filtrate of antagonistic organism inhibited the growth of fungal flora on seeds of *Albizia lebbek, Dalbergia sissoo* and *Acacia nilotica* in Petri plates. FYM and Chicken Manure were found best for the growth of *Streptomyces* sp. for bulk culturing. Antagonistic bacteria were bulk cultured on PDA medium.

Project 8: Standardization of the cultivation technique and utilization of laccate stipitate species in *Ganodermataceae* (*G. lucidum*) [056/CFRHRD-2003/2(6)/ 2003-2007]

Status: Seventy eight specimens of the collected samples of *Ganoderma* species were identified up to species level. Purified cultures have been maintained in the laboratory for further estimation of their medicinal content. Screening of all the *Ganoderma lucidum* was carried out through cellulose degrading capability test. Estimation of glucanase production in four selected strains of *Ganoderma lucidum* was confirmed and categorized as stains of medicinal value. Selected strains cultivated in different nutrient substrate for mass multiplication and production of mycelium.

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

Status: The progeny trial of teak, raised at Mohogata (Maharashtra) during 1988, was investigated for growth and wood traits. Data on growth parameters viz., height, girth and bark thickness and wood traits viz., heart wood and sap wood, were collected from different teak progenies of the half-sib trial. There was significant variation with reference to the above growth and wood traits among the teak progenies. Wood core samples were also collected and processed for microscopic examination of length/diameter variations of vessels and fibers in progenies of half-sib families, to assess their inheritance pattern. Wood samples of teak progenies, collected from 28 years old progeny trial (Chandrapur, Maharashtra) were analyzed for fibre length, fibre thickness and fibre lumen width using micro-technique methodology. Preliminary results showed variation in the above wood parameters among the various progenies of families of teak.



Project 10: Chemical investigations on biologically active chemicals of forest species and their utility for pest control [069/TFRI-2004/NWFP-1(9)/ 2004-2007]

Status: *Jatropha curcas* seed oil was modified by sulphation reaction followed by neutralization. Physico-chemical properties of modified oil were assessed. Solubility of the product was assessed in different organic and inorganic solvents. Specific gravity, wetting power of 1-5% concentration, emulsifying power 1%, foaming power, surface tension, viscosity of different concentration of sulphated products were assessed. Properties were also compared with sulphated castor and karanj oil. Oil%, saponin and phytate contents in *J. curcas* seeds collected from Chhattisgarh were estimated. Herbicidal activities of *J. curcas* seed components and sulphated product was assessed against weed, *Parthenium hysterophorus*. Insecticidal /feeding deterrent activities of *J. curcas* seeds were assessed against insect *Hyblea puera* and termite *Odontotermes obesus* by soil graveyard method on wooden blocks of *Mangifera indica*. Nitrifiability of *J. curcas* seed cake was assessed up to 75 days. Antifungal activities of *J. curcas* seed products was assessed by seed dressing of *Dalbergia sissoo* and *Pongamia pinnata* seeds and appearance of fungal flora was recorded.

Project 11: Evaluation of wild edible plants of central region for polysaccharides and other food value [070/TFRI-2004/NWFP-2(10)/ 2004-2007]

Status: Surveys were conducted and samples were collected of *Curcuma angustifolia, C. pseudomontanum, Costus speciosus, Eulophia nuda, Puraria tuberosa, Randia dumatorum* and *Asterus hygromatricus* from Kalpi, Bichiya (Mandla), Kundam (Jabalpur) and Dindori (M.P.), Dhamtari, Dondi, Kanker (Chhattisgarh) and processed for further laboratory analysis. Different nutritional and anti-nutritional bio-chemicals viz., carbohydrates, starch, protein, tannin, phenols, oil per cent, cyanogens, fibre, minerals in collected fruits and tubers of different species were estimated. Diosgenin content in *Costus specious* tubers collected from different localities was isolated and estimated. Phenolic acids in tubers were extracted for estimation with HPLC.

Project 12: Evaluation, modification and value addition of starches of forest origin [083/TFRI/2005/NWFP-2(13)/ 2005-2008]

Status: Surveys were conducted and fruits of *Careya arboriya* were collected from 5 localities namely Bargi, Kundam, Mandla, Niwas and Sangrampur (M.P.) and starch was extracted. Maximum starch was obtained in 1% ammonium oxalate and distilled water. Rhizomes of *Curcuma aromatica* were collected and starch was extracted. The physico chemical properties of *C. aromatica* rhizomes were also determined.

Project 13: Evaluation of management systems and level of community participation under Joint Forest Management (JFM) [071/TFRI-2004/Silvi-1(6)/ 2004-2008]

Status: Sample plots have been laid out for assessment of JFM activities at Mendha (Lekha) Forest, Dhanora Range at Garchiroli Forest Division, Compartment No. RF-18 (Narwar Beat), MF-19 (Nipania Beat), RF-12 (Aintathar Beat), RF-11 (Jodhpur Beat). Soil samples have been collected for analysis of pH, per cent C and NPK. A copy of Micro plan and MoU signed between Maharasthra Forest Department and Villagers of Mendha Lekha Village has been obtained. Data have been collected for phyto-sociological studies. A micro-plan got prepared for Udaipur village in Maihar Range, Satna Forest Division and socio-economic and phytosociological studies were completed.

Project 14: Sustainable management of medicinal plants in JFM areas in different agro-climatic zones of Madhya Pradesh [079/TFRI/2005/Silvi-1(8)/ 2005-2010]

Status: Regeneration study of Kalmegh in a selected site has been completed. A new site has been selected near Delakhadi Forest Rest House, West Chhindwara Forest Division for study of sustainability of Kalmegh. Sample plots have been laid out and data have been collected. Site has been selected near Budhni village under Shiyarkheda Beat of East Harrai Range under East Chhindwara Forest Division for study of sustainable harvesting of Chironjee.

Project 15: Standardization of nursery techniques of *Strychnos nux-vomica* and *Strychnos potatorum* [080/TFRI/2005/Silvi-2(9)/ 2005-2008]

Status: In order to repeat the experiment for confirmation of earlier results the seeds, roots and branches of *S. nux-vomica* and *S. potatorum* were collected from Sahanikhar, Dhamtari Forest Division and Khutama South Forest Division, Chhindwara, respectively. The physical, chemical and hormonal treatments were given to seeds, roots and branches of *S. nux-vomica* and *S. potatorum* to study the regeneration of the species in silviculture nursery. Different physical, chemical and hormonal treatments were found to be effective in enhancing the germination and rooting performance of *S. nux-vomica* and *S. potatorum* of seeds and vegetative propagules over control.

Project 16: Seed physiology of the tropical forest species with special reference to their maturity and storage [076/TFRI-2004/Silvi-2(7)/ 2004-2009]

Status: Pre-treatment studies for enhancement of germination of seeds have been completed on *Mimusops elengi, Sapindus laurifolia* and *Terminalia chebula.* Studies on desiccation tolerance and seed storage behaviour have been done on *Bassia latifolia, Mimusops elengi*, *Moringa oleifera, Terminalia chebula* and *Holoptelea integrifolia*.

Seeds of *Moringa oleifera, Holoptelea integrifolia, Mimusops elengi,* and *Terminalia chebula* were adjusted to three to five moisture contents and stored at four different temperatures for evaluation of storage potential. Seed maturation studies for determination of seed collection time have been completed on *Mimusops elengi* and *Bassia latifolia* seeds.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Evaluation of Medicinal plant based agroforestry system (Silvi-medicinal) under existing teak plantations [105/TFRI/2006/Agro-1(14)/ 2006-2009]

Status: Existing teak plantations site was identified and selected for the study. The field experiments with Randomized Block Design were laid out for establishing Silvi-medicinal system by raising three medicinal plants viz. *Glosiosa superba, Costus speciosus* and *Curcuma longa* as intercrops under existing teak plantation in OSR (On Station Research), Agroforestry nursery and OFR (On Farm Research), Ranga plantation (private farmer) at Deori, Jabalpur. Observations on growth and yield data of trees and medicinal crops were recorded. Results indicated that *C. longa* performed significantly better as compared to *G. superba* and *C. speciosus.* Soil samples collected from the experimental plots were analysed for macronutrients (Nitrogen, Phosphorus and Potassium) in soil and no significant changes have been observed during the first year of the experiment. Rhizomes of all three medicinal crops were collected for the estimation of their active ingredients (dieosgenin, curcumin and colchicines).

A view of On Farm Research, Deori Village, Jabalpur

A view of On Station Research, TFRI

Project 2: Studies on the efficacy of toxins of soil actinomycetes against major forest insect pests [103/TFRI/2006/Ento-2 (13)/ 2006-2009]

Status: One hundred soil samples were collected from forests of Bargi, Kundam, Sihora, Belkund, Seoni, Rukhad, Mandla, Amarkantak of Madhya Pradesh and Achanakmar, Chhaparawa, Lamni, Atariya of Chhattisgarh. Soil culture of isolated actinomycetes was prepared by dilution plate method and culture filtrate was collected. Nurseries, plantations and natural forests were surveyed for collection of insects damaging teak and siris. Five new insect species (1 lepidopteran defoliator, 2 beetle defoliators and 2 sap-suckers) were reported feeding on *Albizia* species. Teak defoliator and skeletonizer and *Albizia* shoot feeder were collected and their breeding and rearing in the laboratory was carried out. Seed pests of *A. lebbek* were collected and a major bruchid pest, *Bruchus* species was reared in laboratory. Observations were recorded on the pattern of infestation and concomitant loss in seed yield due to bruchids. The culture filtrate of soil actinomycete against teak defoliator was standardized in the laboratory. Culture filtrate of soil actinomycete was tested against skeletonizer and *Albizia* shoot feeder through larval and food treatment. Tests of culture filtrate of soil actinomycete against *Bruchidius bilineatopygus*, a major seed pest of *Albizia* species were initiated.

Project 3: Evaluation of biopesticidal products for the management of teak defoliator and skeletonizer in forest nursery [104/TFRI /2006/Ento-3(14)/ 2006-2009]

Status: The experimental nursery stock was periodically monitored for incidence of the teak defoliator and skeletonizer. Collection of teak defoliator and skeletonizer was made from plantation areas of Udaipur, Kalpi, Tikariya under Mandla Forest Division, Mandla (M.P.) and culture was maintained in laboratory. Eight concentrations of three commercially available botanical biopesticides (Neemgold, Neemsuraksha and Neem oil) were evaluated. Sampling, isolation and identification of entomopathogenic fungi from insects collected from Nagpur (M.S.), Belkund, Kundam, Seoni and Mandla (M.P.) were carried out and cultures were maintained.

Project 4: Development of nursery techniques for *Terminalia chebula* Retx. (Harad) [107/TFRI/2006/Silvi-1(12)/ 2006-2009]

Status: Seeds and vegetative propagules of *Terminalia chebula* were collected from two sources. Different physical, chemical and hormonal treatments were found to enhance the germination of *Terminalia chebula* seeds over control.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

(Externally Aided)

Project 1: Documentation of best practices in collection and processing of NWFPs in Chhattisgarh [089/TFRI-2005/Agro-CGMFP(13)/ 2005-2007]

Findings: Field visits have been made to document the collection and processing methods of NTFPs in all 16 divisions of Chhattisgarh. The Collected data were compiled, tabulated and analysed for preparation of the final report.

Project 2: Training of societies in collection and grading of NWFPs [090/TFRI-2005/Agro-2 CGMFP(12)/ 2005-2006]

Findings: Training was 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”.

Project 3: Developing coalition approach to non-timber forest product for better livelihood of tribal communities of Madhya Pradesh [053/TFRI-2003/Agro-1(DFID)(10)/ 2003-2007]

Findings: Technique of lac cultivation established, maintained and standardized in the study sites viz. villages of Bhajia, Bisenpura, Mehdar and Majhegaon (Kundam block of Jabalpur). Broodlac was raised on about 600 lac host trees and data recorded on yield of lac and growth of trees. Compiled and tabulated data was statistically analysed.

Project 4: Introduction of egg parasitoid, *Trichogramma raoi* to protect teak seed orchards from the loss caused by teak defoliator and skeletonizer [086/TFRI-2005/Ento-3 (MPFD)(11)/ 2005-2007]

Findings: Utilization of indigenous egg parasitoid, *Trichogramma raoi* to protect Teak Seed Orchards (TSOs) from the loss caused by teak defoliator and skeletonizer, proved that application of egg

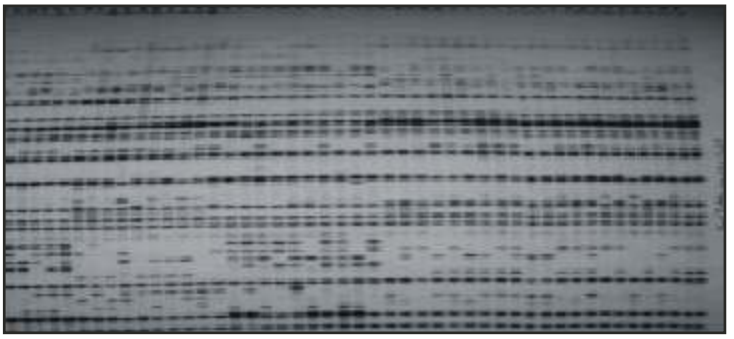
parasitoid between July to September at 1.25 lakhs/ha was highly effective to minimize the intensity of pest attack and annual growth loss in TSOs as compared to the unreleased sites.

Project 5: Taxonomy and documentation of fungi occurring in forests of Madhya Pradesh and Chhattisgarh [061/TFRI-2003/Path-1(CSIR)(7)/ 2003-2007]

Findings: Fungi were collected from forests of Madhya Pradesh and Chhattisgarh. A total of 813 collections were made from plant parts and soil fungi were isolated from 144 soil samples. Total 249 fungi were identified, described in detail with photographs and camera lucida drawings. Documentation and genus wise record of fungi was prepared. The study revealed 2 new genera, 24 new species, 28 new records of fungi from India and 73 new host records for the fungi. The new genera proposed are: *Acrodictiella* and *Kamalomyces*, while the species reported new to science are: *Acrodictiella indica, Acrostroma madhucae, A. sterculiae, Corynespora pogostemonis, C. supkharii, C. woodfordiae, Denticularia terminaliae, Hypoxylon dendrocalami, H. spiralis, Hysterium jabalpurensis, Kamalomyces indicus, Kameshwaromyces butiicolous, Meliola ougeiniae, Mysterosporiella terminaliae, Phaeoseptoria shoreae, Phomopsis ougeiniae, Pseudocercospora isorae, P. schleicherae-oleosae, Rehmiodothis bambusae, Sirosporium aeglicola, S. xylopyrae, Stenella flacourticola, S. liliacearum,* and *S. satpurensis.* The record of identified fungi from forests of M.P. and C.G. was prepared tree wise. In this regard total 803 fungi were listed including 656 fungi on 138 trees, 32 on bamboos and grasses, 8 on palms, 41 on shrubs, 15 on climbers, 13 on herbs, 2 on ferns, 13 on dead wood and dead twigs, 2 on dead unidentified bark, 3 on leaf litter and 18 in rhizosphere soil of tree species. The fungi were also classified on the basis of forest types of M.P. and C.G., into 17 groups. A mycology herbarium of forest fungi was established at the institute and 813 specimens were systematically arranged and kept in herbarium cabinets. An identification service for forest fungi has been started at the institute.

Project 6: Studies on cataloguing the genetic variation in teak species (*Tectona grandis* and *Tectona hamiltonii*) using molecular markers [052/TFRI-2003/Gen-1(DBT)(7)/ 2003-2006]

Findings: Teak populations collected from different forest types of the country were assessed for molecular genetic variation using ISSR and AFLP markers. Analysis of DNA polymorphism detected very high levels of genetic diversity in the teak populations. ISSR analysis of 29 teak populations detected high Nei's genetic diversity (0.36) than AFLP analysis of ten populations (0.26). Most of the teak populations grouped according to their distribution range. In ISSR assay using 29 teak populations, intra-population variation was high (91%) than inter-population variation (3%). AFLP assay using 10 teak populations detected similar trend for albeit comparatively less values (67% intra-population variation and 27% inter-populations variation).



AFLT profile of populations of *T. grandis*

Project 7: Standardization of production technology of some important medicinal plants under tropical climate of Madhya Pradesh [055/CFRHRD- 2003/1(MHFW)(5)/ 2003-2007]

Findings: *Emblica officinalis* (Aonla): Non-destructive harvesting method to harvest aonla fruits was standardized. Major active ingredients viz. ascorbic acid, gallic acid and tannins were estimated in Aonla fruits collected at different time of maturity. January was found the best time to harvest Aonla fruits as it contained higher amount of ascorbic acid. Influence of storage on ascorbic acid content was studied. Green chip grating and drying in sun was found the best method of processing of Aonla fruits.

***Rauvolfia serpentina* (Sarpagandha):** Manure requirement for the cultivation of Sarpagandha was standardized. Vermicompost 2.5 kg plus 5 kg FYM per bed was found superior among all the treatments. April-May was found the best time to sow Sarpagandha seeds to raise seedlings. March-April was found the best time for vegetative propagation through root and stem cuttings. December was found the best time to harvest Sarpagandha roots as at this time it contained higher amount of alkaloids. Non-destructive harvesting practices were standardized for the tropical climate of Madhya Pradesh. Total alkaloid and reserpine content were estimated in Sarpagandha roots. Seeds (7 Kg) were collected for distribution among farmers.

***Andrographis paniculata* (Kalmegh):** Cut method was found superior over uproot method. March-April was found the best time to raise nursery for Kalmegh. Kalmegh samples were analyzed for andrographolide content using HPLC. The variations in andrographolide content were found among samples collected during different time of maturity and locations. Seeds (2 kg) were collected for distribution among farmers/SFDs.

***Gymnema sylvestre* (Gurmar):** Vermicompost 2.5 kg plus 5 kg FYM per bed was found superior to raise Gurmar. The vegetative propagation techniques were standardized. Woody cuttings planted in the month of July performed well in terms of rooting (60%). The Gurmar seedlings were also raised from seeds. However, the germination percentage was only 40%. October-November was found the best time to harvest the leaves. As Gurmar is a climber, it requires support for its development. Gymnemic acid was estimated from the leaves of Gurmar.

***Tinospora cordifolia* (Gurbel or Giloe):** Vegetative propagation techniques were standardized. April-June was found the best time to raise plantlets. Cuttings treated with 500 ppm IBA got 100% rooting. Ninty five per cent germination was recorded in the seeds sown in the month of October. Manure doses were standardized for the cultivation of Giloe. Giloe is a climber, the support system plays vital role in the development and growth of Giloe. Non-destructive harvesting practices were also standardized. The drying and processing technique were developed for Giloe.

***Gloriosa superba* (Kalihari):** Kalihari seedlings were raised from seeds. However, germination percentage was very poor being only 15 %. One-year old rhizomes raised from seeds were planted in nursery. For cultivation of Kalihari good support system is required as Kalihari plant is very tender. Colchicine was estimated from Kalihari rhizomes and seeds.

Project 8: Study of Sal mortality in Forest Divisions of Chhattisgarh [074/TFRI-2004/Patho-3(CGFD)(10)/ 2004-2007]

Findings: Dying of Sal is observed from top to downwards where fire and grazing are common. Soil analysis showed less organic matter and compactness which reduced its moisture holding capacity. The affected Sal trees showed 40-60% rot in the heartwood. In some observations, a root rot fungus *Polyporus shorae* was recorded. Ectomycorrhizal development and regeneration of Sal were very poor. There is needed to improve the organic matter in Sal mortality area by adopting measures for protection from fire and grazing.

Project 9: Non-destructive harvesting practices for selective MFP-Nagarmotha [094/TFRI/2005/NWFP-6(CGFP)(17)/ 2005-2007]

Findings: Different forest areas viz. Hagaria Nala and Haff Nadi, Bissaraghat, Pandaria, Khawardha; Amadoh Nala, Kewchi range, Marwahi Forest Division; Khandajhari Nala, Komakhan, Abhunpur; Chargao, Bhabbar Ganj River, and Kajool Nadi, Dhugli and Dhumtari were surveyed for the occurrence of Nagarmotha. An experiment in Randomized block design with plot size 1x1 meter with 4 treatments and 3 replications were set up in Kajol Nadi in the month of May June 2006. Total plants were counted in each experimental plot and 60%, 70%, 80% and 90% Nagarmotha plants were uprooted, rhizomes were removed and essential oil was estimated to be 0.06%. The experiment was evaluated in the month of December to ascertain efficacy of the above harvesting intensity for regeneration and sustainability. From the experiment it was inferred that for non destructive sustainable harvesting plants should only be harvested up to 80-90% to ensure proper regeneration.

Project 10: Processing techniques of NWFP *Aegle marmelos* (Bael) [095/TFRI/ 2005/ NWFP-7(CGFP)(18)/2005-2007]

Findings: Different forest areas viz. Badora and Rhamankappa in Pandaria, Kawardha and Mohgao in Kharagarh, Chattisgarh were surveyed. Unripe and matured fruits of *Aegle marmelos* in the month of January-February 2006 and ripe and matured fruits in the month of May-June 2006 were collected. Fruits from all the 3 localities were slightly cracked and processed by 3 different methods for the development of best processing techniques of bael fruits. Results indicated that Rhamankappa fruits were best in terms of size, amount of pulp, colour and texture of the pulp as well as taste. Fruits from this locality also yielded best quality pulp with less amount of mucilage. Among different processing methods tested, sun drying method was found to be the best.

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Identification of species and ethnobotanical survey [088/TFRI/ 2005/Biod.3(CGMFD)(6)/ 2005-2008]

Status: Survey in eight People Protect Areas (PPAs) of Chhattisgarh at Karpavan, Machkot, Guriya, Jabarra, Shankra, Lamni, Marwahi and Makadi located in Jagadalpur, Dhamtari, Bilaspur, Pendra Road and Kondagaon was conducted for observations on vegetation status. Quadrate study has been conducted in eight PPA sites for documenting floral wealth and increasing or decreasing trend of important forestry species in the area. Vegetational data of PPA for tree species with girth class, regeneration status of major tree species and medicinal plants available in the area were recorded during the study and from previous survey records. Data collected from Jabarra PPA sites of Chhattisgarh forest area for species richness, Diversity Index and IVI have been calculated. Tabulation of regeneration data from Machkot, Sankara, Lamni, Marwahi and Guriya PPA sites for the year 2004-05 and 2005- 06 have been made. A total of 140 herbarium specimens have been collected. The ethno-botanical uses of medicinal plants observed from above PPA sites have been documented. Common and medicinal uses of 73 plants species including 56 dicots and 17 monocots found in the PPA sites are recorded along with proper identification, botanical name and family.

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)/ 2005-2010]

Status: The suitable sites having 10 ha area were selected at Bargi command area for experiment.

Water samples from the Left Bank Canal (LBC) were collected and analysed for their physical, chemical and biological parameters. The native vegetation of the selected sites was surveyed. Existing cropping pattern in the villages surrounding the selected sites along the LBC of Bargi command area was studied. The soil samples were collected from different horizons and analysed for pH, CEC, organic carbon, available N, P, K, exchangeable Na, K, Ca and Mg. Mechanical analyses for texture of the soil samples were also done. Seeds from phenotypically superior trees of *Albizia lebbeck, Albizia procera, Acacia nilotica, Dalbergia sissoo, Terminalia arjuna, Terminalia tomentosa, Pongamia pinnata, Boswellia serrata, Ailanthus excelsa, Eucalyptus* species (FRI-4 and FRI-5) and *Jatropha curcas* and bulbils from *Agave americana* were collected. About 29000 seedlings were raised in nursery. About 3000 seedlings of *Jatropha curcas* and 1500 seedlings of *Agave americana* were planted at Bargi command area for bio-fencing of the plantation sites. Profile studies were conducted for selected sites. Transpiration rate (E) of the selected species under nursery condition was measured using Photosynthesis system.

Project 3: Screening of indigenous species of *Trichogramma* Westwoodand *Trichogrammatoidea* Girault (Hymenoptera:Trichogrammatidae) from central India and their utilization against important forest insect pests [077/TFRI/2005/Ento-1(9)/ 2005-2008]

Status: Survey of important localities of Jabalpur, Mandla, Seoni, Behrai, Kanjai, Bamandehi, Sagar, Damoh, Guna, Shivpuri, Kawardha, Durg, Rajnand gaon, Raipur, Bhilai, Kanker, Jagdalpur, Bastar, Narayanpur, Bilaspur, Korba, Janjgeer Chanpa, Jashpur Nagar, Ambikapur, Koria, Dantewara, Mahasamund, Nagpur and Amravati were carried out for the collection of *Trichogramma and Trichogrammatoidea species*. Over all 938 specimens belonging to the genera: *Trichogramma* and *Trichogrammatoidea* were collected. Nine species of *Trichogramma* and two species of *Trichogrammatoidea* (*Trichogramma achaeae*, *T. chilotraeae, T. hesperidis, T. plasseyensi, T. raoi, T. sembeli, T. vargasi, T. sericini, T. julianoi; Trichogrammatoidea bactrae* and *T. ruficorpa* have been recorded as indigenous species, existing in Madhya Pradesh and Chhattisgarh. One culture of local indigenous species, *Trichogramma raoi* is being maintained. Six new cultures of *Trichogramma* species were collected from Madhya Pradesh and Chhattisgarh. All six new cultures of *Trichogramma* species are being maintained. Culture of *Corcyra cephalonica* is being maintained for the use of their eggs as laboratory host / fictitious eggs for *Trichogramma* and *Trichogrammatoidea* species.

Project 4: Studies on refinement and scaling up of existing micro-propagation and macro-propagation technologies for *Bambusa nutans* and *B. tulda* [063/TFRI2004/Gen-1(DBT)(7)/ 2004-2007]

Status: Micropropagation/shoot multiplication: In *B. nutans* shoot multiplication experiment was conducted to compare stationary cultures and cultures on rotary shaker. Multiplication rate was better in stationary cultures. *Bambusa tulda* shoot multiplication experiment was conducted under different light regimes, which exhibited non-significant effect on shoot multiplication rate. Presently 750 and 605 propagules of *B. nutans* and *B. tulda* are being maintained for multiplication, respectively.

Hardening and acclimatization of plantlets: In the first set of experiment, *in vitro* raised plantlets of *B. nutans* and *B. tulda* were hardened in four types of sterilized substrates, viz., soilrite, perlite, vermiculite and compost in root trainers. Perlite was found to be most suitable hardening mixture with 91% survival of plantlets of *B. tulda* whereas in *B. nutans* maximum survival (90%) was observed on vermiculite,

which was statistically at par with that on soilrite and perlite. In the second set of experiment six mixtures were tried for hardening, which did not have any significant effect on the survival and height of plants.

Micropropagation of *Bambusa nutans* and *B.tulda*
(a)shoot multiplication of *B. nutans*,(b) shoot multiplication of *B.tulda,*
(c),(d) Hardening in four substrates in root-trainers,(e)plantlets of *B. nutans* (f) plantlets of *B.tulda*

Macropropagation: Cuttings of *B. nutans* from Sambalpur (Orissa) were collected for production of plantlets through adventitious rhizogenesis.

Macroproliferation: Macroproliferation of the plantlets produced through both micropropagation and macropropagation were carried out. For *B. nutans* 1308 number of micropropagated and 521 number of macropropagated plants were produced and for *B. tulda* 708 number of micropropagated plants were produced.

Project 5: Processing techniques of NWFPs of Chhattisgarh *Madhuca latifolia, Shorea robusta, Schleichera oleosa, Pongamia pinnata, Buchanania lanzans* Spreng (Chironjee) [091/TFRI/2005/NWFP-3(CGMFD)(14)/ 2005-2007]

Status: Seeds of *Pongamia pinnata* (karanj), *Madhuca latifolia* (mahua), *Schleichera oleosa* (kusum) from Kundam (Jabalpur) and Kalpi (Mandla); *Shorea robusta* (sal) and *Buchanania lanzan* from Bilaspur (Chhattisgarh) were collected. Collected seeds were processed (decorticated, dried and stored). Oil percentage, physico-chemical properties of oil, carbohydrates, and protein content were estimated. Seeds were dried and stored in different containers for the assessment of effects of processing methods on quality of seeds. Fungal flora of seeds was assessed from collected species.

Project 6: Quality assessment of NWFPs from different regions of Chhattisgarh (Species - *Asparagus racemosus, Buchanania lanzan, Emblica officinalis, Embelia ribes* and *Andrographis paniculata)* [092/TFRI/2005/ NWFP-4 (CGMFD)(15)/ 2005-2007]

Status: Aonla, Satawar, Chironjee, Vaibidang and Kalmegh were collected from Bilaspur, Dhamtari and Bastar regions of Chhattisgarh. Physico-chemical properties of chironjee seeds were assessed. Ascorbic acid in aonla samples were estimated. Kalmegh samples were prepared for the estimation of *Andrographolide* with the help of HPLC. Minerals, carbohydrates and saponins in Satawar samples were estimated.

Project 7: Non destructive harvesting practices for selective MFPs - *Buchanania lanzan* Spreng (Chironjee) [093/TFRI/2005/NWFP-5 (CGMFD) (16)/ 2005-2007]

Status: Physico-chemical properties, viz. moisture percentage, kernel: shell ratio, fruit and seeds weight, oil percentage, specific gravity, refractive index, saponification value, free fatty acid composition and iodine value of oil of Chironjee collected at different intervals were assessed. Minerals and protein were assessed in chironjee seed cake. Two sites (Bilaspur and Sirpur, Chhattisgarh) were selected to conduct experiment for sustainable harvesting.

Project 8: Standardization of sustainable harvesting practices of *Terminalia arjuna* bark [78/TFRI/2005/NWFP-1(MPFED)(12)/2005-2008]

Status: Surveys were conducted at Balaghat and Jabalpur districts of Madhya Pradesh for laying out of experiments to harvest Arjuna bark. Arjuna trees of different age groups and girth sizes were selected for laying out the experiments to harvest the bark. The experiments were laid out in the forest area of Balaghat as well as in the farmer's field for the extraction of bark. The girth of selected trees ranged between 67-218 cm, bark thickness ranged from 7.12 to 18.65 mm were recorded at breast height. Mean bark thickness at breast height in Arjuna trees was recorded 13.50 mm. Mean thickness of bark varied from trees to trees irrespective of the age and girth of the tree. Mean bark yield per square centimeter ranged between 0.29 gm to 1.25 gm and found varying from tree to tree. Collected bark samples were analysed for tannin and oxalic acid contents. The tannin content ranged from 7.70 to 15.35 gm per 100 gm. The amount of oxalic acid in the bark ranged between 10.50 gm to 20.25 gm per

100 gm. Regular field observations were taken on the recovery of bark. The stage of bark recovery (regrowth) varied from tree to tree. In some trees the bark regeneration is complete. In the areas where water is available throughout the year (near nallas) the recovery of bark was faster. In younger trees the bark regeneration was faster in comparison to older trees. Extraction of bark can be done after two years from the opposite quarter of the blaze without destroying the tree. September October was found the best time to harvest the bark.

Project 9: Standardization of non-destructive harvesting practices of Arjuna (*Terminalia arjuna*), Maida (*Litsea chinensis*) and Ashoka (*Saraca indica*) bark [96/TFRI/2005/NWFP-8(CGMFD)(19)/ 2005-2007]

Status: The experiments were laid out to harvest Arjuna and Maida bark in the forest area of Dhamtari, Kanker, Sarguja, Raigarh and Marvahi forest divisions of Chattisgarh. Bark. Samples were collected and processed for chemical analyses. The availability of Maida trees in the forest area is very less. Arjuna bark samples were analysed for tannin and oxalic acid contents. Mucilage and tannin were analysed from Maida bark samples. No Ashoka tree could be found in the forest areas of Chattisgarh. Therefore, experiments were laid out to harvest Ashoka bark in Balaghat and Sagar in Madhya Pradesh. Data on bark regeneration/regrowth were collected from the experiments laid out earlier. The regeneration of bark has started and no tree was found with complete regeneration.

Project 10: Standardization of non-destructive harvesting practices of Baividang (*Embelia ribes*), Baheda (*Terminalia belerica*) and Aonla *(Emblica officinalis)* fruits [97/TFRI/2005/NWFP-8(CGMFD)(20)/ 2005-2007]

Status: Aonla, Baividang and Baheda growing areas were selected in Dhamtari, Kanker, Sarguja, Raigarh and Marvahi forest divisions of Chhattisgarh. Experiments were laid out to harvest Aonla and Baheda fruits. Fresh and dry weight of collected fruit samples was determined. Collected Aonla and Baheda fruits were analysed for tannin, ascorbic acid and gallic acid. Processing of Aonla fruits (boiling, chipping, grating, sun drying, solar cooker drying) was done. Grating was found the best processing method. The different processed samples were analysed for tannin, ascorbic acid and gallic acid contents. The Baividang fruits were analysed for Ca and Mg. Variations were found in fruit size, fruit weight, tannin and ascorbic acid contents in the fruit samples of Aonla and Baheda collected from various locations. The data on regeneration status of Aonla, Baheda and Baividang were collected. New Aonla, Baheda and Baividang seedlings were found in the experimental areas.

Project 11: National Network on Integrated Development of Jatropha and Karanj [73/TFRI-2004/NWFP-3(NOVOD)(11)/ 2004-2007]

Status: *Jatropha curcas*: 8000 seedlings/plantlets have been raised from the collected superior material. National trial of Jatropha comprising of 3 accessions from 2 participating Institutes has been established at the institute campus. A progeny trial comprising of 20 progenies has been established at Barah experimental area of the Institute. All experiments e.g. national trial, zonal trial, progeny trials and package of practices trials are bring maintained at the Institute campus and its Centre at Chhindwara. The observations on growth attributes like height, collar diameter, number of branches, etc. were recorded at regular intervals. The trials are performing well and the survival is more than 95%. Pruning operations were conducted to study the effect of pruning on growth and productivity of *Jatropha*. Fatty oils were extracted and yield was estimated to identify the elite trees of *Jatropha*. The oil percentage

varied from 24.07 - 40.06 % from the seeds collected from various agroclimatic regions of the study area. Out of 25 samples, seeds from seven CPTs have been found to contain more than 35% oil. Ten seed samples were sent to NBPGR, New Delhi for cryopreservation and allotting accession numbers. Initial findings of the study show that the seedlings planted on ridges in the last week of July 2005 performed better than the seedlings planted in pits. Bare-rooted seedlings performed at par with poly-potted seedlings if planted within 24 hours after taking out from the nursery beds. The planting of bare-rooted seedlings reduced the cost of plantation considerably. Pruning had positive impact on seed production of *Jatropha* as it yielded more fruits.

***Pongamia pinnata* (Karanj):** Twenty five Candidate Plus Trees (CPTs) of Karanj have been selected for collection of fruits from Sagar, Gwalior, Shivpuri, Muraina, Shivpur Kala and Damoh districts of M.P. The data pertaining to individual candidate plus tree on height, dbh, crown area, fruit size (pod) and fruit yield, etc. were collected. A total of 3,000 seedlings have been raised from the seeds collected from various sources. The collected seeds were tested for germination. A zonal trial comprising of 5 accessions received from one institution has been established at the Institute campus. However, a progeny trial comprising of 20 progenies has been established at Barah experimental area of the Institute. Twenty five seed samples collected from various parts of Madhya Pradesh were sent to TERI, New Delhi for oil estimation. Out of 25 samples, 18 samples contain more than 35 % of oil. The oil percentage varied from 31.52 to 39.65 percent. Sixteen Karanj seed samples were sent to NBPGR for cryopreservation and allotting accession numbers. National, zonal and progeny trials raised at the Institute campus and Bhandamuri, Balaghat are being maintained. The dead plants were replaced by the seedlings of same age from same accessions. The survival percentage is more than 90 per cent. Regular field observations were recoded on growth attributes of plants e.g. height, collar diameter, etc.

Project 12: 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)/ 2005-2007]

Status: Sample plots of Kalmegh were laid out at Jhalpani, Sonakhan Range under Raipur Forest Division and at Lalunga Range of Dharmjaigarh Forest Division. Sample plots of Kalmegh, Malkangni and Satawar were laid out at Mohali Forest Circle in Karpawond Range of Jagadalpur Forest Division. Two sample plots were laid out of Malkangni at Sankara Forest Range under Dhamtari Forest Division. One more sample plot was laid out for Bael at Mohgoan Gandai Range under Khairagarh Forest Division. As per experimental design and regeneration studies, sampling of Satawar, Malkangni and Kalmegh were done and their fresh and dry weights were taken.

Project 13: Nursery technologies of mass multiplication of superior seedlings Balbaring, Sarpgandha, Chironjee Arjun, Aonla, Bael in Chhattisgarh [099/TFRI /2005/Silvi-4 (CGMFD -11)/ 2005-2007]

Status: Seeds of Baividang and cuttings of Maida have been collected from Biligarh Range, Raipur Division in Chhattisgarh. Vegetative propagation experiments under different hormonal treatments were conducted to study the sprouting and rooting performance.

PROJECTS INITIATED DURING THE YEAR 2006-2007
(Extrenally Aided)

Project 1: Study on utilization pattern of plants in ethno - medicinal uses prevalent in tribal pockets of Satpura plateau in Madhya Pradesh [101/TFRI/JBP/2006/Biod-1 (MPSBDB) (07) 2006-2010]

Status: Field surveys were conducted in Mandla district of Madhya Pradesh and Bijadandi, Kalpi, Motinala, Mohiyanala, Pondi, Sarhi, Chhindgaon, Jamuniya, Tikariya, Kundamali, Bhaiswahi, Rasulganj, Bammari, Babaliya and Amgaon villages have been identified tribal pockets. Fifteen traditional healers have been identified from above villages for documentation of traditional knowledge. Seventy eight plants have been identified from Kalpi, Niwas and Gughari range of Mandla district. The existing utilization pattern of 36 plants was recorded with formulations for cure of various diseases prevalent in tribal pockets. List of 10 traders and middle men involved in collection of raw materials of medicinal plants has been documented from Mandla Forest Divison.

Project 2: Lead institution for Achanakmar-Amarkantak Biosphere Reserve Chhattisgarh [102/TFRI/2006/Ento-1(MoEF)(12)/ 2006-2009]

Status: Data on vegetation available in Achanakmar-Amarkantak Biosphere Reserve (AABR) viz., 7 species of algae, 111 species of fungi, 3 species of lichens, 15 species of bryophytes, 23 species of pteridophytes, 14 species of gymnosperms and 656 species of angiosperms were documented. Seven sample plots were laid out in different ranges of A.A.B.R. and population density of trees, shrubs, herbs and their regeneration were studied. NTFPs existing were also documented. Inventory list of 47 species of butterflies, 22 species of beetles, 1 species of rare cricket, 22 species of fishes, 9 species of amphibians, 45 species of reptiles, 145 species of birds and 29 species of mammals were also prepared. Soil types and nutrient status of 7 sample plots were studied. Tribes inhabiting in 238 villages of AABR were documented and economic status of 6 villages sampled.

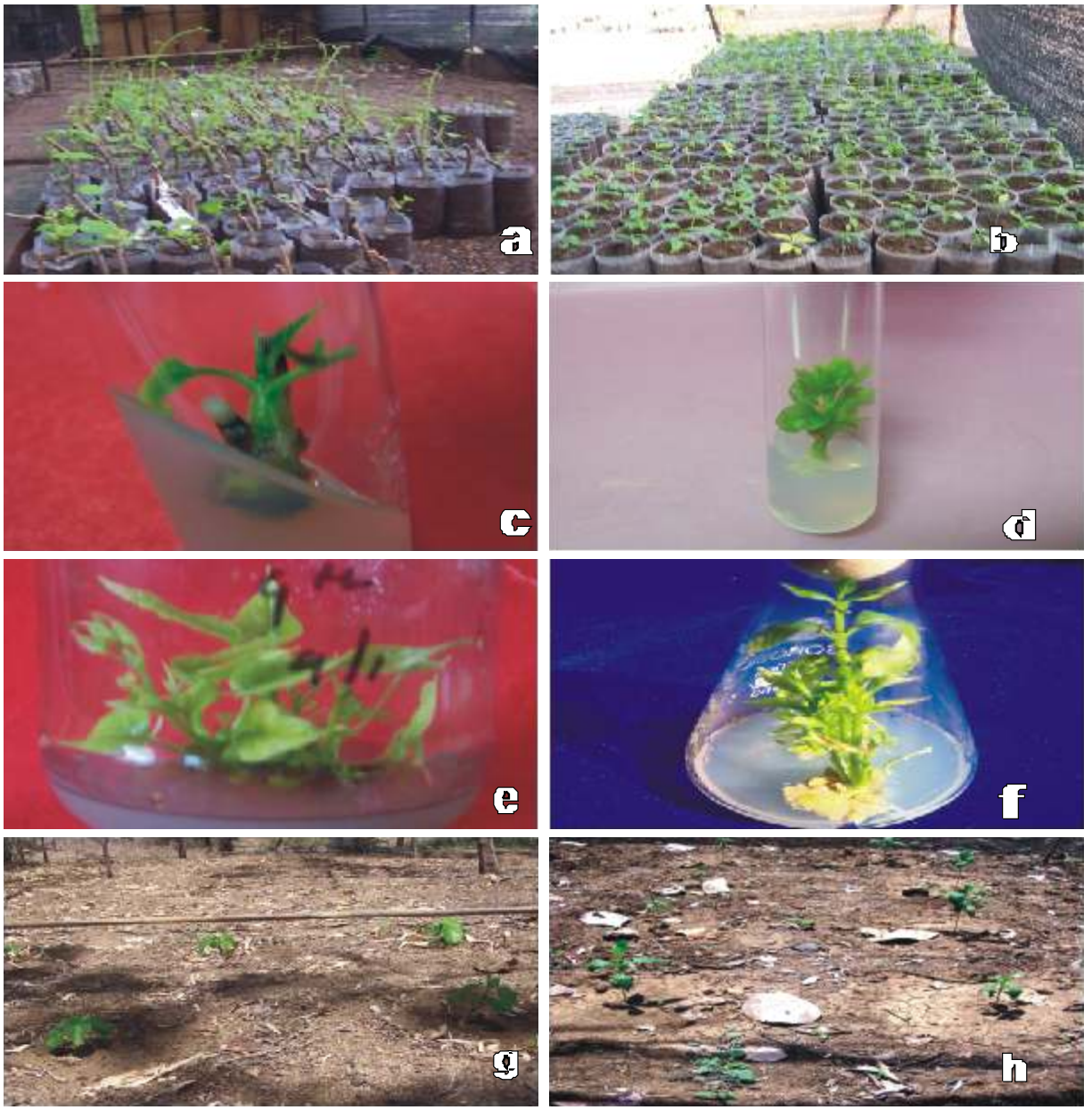
Project 3: Development of integrated insect pest and disease control system for major economically important forest tree species [112/TFRI-2006/ Ento.-4 (MPFD) (15)/ 2006-2009]

Status: Survey were conducted at Hardi / Sirmaur, Rewa; different compartments at Balwara and Katkut ranges, Barwaha Forest Division and Sonaghati, Research and Extension circle, Betul for selection of sites for laying out of experiments. Preliminary screening of six varieties of aonla, *Emblica officinalis* for insect pests and diseases was done. Observations were recorded on dead/dying of teak trees. Five fungi viz. *Diatrype tectonae, Phomopsis tectonae, Pleospora multiseptata, Botryodiplodia theobramoae* and *Stagnospora* species on teak and one insect i.e. sap sucker *Scutellera nobilis* on the fruits of aonla were identified.

Project 4: Varietal improvement of *Rauvolfia serpentina* and *Tinospora cordifolia* through germplasm selection, evaluation and breeding [100/TFRI/2006/Gen-1 (MoHFW) (10)/ 2006-2009]

Status: Vine cuttings of 42 individual plants of *Tinospora cordifolia* from 39 different locations were collected and rooting in cuttings induced with different hormones and their concentrations. 100% rooting was achieved in cuttings treated with 100 ppm IBA. *R. serpentina* germplasm from 48 different locations was collected and maintained for seed increase. Scarified seeds of *R. serpentina of* all collected germplasm were germinated using pre-treatment of 500 ppm GA_3, which resulted in 95% germination. *In - vitro* shoot cultures from nodal segment explants were successfully established in *Tinospora cordifolia* with treatment of 0.1% $HgCl_2$ for 7 minutes on MS medium supplemented with 25 µM BA, which resulted in 34% bud break. The shoot cultures of CIMSHEEL variety of *Rauvolfia*

serpentina were established on MS medium enriched with 10 µM BA+1 µM NAA using nodal segment explants. A four fold *in - vitro* shoot multiplication rate was obtained in *T. cordifolia* on MS medium supplemented with 10 µM BA+150 µM Glutamine. The shoot cultures of *R. serpentina* are regularly maintained on MS medium supplemented with 10 µM BA+1 µM NAA. The germplasm evaluation trial of *T. cordifolia* and *R. serpentina* was established.



Propagation and field evaluation selected germplasm of *T. cordifolia* and *R. serpentina*- (a) Rooting in cuttings of *T. cordifolia* (b) Seed germination in *R. serpentina* pretreated with 500 ppm GA_3. In-vitro shoot culture establishment of *T. cordifolia* (c) and *R. serpentina* (d) using nodal segment explant. Multiplication of shoot cultures of *T. cordifolia* on MS medium with 10µM BA+ 150µM Gl (e) and *R. serpentina* on MS medium with 10 µM BA+1 µM NAA (f). (g-h) Field trial of selected germplasm of *T. cordifolia* (spacing 1m x 1.5 m) and *R. serpentina* (spacing 0.5m x 0.5 m)

Project 5: Studies on *in vitro* regeneration of plantlets and their genetic (molecular) fidelity in *Saraca indica* Linn., a vulnerable medicinal tree [111/TFRI-2006/Gen.-2 (CSIR)(12)/ 2006-2009]

Status: Plant material of *Saraca indica* was collected from JNKVV, Jabalpur. Nodal segments, shoot tips and leaves were inoculated after surface sterilization with mercuric chloride on MS medium supplemented with various plant growth regulators. An experiment on effect of season on aseptic bud break was initiated.

Abstract: No. of Projects

	No. of projects completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	4	16	4
External Projects	10	13	5
Total	**14**	**29**	**9**

TECHNOLOGY ASSESSED AND TRANSFERRED

1. Transferred technology of lac cultivation to the VFC members, forest officials and self-help groups in tribal dominated areas of Madhya Pradesh and Chhattisgarh.

2. Demonstrations of techniques for collection, processing and storage of MFPs were organized at Mahendragarh, Baikunthpur, Ambikapur, Jaspurnagar, Sukma, Jagdealpur, Geedam, Bhairamgarh, Kanker, Kondagaon, Narainpur and Bhanupratappur for VFC members and forest officials.

EDUCATION AND TRAINING

1. Dr. N. Kulkarni attended *hands-on* training on "*Entomopathogenic Nematodes for Insect Pest Control*" from 20th to 29th March 2007 at Project Directorate of Biological Control (ICAR), Bangalore (Karnataka).

2. Shri Rajat S.Pal, CF, attended a one-week compulsory training for IFS officers on "Prospects of Micro-Finance in Forestry" held from 19th to 23rd February 2007 at the Indian Institute of Management, Lucknow.

3. Dr. A.K. Pandey, Scientist-E, attended a training programme on "Forest Certification" on 30th November and 1st December 2006 at Indian Institute of Forest Management, Bhopal.

4. Dr. R.K. Verma, Scientist-D, attended short term training on "Molecular Taxonomy of Fungi" at Thaper University, Patiala from 19th to 24th March 2007.

5. Shri Har Prasad attended "Management and Development Programme on Criteria and Indicators for Sustainable Forest Management" at IIFM, Bhopal from 8th to 10th November 2006.

6. Training organized for VFC members of Dhamtari District (C.G.) on 'Sustainable harvesting of medicinal plants and protection of forest against fire' from 21st to 25th August 2006.

7. Three days training was organized for representatives of NGOs and farmers from 16th to 18th August 2006 on 'Strategies for production, processing and development of Bio-fuels'.

8. Three-days training was organized on 'Biofertilizers' from 14th to 16th November 2006 at TFRI, Jabalpur.

9. One-week compulsory training course organized for IFS Officers from 12th to 16th February 2007 on 'Management of Tropical Forests: Issues and challenges'.

10. Training organized for M.Sc. students in the field of Biotechnology and Molecular biology in May, June and July 2006.

LINKAGES AND COLLABORATION

1. 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, New Delhi; National Research Centre for Agroforestry, Jhansi; JNKVV, Jabalpur etc.

2. A collaborative project entitled “Developing coalition approach to non timber forest produce for better livelihood of tribal communities of M.P. DFID.

CONSULTANCIES

1. Monitoring and evaluation of work done under FDA for Mandla, Guna, Hoshangabad, Datiya, Shivpuri, Harda, Dhar and Jhabua (M.P.).

2. Monitoring and evaluation of work done under FDA in Dhamtari, Raipur, Durg and Kawardha (Chhattisgarh).

3. Evaluation of preservation plots in Maharashtra**.**

CONFERENCE/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organised

1. Organised National Conference on “Increasing Forest Productivity, Genetic and Breeding Options” held at TFRI, Jabalpur from 21st to 23rd February 2007.

2. Organised Training/Workshop on “Management of Forests/Tree lots outside Forests under the control of State Forest Departments- role of State Forest Departments” held at TFRI, Jabalpur from 19th to 20th December 2006.

3. 16th RAG meeting of the institute was held at Tropical Forests Research Institure on 30th August 2006.

4. Meeting of the beneficiaries was organized for the consultant who reviewed X Five year Plan of ICFRE.

Participated

Conference

1. Dr. Fatima Shirin, Scientist-D attended a national conference on Increasing Forest Productivity:

Genetic and Breeding Options held from 21st to 23rd February 2007 at TFRI, Jabalpur and presented a paper entitled "Micropropagation of *Bambusa nutans* Wall".

2. Dr. S. A. Ansari, Scientist-E and Dr. C. Narayanan, Research Officer attended and presented papers in the "National Conference on Emerging Trends and Future Challenges in Biotechnology" on 22nd and 23rd September 2006 at Peoples Educational Society, Institute of Science and Technology, Bangalore.

3. N. Roychoudhury, Scientist E attended a National Conference on Increasing forest productivity: genetic and breeding options held from 21st to 23rd February 2007 at TFRI, Jabalpur and presented a paper entitled 'Screening resistance in teak clones of Madhya Pradesh against major insect pests'.

4. Dr. N. Kulkarni, Scientist E attended National Conference on Recent Advances in Biology on 2nd and 3rd February 2007 at Bhandara (M.S.).

5. S.P. Tripathi attended National Conference on "Increasing Forest Productivity: Genetic and Breeding Options" held at the Tropical Forest Research Institute, Jabalpur from 21st to 23rd February 2007 and presented paper entitled "Role of Mokokchung Forest Development Agency in rehabilitation of degraded forests in Mokokchang district of Nagalnd".

6. Dr. A.K. Pandey, Scientist E attended Regional Conference on Assessment of bio-diversity and traditional knowledge on 27th September 2006 at Research and Extension Circle, Rewa, MP.

7. Dr. A.K. Pandey, Scientist E attended Conference on Natural Products and Biodiversity: Chemistry and Utilization on 2nd and 3rd November 2006 at Forest Research Institute, Dehradun

Workshops

1. S.P. Tripathi presented papers entitled "Tree Farming through Jhum Cultivation in Nagaland and Assessment of Tree Outside Forests and their present status" in Training Workshop "Management of Forest / Tree lots outside forests under the Contract of State Forest Departments "Role of State Forest Department" for Indian Forest Service Officers held on 19th and 20th December 2006 at the Tropical Forest Research Institute, Jabalpur.

2. Dr. A.K. Pandey, Scientist E attended a workshop on Policy and Institutional Framework for NTFP Management in Madhya Pradesh on 27th and 28th October 2006 at Indian Institute of Forest Management, Bhopal.

3. Dr. A.K. Pandey, Scientist E attended the National Workshop on NTFP Taxation, Policies and Management on 20th and 21st November 2006 at India International Centre, New Delhi

4. Dr. A.K. Pandey, Scientist E attended a workshop on Mahua on 27th and 28th February 2007 at Indian Institute of Forest Management, Bhopal.

Symposia

1. Dr. Rajiv Rai attendent National Symposium on "Tribal Health" organized by ICMR, Jabalpur on 19th and 20th Oct. 2006 and presented two research papers.

2. Dr. C. Narayanan, Research Officer presented a paper 'Half sib analysis, estimation of genetic

parameters of growth and wood properties and their interrelationship in plus trees of teak (*Tectona grandis* L.f) of Allapalli region' in National Symposium on Tree Improvement for Sustainable Forestry from 4th to 6th November 2006 at the Department of Forestry, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur, Madhya Pradesh.

3. Dr. R.K.Verma presented a paper entitled 'Fungal diversity in forests of Satpura' in the International Symposium on Microbial Diversity at R.D. Univ. Jabalpur from 19th to 21st November 2006.

4. Dr. Nanita Berry, Scientist C presented a research paper entitled "Women empowerment towards sustainable production" in the National Seminar on "Tree Improvement for sustainable forestry held from 4th to 6th November 2006 at JNKVV, Jabalpur (M.P.).

5. Dr. Nanita Berry, Scientist 'C' attended a National Symposium on "Agroforestry for livelihood security, Environment protection and Biofuel production' and presented a paper entitled "Lac culture: an option for livelihood security" held from 16th to 18th December 2006 at National Research Centre for Agroforestry, Jhansi, (UP).

6. Shri S.P. Tripathi presented paper entitled "Tree productivity and sustainable forestry in Nagaland" in National Symposium on Tree Improvement for Sustainable Forestry Organized by Department of Forestry, Jawaharlal Nehru Krishi Vishwavidyalaya, Jabalpur from 4th to 6th November 2006.

Seminars

1. Dr. V. Nath and Alfred Francis attended National Seminar on "Prospects of organic farming"at Regional Center of Organic Farming, Jabalpur from 26th and 27th April 2006 and presented one research paper.

2. Dr. Rajiv Rai attended National Seminar on "Biotechnology in Sustainable Agriculture Development and Environmental Protection", organized by NGO Jabalpur on 28th and 29th January 2007 and presented two research papers.

3. Dr. V. Nath attended National Seminar on "Increasing Forest Productivity Genetic and Breeding options" at TFRI, Jabalpur from 21st to 27th February 2007 and presented one research paper.

4. Smt. Neelu Singh presented a paper entitled "Effect of drying methods on chemical composition of *Costus speciosus* (Koen) Sm." in the National Seminar on Medicinal, Aromatic and Spices plants- Perspective and Potential held on 18th and 19th December 2006 at Indira Gandhi Krishi Vishwavidyalaya, Raipur, Chhattisgarh.

5. Dr. S. A. Ansari, Scientist-E participated and presented papers in the All India Seminar on "Biotechnology in Sustainable Development and Environmental Protection", on 28th and 29th January 2007 at the Institution of Engineers (India), Jabalpur.

6. Dr. P. B. Meshram attended a National Seminar on "Forest and Forestry Techniques" held on 23rd and 24th March 2007 at G.G. University, Bilaspur and presented a paper entitled "Impact of integrated insect pest management technique on teak (*Tectona grandis)".*

7. Dr. K.C. Joshi and Dr. N. Kulkarni attended "National Seminar on Environment *and* Ethnobiology" at Govt. New College, Rewa (M.P.) on 9th and 10th February 2007 and presented paper entitled "Butterfly fauna of Kanha National Park".

8. Dr. N.Berry, Scientist C participated in International Seminar on "Sustainable agriculture, food security and bioenergy production" and presented a poster entitled "Potential of bioenergy plants in agroforestry " held from 14th to 16th February 2007 at J.N.K.V.V., Jabalpur (M.P.)

9. Shri Rajat S.Pal, Conservator of Forests attended National Seminar on "Tree Improvement for sustainable production held from 4th to 6th November 2006 at JNKVV, Jabalpur (M.P.).

10. Mrs. Neelu Singh, Scientist D attended a National seminar on "Prospects of organic farming" on 26th and 27th April 2006 at Regional Center of Organic Farming at Jabalpur.

11. Dr. A.K. Pandey, Scientist E attended a National Seminar on "Jatropha Cultivation and Bio-diesel Production" on 27th and 28th January 2007 at Uthhan, Allahabad.

12. Dr. Avinash Jain, Scientist D presented a paper entitled "Effect of thermal power plant emission on vegetation and soil in Korba (Chhattisgarh)" in National Seminar on "Bio-technology in sustainable agricultural development and environment protection" on 28th and 29th January 2007 at The Institution of Engineers, Jabalpur (M.P.).

Mela

Tropical Forest Research Institute participated in the Van Mela organised by Madhya Pradesh Forest Department at Jabalpur from 3rd to 6th February 2007.

Meetings

1. Shri Avinash Jain attended meeting on "Biodrainage Group of Indian National Committee on Irrigation and Drainage (INCID) on 6th February 2007 at Krishi Bhawan, New Delhi.

2. Shri Avinash Jain attended 7th R and D Review Session of Indian National Committee on Irrigation and Drainage (INCID) on 26th and 27th February 2007 at North Eastern Regional Institute of Water and Land Management (NERIWALM), Tezpur (Assam).

3. Dr. K.C. Joshi and Dr. N. Roychoudhury attended a Academia/Industry/Forest Officers interaction meeting on Management and Utilization of Forests for Sustainable Development, held on 28th October 2006, at Guru Ghasidas University, Bilaspur and presented a paper entitled "Insect pests of teak and their management".

4. Dr. N. Roychoudhury attended a Task Force meeting on "New Science and Technology policy, plan and strategy", held on 26th November 2006 at Jawaharlal Nehru Krishi Viswavidyalaya, Jabalpur.

5. Dr. N. Roychoudhury attended a State Steering Committee meeting on Achanakmar-Amarkantak biosphere reserve, held on 30th November 2006 at PCCF Office, Raipur.

DISTINGUISHED VISITORS

Dr. S.N. Paul Khurana, Vice Chancellor R.D. University Jabalpur visited the Institute and

inaugurated the National Conference on Increasing Forest Productivity- Genetic and Breeding options from 21st to 23rd February 2007.

MISCELLANEOUS

1. Celebrated World Environmental day on 5th June 2006.
2. Van Mahotsava was celebrated on 27th July 2006.
3. Celebrated Hindi week from 13th to 15th September 2006.

Rain Forest Research Institute
Jorhat

The Rain Forest Research Institute (RFRI), Jorhat, Assam, is a constituent Research Institute of Indian Council of Forestry Research and Education (ICFRE), Dehradun. It is mandated to cater to the forestry research related needs of Northeastern states of India and has been pursuing research in the areas of shifting cultivation, ecology and biodiversity, propagation, cultivation and performance trial of important forest species, integrated management of pests and diseases, bioprospecting of bioresources, genetic improvement of tree species and biotechnology.

An Advanced Research Centre for Bamboo and Rattans (ARCBR), has also been established at Aizawl, the capital city of Mizoram state, and its infrastructural development is in full swing.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: Reclamation of highly eroded site of Cherrapunjee, Meghalaya [RFRI-SM/4/2003-2006]

Findings: *Alnus nepalensis* and *Exbucklandia populnea* were planted in the experimental plot at Cherrapunjee, Meghalaya. Survival percentage of *Alnus nepalensis* was found to be 90.8% and that of *Exbucklandia populnea,* it was 75.18%. Of the sixteen treatment combinations, P2W0M0F1 showed maximum height growth (221 cm) in case of *A. nepalensis* and 63 cm for *E. populnea*. The experimental plot was damaged entirely by fire during February 2006. The burnt area was fenced properly to preserve the plot for the rest of the project period to see the impact of fire hazard on the targeted species. It has been observed that *A. nepalensis* can come up after the fire hazard in more numbers and better height as compared to *E. populnea*.

Exbucklandia populanea

Alnus nepalensis

A. nepalensis after burning

Project 2: Development of an eco-friendly strategy for the Management of *Calopepla leayana* Latr., a serious pest of *Gmelina arborea* Roxb. [RFRI/FE/11/2004-2007]

Findings: Population fluctuation of *Calopepla leayana* on *Gmelina arborea* was studied in and around Jorhat, Assam. The population trend was correlated with abiotic factors of the study site which indicated significant dependence on temperature, relative humidity, and rain fall. Regression equation was also developed to predict population of *C. leayana* based on abiotic factors.

Damage potential of different stages of *C. leayana* on *G. arborea* was also assessed to develop suitable protocol for their management.

Entomopathogenic fungus, *Beauveria bassiana* was isolated and identified as an effective natural pathogen against the larval and adult stages of *C. leayana.* Mass production of *B. bassiana* using different substrates was attempted to produce ample amount of spores.

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Development of Patchouli based viable agroforestry models for NE region of India [RFRI/CFE-04/2004-2007]

Status: Nursery trials were laid out to standardize vegetative propagation of patchouli under four different environments (i.e. under partial shade below tree, agronet shade house, mist chamber and under the open environment).

An extensive survey was conducted for selection of 10 tree garden sites. The farmers were motivated the farmers to take part in On-farm participatory research for development of cultivation and management techniques for patchouli.

On farm trials have been laid out in the tree gardens of Areca nut, Agar, Gamhari (*Gmelina arborea)* and bamboo (*Bambus tulda*) with different age and plantations geometry. Periodic observations on crop have been recorded.

Initial results show that patchouli performs best under Areca nut. In terms of increased herbage production presently the suitability sequence is Areca nut > Bamboo > Gmelina > Agar.

Kissan Nursery raised by Self Help Groups (SHGs)

Farmers maintaining patchouli under Tamul (Areca nut) garden

Project 2: Evaluation of different existing land use systems for development of viable economic models in Northeast India [RFRI/SC/06/2003-2008]

Status: Survey, selection and collection of productivity data of different land use systems in Nagaland and Meghalaya have been completed.

The benefit cost ratio of plantation/ cash crops has been calculated and physico-chemical analysis of soil samples collected from Meghalaya is in progress. The benefit cost ratio (b: c) of settled

Plantation of *Ananas comosus*

Seltted cultivation

cultivation (3.85) and *Ananas comosus* (3.66) was found to be more than that of jhum cultivation (1.61). Evaluation of productivity and benefit cost ratio of important cash crops in Nagaland state revealed that productivity and cost benefit ratio of settled cultivation (2.61), *Ananas comosus*, *Musa paradisica* are quite encouraging than jhum cultivation (0.23) in the state.

Project 3: Stability test of various clones and progenies for different characters in *Gmelina arborea* [RFRI/TI-10/2003-2006]

Status: Data from progeny trials of the selected families reflect that overall performance of progenies at Teliamura (Tripura) was better with 69 % survival, 2.9 m height and 7.0 cm collar diameter as compared to Imphal (Manipur) where survival was 62 %, height was 1.4 m and collar diameter was 4.4 cm. Genetic and environment interaction was found significant at 0.001 level of significance for both height and collar diameter. Hence, there is a likelihood that the same progenies would not perform similar at two different sites.

The results of a germination trial of half-sib progenies of selected families show that the percentage was maximum in case of RRI/GA31. Overall germination was only 26 %. Considering this, a tetrazolium test for seed viability was conducted which showed that 12% and 1% of the total seeds was partially and completely non-viable respectively. Progeny number 43 was most viable (93%).

Project 4: Genetic improvement and clonal propagation of *Dipterocarpus retusus* [RFRI/TI/11/2004-2007]

Status: For progenies' performance, seventeen progenies along with check planted at Deovan, were evaluated for different traits viz. plant height (Ht), diameter at breast height (DBH), height at first branching and crown diameter. The progenies DMP-9, DMP-2, and JKG-2 were found to be superior. Development of clonal propagation protocol rooting of shoot cuttings of *D. retusus* is going on.

Project 5: Development of Nursery practices for production of quality planting stock of Bamboo in N.E. [RFRI/SM/06/2005-2008]

Status: Offshoots were separated from the two noded culm and branch cuttings of *Dendrocalamus hamiltonii* and planted in the polypots having different potting media. Seven treatments were given

which included vermicompost, vermicasting (culture) and vermicasting (wild) apart from FYM, sand and soil.

Project 6: Management of *Bambusa nutans* for enhancing the productivity of marketable culm through silvicultural practices [RFRI/TI/13/2005-2008]

Status: Thinning and soil mounding of the bamboo clumps were carried out. Regular observation and data recording on various growth parameters is in progress. A market survey at various bamboo depots at different places in Assam was undertaken. Fertilizer application in the plot has also been carried out. Other required silvicultural operations are being carried out at a regular interval.

Project 7: Comparative studies on natural resistance of bamboos to biodegradation in Assam [RFRI/FP-8/2005-2008]

Status: Eleven species of bamboos of NE region viz. *Bambusa balcooa; Bambusa longispiculata; Bambusa pallida; Bambusa polymorpha Bambusa tulda; Bambusa nutans; Dendrocalamus hamiltonii; Dendrocalamus sikkimensis; Melocanna baccifera; Dendrocalamus giganteus* and *Bambusa bambos* were collected from different parts of the region; cut and sized to about 1 meter length and their fresh weight was recorded. They were shade dried to record the dry weight. Their volumes were also recorded. The samples were then planted, in test yards at selected sites viz. Burnihat, Jorhat and Nagaon for their natural durability against bio-degradation. During the initial observations presence of *Syzophyllum commune* was seen at Burnihat and Jorhat. Periodic meteorological data is being recorded.

Project 8: The Potential role of bamboo species with reference to carbon sequestration in Assam and Mizoram [RFRI/EE/07/2005-2008]

Status: Data collected for potential role of bamboo species with reference to carbon sequestration in Assam and Mizoram. Biomass of different age groups of *Bambusa tulda* and *Dendrocalamus hamiltonii* from Assam and Mizoram has been estimated to evaluate carbon sequestration.

Biomass estimation in progress at Mizoram

Project 9: Bioecological studies of seed insect pests of *Dipterocarpus retusus* [RFRI/FE/12/2005-2008]

Status: Bioecological studies of seed insect pests of *Dipterocarpus retusus* were made in Gibbon Wildlife Sanctury (GWS), Assam. *Alcidodes crassus* Poscoe. (weevil-Coleoptera), *Enarmonia pulverulla* Meyrick and *Dioryctria abicutella* Denis (Lepidoptera) were found infesting seeds. Germination percentage of *D. retusus* in natural stands (in-situ) was found to be 3-5%. However, in nursery (ex-situ) it was 19.9%. The loss due to *Thamnurgides spp* on seeds of *D. retusus* collected from forest floor as well as using nylon net before falling to the floor was estimated.

Project 10: 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: Diversity studies of Arbuscular Mycorrhizal (AM) fungi associated with medicinal and aromatic plants in eight districts and Majuli Sub-division of Assam were completed. Mycorrhizal spores were isolated from the collected samples and their quantification was done. Root infection percentage was also calculated and it was found that AM fungi infect the plants with varying degree.

Ban-holodhi *(Curcuma aromatica)*

Jom lakhuti *(Costus speciosus)*

Project 11: Studies on structural formation of vegetation for the conservation of Biodiversity in Gibbon Wildlife Sanctuary Assam [RFRI/SC/08/ 2005-2008]

Status: Ecological enumeration was carried out and plant communities were identified. A total of 152 plant species were identified and documented. Feeding height of gibbons during this study was found to be between 25 to 30 m. Gibbons generally utilize the top canopy trees for meeting their needs for food, cover, and movement by adopting to brachiatry. The most preferred food plants of gibbons in the study area were recorded. Seasonal requirement of plant species targeted by Gibbons for food in the area was also recorded.

Semi-evergreen forest at GWS

NEW PROJECTS INITIATED DURING The YEAR 2006-2007

Project 1: Investigations on the formation of agar wood in *Aquilaria malaccensis* [RFRI/FP/11/ 2006-2009]

Status: Surveys were made in different Reserve Forests *viz.,* Hollongapar and Salnah Reserve Forests and homestead plantations at Amguri, Namti, Nahoroni, Alengi, Melamati, Jalukoni, Rowroiah in upper Assam for infected agar trees. Maximum infection of agar trees was recorded at Amguri of Sibsagar district followed by Alengi in Jorhat district. Various symptoms of infected agar trees were recorded to identify the infected tree. Infestation of borer, *Zeuzera conferta* was observed on agar tree in different study sites. Fungal species viz., *Fusarium* sp., *Rhizopus* sp., *Aspergillus* sp., *Mucor* sp. and *Penicillium* sp., were isolated from the infected host tissues as well as faecal matters of the borer. Studies on phyllosphere mycoflora also revealed the presence of nine species of fungi. Artificial inoculation of agar trees is being conducted at Nahoroni of field station of RFRI.

Project 2: Investigation on propagation and cultivation of selected Rattan species [RFRI/FE/10/ 2006-2009]

Status: Status survey of canes carried out in Jorhat, Golaghat, Karbi-Anglong, Dibrugarh and Tinsukia Districts of Assam and demarcated seed stands for *Calamus tenuis* and *C. flagellum*. Mature fruits of *Calamus flagellum* were collected from selected stands at Gibbon Wildlife Sanctuary, Jorhat. Species viz. *C. leptospadix, C. namborensis, C latifolius* and *C. flafellum* were collected during survey and planted in canetum.

Establishment of Canetum

Fruits of *Calamus tenuis*

Flowering of *Calamus tenuis*

Project 3: Improvement of degraded shifting cultivation lands through introduction of *Thysanolaena maxima* (Broom grass) along with *Cajanas cajan* as N_2 fixing plant [RFRI/SC/09/ 2006-2009]

Status: *Thysanolaena maxima* (Broom Grass) growing areas of Assam were surveyed and best planting materials collected based on selective criteria for evaluation of performance trials. Collected rhizomes were successfully multiplied in the nursery for plantation in the degraded shifting cultivation areas.

Project 4: Standardization of nursery technique for *Bambusa pallida* [RFRI/SM/07/ 2006-2008]

Status: Different concentrations of IBA are being used for development of propagation protocol. More seedlings sprout was observed in 300-ppm concentration. Growth data recording is continued.

Insertion of solution to the culm cuttings

Sprouting of culm cuttings

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Conservation of productive land and promising flora of Majuli Island in Brahmaputra River [RFRI/EP/05/2003-2006]

Status: The approved project duration was over in March 2006. However, due to non release of fund as per approved grant in aid, some of the activities could not be completed. The funding agency has been requested to extend the project duration. Response in this regard is awaited.

Bunds and Mating with treated Bamboo and Ipomoea plantation for soil stabilization

Project 2: Control of soil and riverbank erosion in Majuli through bamboo based vegetative embankment (Sponsored by TIFAC/DST, Govt. of India) [RFRI/EP/07/ 2004-2007]

Status: Construction of bunds and *Ipomoea* plantation in zero zone on the bank of Brahmputra river for control of shore and surface run off of soil accomplished. Plantations of Bamboos, *Dalbegia sissoo*, *Thespesia populnea*, *Bombax ceiba* and *Bambusa nana,* and grasses in first, second and third zones at the bank of river have been found to check surface run off of top soil.

Project 3: Validation, testing and locational trial of micro/macro propagated planting stock of selected bamboo species in Northeast India (Sponsored by: DBT, Govt. of India) [RFRI/EP/08/2005-2008]

Status: Liaison maintained with all the 8 nodal officers of Field Implementing Agencies (FIAs) in the NE states. Procurement of 46000 tissue culture saplings of bamboo from Growmore Biotech, Hosur and their hardening at HPCL site completed. Hardened TC plants were supplied to various FIAs. Establishment of Demonstration and Experimental Trial plantations of target bamboo species (*Bambusa balcooa*, *B. nutans* and *Dendrocalamus hamiltonii*) covering 90 ha area out of the total target 160 ha in different NE states. Standardization of monitoring and evaluation parameters and development of formats for recording of growth and performance data of trial plantations. Monitoring of the trial plantations established in different NE states and data recording is in progress.

Project 4: Improvement of infrastructural facilities in botanical garden/Centers of *ex-situ* conservation at Deovan, RFRI, Jorhat, Assam [RFRI/EP/09/2003-2007]

Status: The civil works sanctioned by MoEF relating to the construction of the orchidarium and shade cum polyhouse, has been completed and irrigation system installed. This infrastructure is being utilized for the developmental activities of botanical garden. Introduced 29 species of medicinal plants, 39

species of orchids, 19 species of commercially important trees of NE India and 12 species of rare and endangered plants in the botanical garden.

Commercially important tree species of NE region

Construction of footpath in progress

Orchids in shade cumpoly house

Project 5: Augmentation of Entomopathogenic fungi for the management of *Calopepla leayana* on *Gmelina arborea*: An ecofriendly approach [RFRI/EP/10/2005-2007]

Status: Augmentation of entomopathogenic fungi, viz., *Metarhizium anisopliae* (2 isolates from *Calopepla leayana* (RFRI/EP/04) and bamboo plant hopper (RFRI/EP/05), *Aspergillus niger* (RFRI/EP/06), *A. flavus* (RFRI/EP/07) and *A. fumigatus* (RFRI/EP/08) (isolated from soil) and *Beauveria bassiana* (2 isolates from rice hispa (RFRI/EP/02) and lepidopteran larva (RFRI/EP/03)) along with a positive control of *B. bassiana* isolated from *C. leayana* (RFRI/EP/01) was made against *C. leayana*. Among the eight fungi tested against adults of *C. leayana*, RFRI/EP/02 was found to be more pathogenic followed by RFRI/EP/04, RFRI/EP/05, RFRI/EP/06, RFRI/EP/03, RFRI/EP/08 and RFRI/EP/07. However, RFRI/EP/01, which, was isolated from *C. leayana* was found to be the more pathogenic than any other fungi. The average per cent mortality was found to be ranging between 60 to 92.

Project 6: Sustained capacity enhancement of economically backward Scheduled Tribes of North Eastern region through composite R & D technologies [RFRI/EP/11/2006-2009]

Status: Socio economic survey of the adopted village namely Kakotibari, and Golaghat in Assam was done. Formed a registered Co-operative Society involving the villagers. Imparted training on nursery and planting technologies of Bamboo / Rattan. Developed kitchen garden and distributed various vegetable seeds, seedlings and horticulture species to all the 65 families of the targeted village.

Installation of two Gobar gas plants is in progress. Distributed fifteen numbers of bee keeping boxes and bee colonies. Imparted training on bee keeping and management.

Training on bamboo and rattan

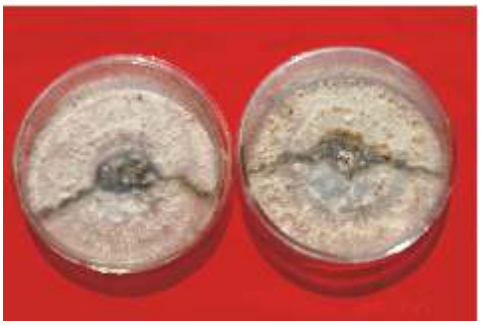
Establishment of fish pond

Training on bee keeping

Installations of gobar gas plant

Project 7: Biological control of *Mimosa invisa*, a destructive alien weed threatening Kaziranga National Park (Grassland) [RFRI/EP/12/2006-2009]

Status: Survey and screening of *Mimosa invisa* was done at the Kaziranga National Park and other areas for natural presence of any biological control agents. Few fungal species were isolated from infected *M. invisa* plants and purified. Preliminary laboratory studies are being conducted for their use as possible use as biocontrol agents. One insect was found to infest on *M. invisa*. Laboratory studies are being conducted to ascertain the efficacy of this insect species as bio-agent. Efforts have been made to use fungal culture obtained from the Indian Type Culture Collection, Division of Plant Pathology, IARI, New Delhi.



Fungi isolated from *M. invisa*

Insect species feeding on *M. Invisa*

Project 8: Genetic improvement and conservation of genetic resources of some economically more important bamboo species of Northeastern India [RFRI/EP/13/2006-2009]

Status: Liaison established and MoUs signed with SFDs of Tripura, Mizoram, Assam and Nagaland for conducting clonal trials. Sites for clonal trials at 2 places each in Assam and Mizoram, and 1 place each in Nagaland and Tripura have been selected. Areas (2 ha each) have also been selected in RFRI, Jorhat (Assam) and ARCBR, Aizawl (Mizoram) for establishment of Gene Bank. Field layouts and statistically feasible plantation designs have been prepared for clonal trials and Gene Bank. Species-wise criterion for survey and selection of Candidate Plus Clumps (CPCs) has been finalized and their passport formats have been developed. **Bamboo growing areas in Upper Assam and Manipur** have been surveyed and superior clumps of target bamboo species have been selected. Multiplication works have been started for production of planting stock. Plans developed for *Melocana baccifera* staggering trial.

Project 9: Biodiversity studies of Orthoptera in Kaziranga National Park, Assam [RFRI/EP/14/*2006-2009*]

Status: Preliminary survey of Orthoptera was made in Kaziranga National Park (KNP) and a total of 11 species were encountered of which, 9 were acridids, tettigoniids and gryllids represented one species each. *Oxya nitidula* (Walk.), *Acrida exaltata* (Walk.), *Diabolocatantops pinguis* (Walk.), *Catantops ferruginuous* (Walk.), *Atractomorpha crenulata* (Fab.), *Ailopus thalassinus* (Fab.), *Oxya hyla hyla* (Serv.) and *Anacridium flaviscens* (Fab.) were common in KNP. Seven species were observed in forestlands and 6 species in grasslands. Two species were found both in forestlands and grasslands.

Project 10: Mapping and quantitative assessment of geographic distribution and population status of plant resources of eastern Himalayan Region [RFRI/EP/15/2006-2009]

Status: Workshop and First Interaction Meeting of the Project Investigators (PIs) for methodology development and finalization was held on 17th and 18th April 2007 at North-Eastern Hill University, Shillong. Literature survey is going on.

Project 11: Establishment of a Network to Facilitate Collection, Processing and Dissemination of Statistics Pertaining to Tropical Timber and other Forestry Parameters in India (Supported by ITTO and Co-ordinated by ICFRE Dehradun)

Status: Information was collected from Agartala (Tripura), Aizawl (Mizoram) and Imphal (Manipur) regarding (1) Joint Forest Sector Questionnaires JQ1 & JQ2, (2) Timber/Bamboo Trade Bulletin and (3) Format of Forestry Statistics India Data for the year 2004-05 and 2005-06.

Abstract: No. of Projects

	No. of projects Completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects intiated in 2006-2007
Plan Projects	2	11	4
External Project	-	11	-
Total	**2**	**22**	**4**

EDUCATION AND TRAINING

Education

Dr. Ajay Thakur, Scientist C and Head Biotechnology and Genetic Division,RFRI was awarded Ph.D. degree from University of Wales, Bangor, U.K. In August 2006.

LINKAGES AND COLLABORATION

The linkage and collaboration were established with State Forest Departments of NE States, Universities, other research organizations viz. GBPIHED, NMBA, MoEF, DBT, NEC and NGOs working in the field of forestry and forestry research.

PUBLICATIONS

Reports

1. Project Completion Report on Assessment of biological diversity of various ecosystems and to establish methods for conservation in Kaziranga National Park (RFRI/EP/06) P. K. Khatri (2007) being submitted to GBPIHED.
2. Project Completion Report on Financial assistance for improvement of Infrastructural facilities in Botanical Garden /Centres of *ex-situ* conservation at RFRI (RFRI/EP/09,) P. K. Khatri (2007) submitted to MoEF.
3. The project progress report in Group Monitoring cum sensitization workshop on Technology Intervention for Mountain Ecosystem (TIME) under Science and Society Division of Department of Science and Technology, GoI, New Delhi, Organised by HESCO, Dehradun in Bethany Society campus, Shillong from 25th to 27th September 2006.
4. Meeting report of seminar on "Biological control of insect pests and diseases of forestry importance" was organized on 18th September 2006 at Rain Forest Research Institute, Jorhat, Assam, sponsored by Science and Society Division, Department of Science and Technology (DST), Govt. of India, New Delhi, *Current Science*, 92(2): 166-167.

Extension literature

Training manual on Propagation and cultivation of Bamboo was prepared.

Pamphlets in Assamese language on the following topics were prepared.

1. Compositing for organic farming : Techniques and Application.
2. Modern Bamboo nursery for self employment.
3. Vermicomposting: An ecofriendly technology for rural employment.
4. Chemical preservation of bamboo: Tools and techniques.

CONSULTANCIES

1. Evaluation of Afforestation and Tree Planting Activities sponsored by National Afforestation and Ecodevelopment Board (NAEB), Ministry of Environment & Forests (Govt. of India) under Integrated Afforestation and Ecodevelopment Projects (IAEP) at Dibrugarh District, Assam; Mon District of Nagaland; Golaghat FDA District of Assam; West Garo Hills, FDA, Meghalaya; East Garo Hills, FDA, Meghalaya; and Deomali District, FDA, Arunachal Pradesh.

2. Monitoring and Evaluation of the promotional projects assisted by National Medicinal Plant Board, Ministry of Health and Family Welfare, Department of AYUSH, Govt. of India in Assam, Arunachal Pradesh, Meghalaya, Mizoram and Nagaland.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/ SYMPOSIA/ EXHIBITIONS

Organised

1. One day Regional workshop on "Forestry Extension" on 18th July 2006 at RFRI, Jorhat.

Regional workshop on "Forestry Extension"

2. Trainers training on Bamboo Propagation and Cultivation from 21st to 24th August 2006 at RFRI, Jorhat.

Training on bamboo propagation and cultivation

3. Industrial training to pre-final B.Sc., students of NERIST, Arunachal Pradesh from 2nd June to 21st July, 2006.
4. One day seminar on "Recent trends in biological control of insect pests and diseases of forestry importance" on 18th September, 2006 at Rain Forest Research Institute, Jorhat, Assam, sponsored by Science & Society Division, Department of Science and Technology (DST), GOI, New Delhi.
5. 8th RAG meeting on 22nd November, 2006 at RFRI, Jorhat.
6. Training on Apiculture and Management on 18th March, 2007.
7. Training on bamboo propagation technique and cultivation strategies for forest officials in Arunachal Pradesh on 19th march, 2007.
8. Awareness generation programme at RFRI on World Forestry Day (21 March 2007).

Attended

1. Shri E. Meru, IFS, GCR, attended a workshop on National capacity, self assessment NCSA for biodiversity conservation in the North East region held at Shillong on 26th August 2006.
2. Dr. Y.C. Tripathi, Scientist E, attended Rajbhasha Technical Workshop on Biodiversity organized by Ministry of Environment & Forests -Regional Office, Shillong on 18th and 19th September 2006. He chaired the 1st Technical session and presented paper.
3. Dr. Y.C. Tripathi, Scientist E, attended 3rd Meeting of Scientific Advisory Committee on Micropropagation Research and Technology Development (SAC-CMRTD) held at Department of Biotechnology, New Delhi on 27th October 2006.
4. Shri B.K. Pandey, Scientist C attended Zonal Workshop on "Production of quality planting material for Afforestation" as a resource person held at Dibrugarh Circuit House on 06th September 2006.
5. Shri B.K. Pandey, Scientist C, attended the Regional Workshop on " Bamboo Species of North East India: Adoption of suitable Cultivation Techniques for Socio-Economic Development of Rural People" as a resource person, 15th-16th December, 2006 organized by Department of Forestry, NERIST, Nirjuli, Arunachal Pradesh.
6. Shri B.K. Pandey, Scientist C, attended meeting with Dr. Jayanta Madhab, Advisor to Chief Minister - Assam (Economic & Finance) at DRDA Conference Hall, Jorhat on 2nd March 2007.
7. Shri B.K. Pandey, Scientist C, attended meeting with Dr. Tapan Dutta, Agriculture Advisor to Chief Minister of Assam at Conference Hall of Zilla Parishod, Jorhat on 27th March 2007.
8. Shri B.K. Pandey, Scientist C, attended the Seminar on " Commercial Cultivation of Bamboo" on 27th March 2007, Organized by District Agriculture Office, Jorhat.
9. Shri D. Gurung, R.O., attended writers meeting on Bamboo and rattan at School of Agriculture, IGNOU, New Delhi during July 2006.
10. Dr. N. Senthilkumar, Scientist B, attended and presented progress report of DST project in Group Monitoring cum sensitization workshop on Technology Intervention for Mountain Ecosystem (TIME) under Science & Society Division of Department of Science and Technology, GOI, New Delhi, Organised by HESCO, Dehradun in Bethany Society campus, Shillong, 25-27, September, 2006.
11. Dr. N. Senthilkumar, Scientist B, attended 16th RAC meeting of Central Silk Board, CMER and T I , Lahdoigarh, Assam as a representative of Director, RFRI on 13th and 14th March 2007.
12. Dr. P. K. Khatri, Scientist C, participated in Rajbhasha Technical Workshop on Biodiversity at Shillong organized by MoEF, Northeastern Regional Office, Shillong on 18th and 19th September 2007.
13. Dr. D. Dutta, Research Officer participated in Dissemination Workshop (International) on Unlocking opportunities for forest dependent people in India, on 5th and 6th June 2006, at Administrative Staff College, Khanapara, Guwahati, organized by MoEF, Govt. of India, and Deptt. of Environment and Forest, Govt. of Assam in association with TERI and World Bank.
14. Dr. D. Dutta, Research Officer participated in Workshop on "Documentation /involvement of formal and informal organization related to implementation of JFM in the field with a focus on institutional/ organizational process in relation to participation of different groups of stakeholders in Assam" 17th June 2006 organized by Department of Environment and Forest, Govt. of Assam, Regional Centre NAEB, Shillong, Meghalaya at Administrative Staff College, Khanapara, Gauhati, Assam.

15. On day training on Biotechnological application by Bangalore Genie was attended by Dr. Ajay Thakur, Shri A. K. Sarkar, Shri S. Bordoloi and Dr. Papori Sharma at AAU, Jorhat on 11th September 2007.

16. Dr. Papori Sharma attended six days training on Mass multiplication of oil yeiding plants at IIT, Guwahati.

AWARDS

Shri Mridul Saikia (Khalasi, Motor Mechanic) of this institute who represented ICFRE in the XV All India Forests Sports Meet held at Jaipur, Rajasthan on 6th to 10th February 2007 bagged the BRONZE MEDAL in Weight Lifting.

DISTINGUISHED VISITORS

1. Dr. T.C. Dutta, Adviser (Agriculture) to the Hon'ble Chief Minister of Assam, visited RFRI on 24th August 2006 to attend concluding session of Trainers Training on Bamboo Propagation and Cultivation Programme as Chief Guest.
2. Shri D.S. Tomar, IFS, Managing Director and Shri R.B. Kala, Manager (Planning), Uttaranchal Forest Development Corporation, Dehradun visited RFRI on 21st December 2006.
3. Shri K.B. Thampi, IGF (NAEB) and Shri Sanjay Kumar, DIGF (NAEB), MoEF, New Delhi visited ARCBR, Mizoram on 7th February 2007.
4. Shri R.P. Agarwalla, IFS, CCF, Assam visited RFRI on 27th March 2007.

Arid Forest Research Institute
Jodhpur

Arid Forest Research Institute, Jodhpur (Rajasthan), is one of the eight Institutes under the Indian Council of Forestry Research and Education (ICFRE). The mandate of the Institute is to carry out scientific research in forestry and allied fields, to enhance the productivity and vegetative cover; conserve the biodiversity and develop the technologies for the end-users, especially in the hot arid and semi-arid regions of Rajasthan, Gujarat and Dadra and Nagar Havelli.

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 modeling, planting stock improvement, bio-fertilizers and bio-pesticides, agroforestry, JFM and extension, phytochemistry and non-timber forest products, integrated pest and disease management and forestry education.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: Stand dynamics of some important tree species of Gujarat [AFRI-57/Silvi/ 2001-2006]

Findings: Total wood and variable bole-length volume equations have been derived and validated for *Eucalyptus* hybrid and *Acacia nilotica* species that assume importance in projecting the total and commercial volume at different stages (thinnings and final harvest) as the plantations mature. Volume equations proposed may be applied on any population/sample of these species available in the study area as these equations have been validated for independent data set.

The site index equations developed may be used for assessing productive capacity of site and to select sites suitable for a particular species. These are also useful in estimating site index at base age as well as estimating height at some desired age at given site index.

The relationship between the average tree size and the number of surviving trees per unit area has been described by means of a limiting line. This relationship is helpful in generating information about the maximum number of trees ha^{-1} to be kept in the stands given the mean diameter of the trees in the stands.

Path invariant algebraic difference form basal area prediction models have been developed and these can be used to analyze the relationship between stand density and tree growth. In combination with the stand density model, the proposed basal area projection models may also be used to define the type and weight of thinnings in the stands. Thus the models are crucial in evaluating silvicultural treatment options.

Project 2: Studies on seed quality improvement in respect of various tree species of arid and semi-arid areas [AFRI-59/Silvi/2002-2006]

Findings: Neem seeds collected either from morphologically superior or inferior stands for immediate sowing. Superiors gave better results during storage.

The best period for collection neem seeds is 11 WAA (weeks after anthesis). Fresh neem seeds of all mother tree age showed higher oil content than stored seeds. However, age classes I and II

exhibited higher oil content as compared to age classes III and IV. Reduction in oil content was minimum in age class IV during storage and it was best for oil production.

The neem seed stored under airtight containers at low moisture content showed P_{50} for 85 days. However, seeds can be stored best at low moisture (M_4, 5.5%) and low temperature (T_3, 5±1ºC) for longer period (P_{50}, 326 days) in airtight container. Open container seeds showed P_{50} for 233 days at ambient room temperature.

Hydration pre-treatment enhanced viability upto 3-6 times of stored neem seeds. Fresh neem seeds do not require any type of pre-treatment. However, stored seeds may need pre-treatment with Urea (1%) for better germination and seedlings attributes. Fresh neem seeds should be sown either in horizontal or in downward orientation and upto 3 cm depth whereas, stored seeds should be sown only in horizontal orientation.

Project 3: Micropropagation of an important medicinal plant of the arid and semi arid *Commiphora wightii* (Arn.) Bhandari [AFRI-42/FGTB/2002-2007]

Findings: Method for identification of the right stage immature embryo containing unripened seeds for initiation of the embryogenic callus cultures has been developed. Medium for somatic embryo multiplication and maturation has been optimized. Complete regeneration protocol utilizing the two pathways involving callus phase (somatic embryogenesis) and bypassing the callus phase (micropropagation) has been established.

A systematic two phase hardening protocol has been developed and used successfully:

? Phase I: *In-vitro* hardening (done in tissue culture lab itself).

? Phase II: *Ex-vitro* hardening: The successfully *in-vitro* hardened plantlets (after passing through phase I) are subjected to *ex-vitro* hardening in mist chamber.

A total of 15 hardened plants were planted in the field and their performance evaluation has been carried out. The plants have shown 100% survival in 2 months.

Project 4: Litter dynamics and soil changes during stand development in plantation forest [AFRI-35/FED/2002-2006]

Findings: The experiment was initiated in the year 2002 to study litter dynamics and soil changes at various stages of plantation in Indira Gandhi Nahar Pariyojna (IGNP). Four age groups and six species were selected for the study. A total of 76 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 IGNP.

Litter production varied greatly among species as well as age classes. *E camaldulensis* was found to produce highest quantity of litter. Though leaf litter production was high in *D. sissoo* compared to *A. tortilis* and *A. nilotica*, total litter production was low. Bimodal pattern of litter-fall was observed in the species and it was observed to be highest in summer. Decomposition rate (weight loss) was rapid in case of *A. nilotica* litter with half decay in 0.66 years. Litter in *E. camaldulensis* plantation showed a slow rate of decomposition. There was an increase in soil organic carbon (SOC), NH_4-N, NO_3-N and PO_4-P in the plantation area with increase in age. Lowest availability of all these nutrients was observed in *T. undulata* and *E. camaldulensis* plantations. Litter nutrients were high in old stands.

Litter plot in *E. camaldulensis* plantation in IGNP area

Carbon stock in top 25 cm soil layer has been worked out to be high in *P. cineraria* and *A. nilotica* (7.87 Mg ha^{-1}), followed by *A. tortilis* (7.75 Mg ha^{-1}), *E. camaldulensis* (6.75 Mg ha^{-1}), *D. sissoo* (6.37 Mg ha^{-1}) and *T. undulata* (5.25 Mg ha^{-1}). The study reveals that the plantations of different species and stand age modify the nutrient compositions in varied degree and in general improve soil condition and increase carbon stock in biomass, litter and soil.

Project 5: Development of suitable models for urban aesthetic forestry suitable for arid and semi arid region of Rajasthan [AFRI-63/Silvi/UIT/ 2001-06]

Findings: About 6000 plants were planted at road sides at seven important locations within the Jodhpur city during 2002 to 2005. Growth and survival data of plants raised under the experimental plantations on various road sites have been recorded. Average height and diameter of various tree species raised under the experimental plantations have been recorded in the order of *Dalbergia sissoo* > *Azadirachta indica* > *Cassia siamia* > *Tecomela undulata* >*Pongamia pinnata* > *Alstonia scholaris* > *Cassia fistula* > *Delonix regia.*

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Market survey on timber, bamboo and fuelwood [AFRI-58/Silvi/Continue]

Status: The data regarding prices of various forest produces viz., timber, fuel-wood, bamboo collected from the markets of Jaipur and Ahmedabad on quarterly basis were compiled and submitted to the ADG (Stat.), ICFRE, Dehradun for further publication in Timber and Bamboo Trade Bulletin.

Project 2: Screening of exotic and indigenous plant species for their performance on salt affected soil with different management project [AFRI-49/NWFP/1997-2008]

Status: An experimental trial was laid out in August 2003 with two fodder species namely *Zizyphus mauritiana* (ber) and *Colophospermum mopane*. The trial was treated with two levels of gypsum (0 and 100 % soil G.R.) and three doses of nitrogen (0, 9 and 18 g of N in the form of urea) on two modes of planting (control and circular dished mound). *C. mopane* registered 95 % survival on CDM and 89 % in control after three years of planting, while it was 53 % and 64 % for *Z. mauritiana*. Mopane recorded better mean height (77.8 cm) and crown diameter (114.4 cm) on CDM as compared to control (71.5 and 106.4) while for Ber, crown was more on control 60.2 to 57 cm. Over all mopane recorded 100 % and 76.9 % more crown on CDM and control than Ber. Positive influence of nitrogen application was observed for height and Crown diameter for mopane only. In third year of growth ber showed better growth under control conditions compared to CDM.

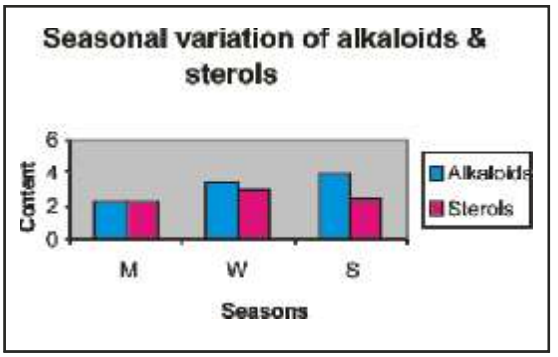
There is no appreciable difference in soil pH values in pre and post monsoon seasons for Ber and Mopane. Soil pH is ranging from 8.1 to 9.0 and 8.2 to 9.1 in 0-25 and 25-50 cm soil layer from plant pit in summer (May 05). Trench (0-25 cm soil layer) recorded pH from 8.1 to 8.6. No change was observed on soil pH of post monsoon season collected in November 2005.

Soil Organic Carbon from 0.13 to 0.25 % in post monsoon season registered 50% increase over initial values in plant pit and inter- row spaces.

Sueada nudiflora after 72 months recorded 79.2 and 66.7 per cent survival on CDM and DRM as compared to 55 % under control conditions. The average growth (height and crown diameter) on structures was also recorded higher. The total dry biomass was also 98 and 106 % more on DRM (2.16 tha^{-1}) and CDM (2.25 tha^{-1}) than on control (1.09 tha^{-1}). High percent ash content in leaves is balanced by high percent protein content (27.5 and 16.4 in CDM; 34 and 13.9 in DRM and 28.5 and14.0 in control). The total soluble sugar content was higher in control (6.01%) as compared to CDM (4.55 %) and DRM (3.30 %). Thus *S. nudiflora* has the potential to be introduced as fodder species on arid sandy soils.

Project 3: 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: The project aims at determining the optimum harvesting time for flowers of *Calotropis procera* so that the medicinally active principles can be exploited to the maximum. *Calotropis procera* flowers were collected for different seasons for two years and active principles extracted over soxhlet with various solvents. Total extractives determined show maximum extraction during monsoon. Investigations on sterol and alkaloid content of these flowers showed that the total alkaloid content was maximum in summer season and minimum in monsoon season. Yield of total sterols was maximum during winters and lowest in monsoon. The mean alkaloid content was found 2.27 %, 3.33 % and 3.89 % and sterol content was 2.30 %, 2.86 % and 2.35 % in monsoon, winter and summer seasons respectively.



Project 4: Genetic improvement of *Tecomella undulata* [AFRI- 44/FGTB/2002-06]

Status: Rohida (*Tecomella undulata*) has multifarious uses and is well grown in arid regions. It is well distributed in Rajasthan and Gujarat. The species has been overexploited from its natural habitat for obtaining good quality timber. To bring improvement in the productivity of this tree, candidate plus trees (CPTs) in different areas have been selected; 30 CPTs in the irrigated tract of IGNP canal area from the plantation raised in 1987 and 35 CPTs in the unirrigated areas in the Farmers Field. The data has been recorded for the total height, clear bole d.b.h., and the colour of the flower. The clear bole percentage was calculated over the total height of the CPTs selected, the maximum clear bole over the total height was recorded 46.5 per cent and minimum 17.9 per cent.

Photographs of the CPTs selected

Project 5: Screening of high oil and azadirachtin in Neem [AFRI-45/FGTB/ 2002-06]

Status: Twelve hectares of progeny trials of summer and winter flowering CPTs at AFRI, Jodhpur and high azadirachtin and high oil CPTs at Govindpura Jaipur are being maintained periodically. Phenological observations are recorded on the trial.

Project 6: Multilocational trial of *Eucalyptus camaldulensis* and *D. sissoo* clones [AFRI-41/FGTB/2002-2006]

Status: Multilocational clonal trial of *Eucalyptus camaldulensis* and *Dalbergia sissoo* was established in August 2003 at four different locations namely Deesa, Kheralu, Gandhinagar, Rajpipala in Gujarat state. These clones are superior from germplasm selected under WB project and other sources. Best four clones identified for both the species after 3½ years of growth and listed along with site within brackets for *E. camaldulensis* 99(D,K,G,R)4; 128(D,K,G)3; 115(D,G,R)3 and 105(D,K,R)3; and for *D. sissoo* G5(D,G,R)3; 89(D,K,R)3; 6(D,K,G)3 and 3(D,R)2.

Project 7: 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. 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 analyzed for soil nutrients and soil

enzymes. Acid phosphatase activity increased from August to November and lowest activity was observed in December (greater than control). Nearly same trend was also observed for alkaline phosphatase activity. Acid and alkaline phosphates activity was 2.23 and 2.18 fold, respectively, greater than control. An increasing trend was observed in dehydrogenase activity also from August to October. Dehydrogenase activity was always higher (2 to 3 fold) in the soil collected from the rhizosphere of the plants as compared to the control plot.

Project 8: 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: Rajasthan, Gujarat and Dadra and Nagar Haveli research results and other activities of the institute have been displayed through charts, exhibits, photograph and models.

Project 9: Develop strategies and methodologies for extension of forestry research technologies in semi-arid and arid areas [AFRI-71/AFE/2005-2009]

Status: Extension through handouts/paper articles insertions, multimedia applications and mobile exhibit displays periodically. Organized Quiz and Painting Competition, published 5000 leaflets and 3 banner slogans. “World Environment Day 2006” was celebrated; and 10,000 leaflets, 10 banner slogans, sticker, article and poems were distributed.

Project 10: Relative resistance of neem provenances to insect pests and mites and their biomanagement in arid areas [AFRI-73/FP/2006-09]

Status: Three species of termites, ***Odontotermes obesus*** (Rambur), ***O. redemanni*** (Wasmann) and ***O. gurdaspurensis*** Holmgren (Termitidae) are among the common insect pests in neem provenance at AFRI. Termite workers feed on the roots and stem portions irrespective of age and ecological parameters of neem plants. The damage occurs by hollowing out or by partly removing the bark of the roots and stem. The oriental yellow scale, *Aonidiella orientalis* Newstead (Diaspididae), neem scale, *Pulvinaria maxima*, *P. azadirachtae* Green, Indian wax scale, *Ceroplastes ceriferus* Anderson, Wax scale, *Ceroplastes pseudoceriferus* Green, The shield scale, *Lecanium* sp. (Coccidae) *and Pseudococcus* sp. (Psedococcidae) are amongst the insect pests collected and identified during the last three months. Four species of sap sucking insects have been identified to cause minor damage to the robust trees of neem in the provenance trials.

Project 11: Management of potential insect pests and diseases of important medicinal plants grown in arid and semi-arid regions [AFRI-72/FP/2006-2009]

Status: Severe infestation of a noctuid caterpillar species has been noticed on all mehndi (*Lawsonia inermis*) growing areas at Sojat road (Pali). Heavy termite infestation was recorded in the Guggal (*Commiphora wightii*) plantation at Kailana (Jodhpur). About 1.50 cm thick stem of Guggal were found infected by stem rot as well as termite infestation resulting drying of the stem and shoots. Guggal plants at AFRI model nursery were noticed infested severely by a lepidopteron pest and white fly. Foliar spray of 0.02 % of Monocrotophos in combination with Bavistin 0.1 % is recommended as remedial measure. Severe infestation of termites has also been noticed in the root system of mature Guggal plants at Herbal Guggal Farm, Mangaliavas near Ajmer. Ashwagandha (*Withania somnifera*) were found attacked by aphids and leaf blotcher. Two species of predatory beetles (Coccinelidae) were recorded to feed on these sap sucking insects from adjoining areas of Jodhpur. Sporadic incidence of black leaf

spot, brown leaf spot and blight disease was commonly found in all mehndi (*Lawsonia inermis*) growing areas at Sojat road (Pali). The pathogen was identified as Alternaria sp. causing black leaf spot disease. Some mehndi fruits were found attacked by fruit-rot disease. Stem dry rot in Guggal (*Commiphora wightii*) was noticed in young plantations of Guggal from AFRI nursery, adjoining Guggal growing areas at Jodhpur and Vasan nursery, Gandhinagar. Two pathogens namely, *Rhizoctonia bataticola* causing charcoal root rot and *Rhizoctonia solani* were isolated and identified from Guggal collected from Vasan Nursery, Gandhinagar. Leaf blight disease was recorded from Ashwagandha (*Withania somnifera*) at AFRI model nursery. The fungus was isolated and identified as *Alternaria* sp. Isabgol (*Plantago ovata*) crop was found severely attacked by downy mildew disease at Sojat (Pali). The fungus was identified as *Peranospora* sp. Farmers were advised to foliar spray (0.02%) of Monocrotophos in combination with Dithane M-45 at 0.2 % after fifteen days interval as remedial measures.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Assessment of Neem International Provenance Trial

Status: The project was started in July 2006. Observations were taken for growth parameters of the different provenances and flowering time in the provenances. During the initial observation, i.e. in the month of August few fruits were found in some international provenances, giving an indication that the flowering either started late or it could be late flowering. No flowering has been observed in the trial until last observation was made.

Project 2: Demonstration trial of male and female *Ailanthus excelsa* plants raised through grafting and tissue culture

Status: *A. excelsa* trees (50 males and 50 females) have been identified and marked for two ha site at AFRI (VMG field) for demonstration. Seedlings have been raised as root stock for grafting. Grafting work of male, female scion on the root stock is in progress. Similarly establishment of in vitro cultures of male, female *A. excelsa* trees is also in progress.

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally aided)

Project 1: Genetic improvement of *Jatropha curcas* for adaptability and oil yield [AFRI-66/Silvi/CSIR/2005-2010]

Status: Collected 23 elite and 180 native accessions of Jatropha and planted these in AFRI experimental field. Elite accessions planted in September 2005 and 2006 showed variation in percent survival, total mean height, collar diameter, crown diameter, number of branches, and female to male ratio. The survival percentage ranged from 18.75 to 100 %. Accession number SKNJ-1 (Sardar Krushi Nagar) has died and was unable to survive here. The major threat in arid region is termite infestation and cost of termite treatment is very high in arid areas. The maximum (100%) survival was obtained in accession numbers 12 and 13 from CRIDA; 20 from FRI, Dehradun and 21 from PAPL Bangalore. Other accessions showed 18.75 to 93.75% survival.

After 18-months of planting in the field, accession numbers CSMCRI-GJ-PCM-C_3, CRIDA, Raipur and JPH009, PAPL, Bangalore performed better. Production of fruits per plant varied from 175 g in CSMCRI-GJ-PCM-C_3 to 3.67 g in SKNJ-$_9$, Urli Kanchan.

Out of 180 accessions planted, 30 accessions have died and remaining accessions showed 33 to 100 percent survival. Maximum mortality was observed in accessions supplied by CRIDA (12 accessions), followed by NBPGR (8) and FRI (6). Accessions received from CSMCRI, Bhav Nagar and AFRI showed no mortality and 2 accessions each from NBRI and PAPL died after transplantation in the field.

For developing agro-technology, seeds from a single tree having more than 40% oil have been collected and seedlings have been raised. Plantations have been done in July 2006 in split plot design. Initial observations have been recorded on above ground height, number of branches and crown diameter after 6-months of planting.

Project 2: Locational trials on Bamboos (NMBA) [AFRI-43/GTB/2005 2008]

Status: All the three trials were established in July 2006. Initial and after one month growth data has been recorded as per guidelines of NMBA. Soil samples have been collected from all the three experimental plots and analysis for of pH, EC, NPK and carbon stock have completed.

Project 3: Multiplication and field trial of Bamboos through tissue culture in Rajasthan and Gujarat [AFRI-68/GTB/2005-2008]

Status: Superior Planting stocks of *Bambusa bambos* TC plants (8000) were procured from TERI New Delhi and *Dendrocalamus strictus* (4000 plants) were procured from I.H.B.T., Palampur. Remaining planting material of *D. strictus* was raised at TC lab of AFRI Jodhpur from seed source of TFRI, Jabalpur. The achievements of the project so far are given below:

1. Demonstrations and experimental plantations of *Bambusa bambos* and *Dendrocalamus strictus* plants were raised through tissue culture in July 2006 (25 ha Dahod Gujarat, 20 ha Kushalgarh and 5 ha Saira in Rajasthan).
2. Survival percentage of both species after four months was above 95 % at Kushalgarh (Rajasthan) and Dahod (Gujarat) locations. However survival percent was about 70 % at Saira, Udaipur in Rajasthan.
3. Data and soil samples (75 No.) were collected from all three sites and analysis for pH, EC, NPK and carbon stock has been completed.

Project 4: Efficacy and economics of water harvesting devices in controlling run-off losses and enhancing biomass productivity in Aravalli ranges [AFRI-39/FED/2002-2006]

Status: Seventy five plots of about 700 m^2 area were laid in 0-10 %, 10-20 % and >20% with five treatments (control, contour trench, gradonie, Box trench and V. ditch rainwater harvesting structure) in five replicates. Growth and seedling survival were recorded in June 2006 and January 2007. Casuality was replaced in July 2006. Runoff measured from July to October 2006 (12 times) and water samples were collected (2 times) for nutrient analysis. Vegetation diversity monitored and community biomass determined.

Highest run-off losses were recorded from 10-20 % slope plots. Water loss was highest in control plots, whereas the lowest run-off loss was from Contour trench plots.

Growth of planted seedlings and vegetation at Banswara site

Nutrient loss (NH_4-N and NO_3-N) along with run-off water was highest in control plots. Loss of dissolved solids and PO_4-P was lowest from Contour trench plots. Soil water content (SWC) determined in May, August, September, November 2006 and January 2007 indicated highest SWC in >30 % slope plots except in September and January. Lowest SWC was in 10-20 % slope in all the observations. The SWC in May 2006 was in order of Contour trench > Box trench > Gradonie > V-ditch > Control.

Seedling survival was highest in *Emblica officinalis* (91.1 %) and lowest in *Dendrocalamus strictus* (79.5 %) in May 2006. The survival was highest in 0-10 % slope area (86.1 %) and lowest in >20 % slope area (70.7 %) with an average survival of 79.1 %. Considering the rainwater harvesting structures, the survival was lowest (76.0 %) in the control plot and highest in Contour trench plot (83.4 %). Seedlings of *D. strictus* were tallest whereas the seedlings of *Holoptelia integrifolia* were smallest.

Seventy five herbs and grass species were recorded in October 2006. Highest numbers of herbs/grass species and their population were in 0-10 % slope area. Vegetation production was highest in 10-20 % slope. Both fresh and dry masses of the grasses were lowest in the plots of >20 % slope area. Average vegetation production was 273.9 g m^{-2} (84.8 g m^{-2} in upside of the plots, 393.6 g m^{-2} within the treated plots and 342.3 g m^{-2} down side of the treated plots) in the protected (experimental) area as compared to 105.4 g m^{-2} in the unprotected area (i.e., outside of the experimental area).

Project 5: Study of characteristic features pertaining to bio-drainage potential of some selected tree species [AFRI-38/FED/2004-2008]

Status: Growth parameters have been recorded quarterly from sample plots at Anupgarh branch and 1357 RD, IGNP in the plantation raised by State Forest Department, Rajasthan and AFRI. At 1357 RD, crown spread and girth at breast (GBH) height of the plants was high in *Eucalyptus rudis*. Though plant height was more in *E. camaldulensis* but crown spread and GBH were less than *E. rudis* plants. Two and half year old *E. camaldulensis* plants at Anupgarh attained average height of 1472 cm. Crown diameter and collar girth was 294 cm and 35 cm respectively. Height, crown diameter and collar girth in three and half- year-old plants was 1808 cm, 378 cm and 48 cm, respectively.

High transpiration (3.11 mmol H_2O m^{-2} s^{-1}) and photosynthesis rate (10.14 µ mol CO_2 m^{-2} s^{-1}) were recorded in *E. rudis*. Soil samples collected and analyzed for pH, EC and organic carbon. Soil pH ranged between 98.3 and 10.3 at different sites. Soil organic carbon was more in surface than the sub-surface. Soil EC, recorded in August 2006 was low at 1357 RD, IGNP in comparison to the observations recorded in December 2005.This may be attributed to leaching effect due to rain.

In another experiment out of the four species planted (viz. *Eucalyptus camaldulensis*, *Acacia nilotica*, *Tamarix aphylla* and *Casuarina junghuhniana*) *Tamarix* and *E. camaldulensis* recorded better survival and growth. One year old *Tamarix aphylla* attained height and crown growth of 207 cm and 172 cm at 1357 RD experimental plot out performing *E. camaldulensis* (130 cm, 80 cm and 6.5 cm of height, crown diameter and collar girth respectively).

Project 6: Baseline survey study on biological diversity in Mangala, Sarswati and Rageshwari Areas of Rajasthan Hydro Carbon Project [AFRI-75/FED/2006-2008]

Three year-old *E. rudis*

Status: The present proposal was formulated with a view of survey of existing bio-diversity in the eco-sensitive areas and compile inventory i.e., Ecosystems/areas (terrestrial and aquatic if available), Floral and faunal community/ species assemblages, Eco-sensitive areas like sanctuaries, wildlife habitats, breeding grounds, migratory routes and flocking areas if available. Winter season vegetation survey of 372 plot (319 agriculture land, 14 forest land, 23 gauchar land and 16 orans /Nadi) covering an area of about 1700 km^2 in Barmer district was completed. Data entries, analysis and interim report is in progress. Socio-economic and vegetations in schools, temples and other community lands data have also been collected. About 122 (12 trees. 15 shrubs, 68 herbs and 27 grasses/ sedges) have been recorded. One new variety has been recorded.

Project 7: Productive propagation of remunerative medicinal plants for establishment of Silva-Ayurveda demonstrative models in the arid and semi arid areas, their preservation for further improvement, research, extension, development and diversification [AFRI-70/AFE/2006-2009]

Status: Literature survey was done. Thirteen plots in 10 hectares of targeted area involving eight stakeholders for medi-culture were selected. Analysis of soil and water samples collected from the selected areas was completed. MoUs signed with the farmers were completed. Nursery site was selected and choice of species worked out. Sowing of *Moringa oleifera* in 580 polybags, Ber in 620 polybags, Tulsi, sown in 2 beds of 12x12 feet and Guggal cuttings sown in 2300 polybags was carried out. Brahmi plantlets (2500) were also planted in 2 beds of 12x12 feet.

Project 8: Integrated management for qualitative improvement and increased production of rohida *(Tecomella undulata)* in Rajasthan [AFRI-65/FP/2005-2007]

Component 1: Insect pests and disease studies

Status: The observations revealed that the tree deformity pertaining to hollowness might initiate the formation of cankers in the main trunks of the trees. Canker formation was found in trees having girth range from 80 cm onwards irrespective of age and girth class. The maximum percentage (18.65 %) of cankers has been noticed in the trees with girth range above 121 cm.

Thirty rohida trees exhibiting symptoms of hollowness in IGNP area as well as in the farmers' fields were identified. Regular examination was made and studied marked trees pertaining to causal agents responsible for the hollowness problem.

Thirty five insect species belonging to 5 insect orders *viz*., Coleoptera, Hemiptera, Isoptera, Lepidoptera and Orthoptera, have been recorded feeding on *T. undulata*. Majority of the insects are polyphagous and infest *T. undulata* in a moderate pattern but some are potential pests and have been found to cause epidemics in plantations in the selected localities around Bikaner and Jaisalmer. Of them, 12 species of Coleopterous beetles and weevils are found causing economic damage to the shoot and root system of *T. undulata. Aeolesthes holosericea* and *Celosterna scabrator* are the most damaging species and can be termed as the key pests of *T. undulata*. Eggs of these 2 species are laid on the bark and stem. Yet another species of Cerambycidae, *Derolus volvulus* is a polyphagous in nature and its damage has been recorded in IGNP areas. Minor infestation of *D. volvulus* was noticed in the old plantation of *T. undulata*. Larvae excavate small tunnel of about 3-5 cm in the sapwood. The tunnels are filled with frass. Three species of termites are observed to be associated with the infestation in *T. undulata*. They cause considerable damage to the dead wood as well as living trees. *Odontotermes wallonensis*, *O. obesus* and *Microtermes obesi* (Termitidae) are recorded to be injurious in the Rohida plantations. *Inderbela quadrinotata* is the only lepidopterous insect causing damage as the insect borer of living rohida trees in IGNP area.

Heavy termite infestation in rohida trees at 1438 RD, Mohangarh and 1252 RD and 1265 RD at Nachna was also observed. Species responsible for the damage of bark and canker were identified as *Microcerotermes* sp. *Botryodiplodia theobromae* and *Phoma* sp. The infection occurs in the form of splitting of bark on the bole, which spreads in upward and downward direction.

Component II: Rohida Macropropagation

Status: An experiment has been conducted with following four variables:

1. Conditions: In side polyhouse/out side polyhouse.
2. Container: Poly bags/ root trainers.
3. Treatment: Wax coating/without wax coating.
4. Stem thickness: (1.0 ± 0.4 cm and 2.0 ± 0.4 cm).

Therefore, a total of 16 combinations of treatments were given to Rohida stem cuttings and 60 cuttings were raised with each treatment. Data were recorded after three months on sprouting, root primordia formation, root induction as well as number of cuttings attached by pathogens. Surviving (1.0 ± 0.4 cm diameter thick) stem cuttings exhibited high percentage of sprouting 100 %, root primordial formation (72.7 %) and rooting (27.0 %) if raised in polybags, treated with wax coating and raised in polyhouse at intermittent misting interval (99 minutes off, 99 seconds on).

Component-III: Growth and yield studies on Rohida plantations

Status: Annual measurements were carried out in 22 sample plots of *T. undulata* laid out in IGNP Stage-II of Rajasthan state.

The data collected were compiled and plot computations were completed. The summary results indicated that depending upon age, site and density, average height in the stands varied from 3.45 to 6.24 m, mean quadratic diameter from 6.30 to 12.28 cm, dominant height from 4.56 to 8.54 m, basal area from 1.94 to 14.21 m^2/ha, volume yield from 4.20 to 44.10 m^3/ha, height increment from 0.19 to 0.37 m/yr, dbh increment 0.36 to 0.64 cm/yr and MAI from 0.22 to 2.47 m^3/ha/yr.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007
(Externally aided)

Project 1: Source variation, extraction and cultivation practices for *Commiphora wightii* Arn. Bhandari [NMPB]

Component 1:

Status: Various clonal accessions (seed sources) of guggal from 13 different regions of Rajasthan were collected and their performance trial tested.

As a common practice, in general, half mature fruits were collected for seeds, this results into low germination. Depulping these half ripe-fruits gave black and white coloured seeds. Black coloured seeds were viable and gave 75-90 % germination.

Material collected from various places was kept in 12x22 cm size polythene bags with good soil and FYM in the ratio of 2:1. All bags were kept in polyhouse having misting facility.

Component 2:

Status: Field visits were undertaken to Mangaliawas Guggal Herbal Farm, Ajmer Forest area in Jaisalmer and Kumatia encloser in Kailana, Jodhpur.

Component 3:

Status: Fresh callus cultures have been established from juvenile explants on MS medium. Experiments on applicability of Guar gum, sago granules and powder and isabgoal as viable gelling agents have been initiated and are underway. The results are encouraging and it has been observed that each of these can be used as an alternative gelling agent. Older somatic embryogenic cultures have been revived and cultures are being maintained. Here isabgoal has shown promising results compared to two others tested so far.

Project 2: Studies on prediction of NTFP availability and potential for extraction in Aravali region of Rajasthan

Status: A total of 42 villages from three forest divisions i.e. Pratapgarh, Udaipur (C) and Banswara were selected for detailed study. Initial as well as post monsoon observations for natural regeneration in 84 plots of 42 villages have been taken. Socio-economic survey of these villages has been done.

Project 3: Enhancing productivity of saline wastelands in Kutchch through improved tree planting techniques and silvipastoral study

Sub Project A:

Status: The experimental area is located in Kordha, Sami Range in Patan (23.83° N latitude 72.12° E longitude) of Gujarat, India. The area is on the fringe of little Rann of Kutchch.

It is a highly saline silty clay textured black soil (medium) having soil depth 75-100 cm. *Salvadora persica* and *Tamarix dioca* did not survive the experimental conditions after three months. The percent survival of *Sueada nudiflora* after six months was 66.6, 78.6, 58.3, 70.3 and 51.5 for T_1- T_5 treatments respectively. In case of *A. ampliceps* it was 29.6, 33.3, 33.3 and 81.4 and height and crown diameter was 31.7 and 20; 36.1and 30.7; 33.6 and 33.6 and 40.5 and 56.1 cm for T_1 to T_4 treatments indicating that application of wheat husk with FYM is the most suitable treatment. There was no change

in pH but EC values decreased to 3.29 to 6.21 and 4.29 to 8.4 dsm^{-1} in upper and lower soil layers due to various treatment applications. Weed evaluation is done, mostly halophytes dominated by *S. nudiflora* appeared.

Sub Project B:

Status: The experimental site was located at Mochirai forest range in Bhuj district (23.15° N latitude, 69.49° E longitude) of Gujarat, India. The area was undulating, and soils were loamy sand textured. Soil pH and EC was 7.3 to 7.5 and 0.49 to 0.89 dsm^{-1} for 0-25, 25-50 and 50-75 cm soil layers. Organic carbon in 0-25 cm, 25-50 and 50-75 cm soil layer was 0.34, 39 and .36 % respectively. Soil depth to an impermeable underlying calcium carbonate layer was 25-75 cm at different places. Trials with four tree species namely *Cordia gharaf, Prosopis cineraria, Ziziphus mauritiana* and *Colophospermum mopane* and three grass species, namely, *Cenchus ciliaris, C. cetigerus* and *Dicanthium annulatum* were laid in RBD in three replication at Mochirai, Bhuj in July 2006. The six-month old seedlings of tree species in polybgs were planted in pits of size 30 x 30 x 30 cm at a spacing of 6 x 4 m. Among the tree species the percent survival was *P. cineraria* (98.76 %), *Z. mauritiana* (100 %), *C. gharaf* (100 %), and *C. mopane* (92.59 %) for tree control and *P. cineraria* (100 %), *Z. mauritiana* (95.67 %), *C. gharaf* (100 %), and *C. mopane* (91.35 %) with grass species after six months. Growth wise *C. gharaf* recorded maximum growth (height and crown diameter) while minimum growth was for *C. mopane* after six months of planting. After fortnightly irrigation with saline water (pH_2 7.4, EC_2 5.6 dsm^{-1}) from October 2006 there is an increase in EC in plant furrows. Now it ranges from 0.5-1.8 dsm^{-1} for 0-25 cm soil layer and 0.33 to 2.1 dsm^{-1} for 25-50 cm soil layer while EC in inter row spaces is 0.1 to 0.26 and 0.12 to 0.22 dsm^{-1} in upper and lower soil layer.

Green (dry) grass yield was estimated in September 2006 and an average yield of 1.21 (0.33), 0.67 (0.18), 1.02 (0.28), 0.78 (0.21), and 1.08 (0.29) Kgm^{-2} was recorded for *Z. mauritiana*, *C. gharaf*, *P. cineraria*, *C. mopane* and grass control respectively for *C. ciliaris*. In case of *C. setigerus* these values are 0.59 (0.21), 0.80 (0.29), 0.83 (0.30), 0.69 (0.25) and 0.60 (0.22) Kgm^{-2} respectively. Germination of *D. annulatum* was poor and only 0.37 kgm^{-1} yield was recorded in scattered pockets. However 0.89 kgm^{-2} yield of local vegetation, 60-80 % of which was palatable was recorded.

Abstract: No. of Projects

	No. of projects completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	5	11	2
External Projects	1	8	3
Total	**6**	**19**	**5**

TECHNOLOGY ASSESSED AND TRANSFERRED

Growth and yield functions (volume equations, site index equations, potential density and Basal area projection models) were developed for *Acacia nilotica* and *Eucalyptus* hybrid plantations in Gujarat State. The detailed report incorporating these models and results was sent to the PCCF, Gujarat and other concerned officials for being used in sustainable management of the plantations of the two species in the state.

EDUCATION AND TRAINING

Education

1. Mr. Pradeep Chaudhry was awarded Ph.D degree from FRI University, Dehradun in Forest management i.e. "Valuing recreational benefits of Urban Forestry-A case study of Chandigarh City" under the supervision of Dr. V.P. Tewari, Scientist E, Silviculture Division, AFRI, Jodhpur.
2. Ms. Neelam Verma was awarded Ph.D degree from FRI University, Dehradun in Forest Pathology i.e. "Dependency, evaluation and selection of efficient strains of a mycorrhizal fungi for *Prosopis cineraria* (L) Druce. In Western Rajasthan" under the supervision of Dr. K.K. Srivastava, Scientist E, Forest Protection Division, AFRI, Jodhpur.
3. Mr. Sandeep Kaushish was awarded Ph.D degree from FRI University, Dehradun in Forest Genetics i.e. "Assessing variability of seed, seedling and sapling on some morphological and chemical traits of superior germplasm of *Azadirachta indica* A. Juss. in hot arid environment" under the supervision of Mr. C.J.S.K. Emmanuel, Scientist-F, Head, Forest Genetics and Tree Breeding Division, AFRI, Jodhpur.
4. Mr. Devender Kumar was awarded Ph.D degree from FRI University, Dehradun on "Studies on viability and performance potential of neem (*Azadirachta indica* A. Juss)" under the supervision of Dr. D.K. Mishra, Scientist E, Silviculture Division, AFRI, Jodhpur.

Training attended

Dr. S.I. Ahmed attended a training programme on "Intellectual Property Rights and World Trade Organization Related Issues" sponsored by Department of Science and Technology, Government of India from 31st July to 4th August 2006 at Administrative Staff College of India, Hyderabad.

Training organized

1. A training programme was organized from 12th to 16th September 2006 for Watershed Development Team consisting of 42 participants, including 9 Technical members, 11 Agricultural Experts, 6 Animal Husbandry experts and 16 Social Workers; on "Watershed Development" sponsored by Zila Parishad, Jodhpur under Hariyali-2003 programme of Ministry of Rural Development, Govt. of India.
2. A training programme was organized at AFRI from 17th to 22nd December 2006 for Watershed Development team members consisting of 60 participants, which included Agricultural experts, Animal husbandry experts, Social workers and Junior engineers; sponsored by Zila Parishad, Jalore, Rajasthan under Hariyali-2003 programme of Ministry of Rural Development, Govt. of India.
3. One week IFS officers' refresher training course was organized at AFRI, Jodhpur from 21st to 25th August 2006 on "Integrated approach for sustainable development of fragile desert ecosystem". Ministry of Environment and Forests, Government of India, New Delhi, sponsored the training. Eighteen IFS officers from different states participated in the refresher course.
4. A training programme was organized on "Pure multiplication of VAM inoculum and isolation techniques of Rhizobium" to the freshly recruited JRFs under Boifertilizer project of SFD, Gujarat at Training and Research Centre, Gandhinagar on 11th and 12th August 2006.
5. A training programme was organized on VAM technology, conducted for 35 members (ACFs, Rangers, Foresters, Progressive farmers and JRFs) under the consultancy project entitled "Identification of mycorrhizal and rhizobial association, establishing gene bank and technology transfer to farmers in field" funded by Gujarat State Biotechnology Mission at Training and

Research Centre, Gandhinagar.

6. Desert Learning Programme was organized for 45 students from Ambala, Haryana, from 12th to14th December 2006 at AFRI in collaboration with Ashoka Trust for Research in Ecology and the Environment (ATREE), New Delhi.

LINKAGES AND COLLABORATION

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 Medicinal Plants Board, New Delhi.
6. Department of Biotechnology, Govt. of India, New Delhi.
7. National Mission on Bamboo Application, New Delhi.
8. Ministry of Water Resources, New Delhi.
9. Rajasthan Forest Department.
10. Gujarat Forest Department.

PUBLICATIONS

Brochures/pamphlets

1. Brochure on `Food from forests' published and released during National Workshop on "Forestry for Food Security in dry zones" held at AFRI, Jodhpur on 6th and 7th October 2006.

2. A bilingual brochure on '*Desertification: its significance, challenges and solutions'* published and released on 17th June 2006, the World day to combat desertification.

CONSULTANCY

Consultancy on "Identification of mycorrhizal and rhizobial association, establishing gene bank and technology transfer to farmers in field" was funded by SFD, Gujarat. Under this consultancy, training was imparted to SFD officials, seven different species of AM fungi and Rhizobial strains were isolated and mass multiplied, and AM inoculation experiments on six different tree species were laid out in nursery at Gandhinagar.

Training programme on biofertilizer organized at TRC, Gandhinagar

Preparation of inoculum

AM inoculation in nursery

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. A day long brain storming session on "Floods in Thar and Challenges of Natural Disaster: Prevention, Relief and Rehabilitation" was organized jointly by Arid Forest Research Institute (AFRI), Jodhpur and The School of Desert Sciences (SDS), Jodhpur at AFRI, Seminar Hall on 19th November 2006.

2. A consultative meeting on *Commiphora wightii* (Guggul)-an endangered medicinal plant, was held at AFRI on 20/02/07, which was chaired by Shri B.S. Sajwan, Chief Executive Officer, National Medicinal Plants Board, New Delhi.

3. A National workshop on "Forestry for food security in dry zone" was organized on 6th and 7th October 2006, to commemorate International Year of Deserts and Desertification.

Attended

1. Shri CJSK Emmanuel, Scientist-F participated as resource person for UGC refresher course on "Plants and Microbes as Natural Resources" organized by Department of Botany, JNV University, Jodhpur.

2. Dr. R.L. Srivastava, Director and Dr. G. Singh, Scientist-E, attended a meeting to finalize 3rd National report on implementation of provisions and processes of United Nations Convention to Combat Desertification (UNCCD) in India at India International Centre, Lodhi Estate, New Delhi 110003 on 13th July 2006.

3. Dr. R.L. Srivastava, Director attended Agri Conclave 2006, organized by Confederation of Indian Industry at Kota, Rajasthan on 14th and 15th July 2006 and

Agri Conclave at Kota, Rajasthan

chaired the plenary session on "Soil Mapping and Quality Inputs" during the conference-cum-showcase on Agriculture and Food Products.

4. Dr. R.L. Srivastava, G. Singh and Dr. D.K. Mishra participated in International conference on 'Biofuels Vision 2015'at engineering college, Bikaner, Rajasthan from 13th to 15th October 2006.

5. Dr. R. L. Srivastava, Director, AFRI attended 3rd meeting of DBT, at New Delhi on 11th and 12th October 2006.

6. Dr. R.L. Srivastava, Director AFRI, undertook evaluation tour of Raipur (Chattishgarh) under DBT network programme on "Production and demonstration of high quality planting Jatropha" from 30th October to 2nd November 2006 along with other DBT team members.

7. Dr. R.L. Srivastava, Director AFRI attended National symposium on "Tree improvement for sustainable forestry" at Jawahar Lal Nehru Krishi Vishwa Vidalaya, Jabalpur from 4th to 6th November 2006.

8. Dr. R.L.Srivastava, Director, AFRI attended a DBT meeting at New Delhi on 14th December 2006 to discuss and workout modalities of "DBT bioresources and biotechnology awareness generation clubs for school children".

9. Director, AFRI attended Second meeting of Scientific Advisory Committee on Biofuels and Bioenergy at Department of Biotechnology, New Delhi on 28th and 29th March 2006.

10. Dr. R.L. Srivastava, G. Singh and Dr. D.K. Mishra participated in International conference on 'Biofuels Vision 2015' at Engineering College, Bikaner, Rajasthan from 13th to 15th October 2006.

11. Dr. R.L.Srivastava, Director, AFRI attended the meeting of stakeholders on "Proposed policy reforms to remove the barriers to CDM Afforestation and Reforestation (A/R) Projects" at ICFRE, Dehradun on 14th and 15th September 2006.

12. Dr. R.L.Srivastava, Director, AFRI attended a workshop on Desert and Desertification on 21st September 2006 at Jaipur, organized by Ministry of Environment and Forests, Govt. of India, New Delhi.

13. Dr. R.L.Srivastava, Director, AFRI participated in two days Regional conference, organized by Gujarat Institute of Desert Ecology on " Natural Resource Conservation, use and sustainability in dry lands " at Bhuj, Gujarat on 18th and 19th December 2006.

14. Shri N. Bala, Scientist D attended Regional Conference on Scope of Production Forestry for Carbon Sequestration at IIFM Campus, Bhopal on 23rd and 24th November 2006.

15. Dr. R. L. Srivastava, Director AFRI presided over the inaugural session of one day seminar on "Recent Advances in Natural Resource Appraisal for Sustainable Management" on 15th March 2007 and held at State Remote Sensing Application Centre, Jodhpur.

16. Dr. R.L.Srivastava, Director AFRI was the chief guest in a crop consultative meeting on "Horticulture and medicinal plants" organized by IFFCO on 16th March 2007 at Govt. hospital, village Borunda, District Jodhpur.

17. Dr. R. L. Srivastava and Pradeep Chaudhry participated in two days National Seminar on " Trees outside Forests: Potential for socio-economic and ecological development " at Chandigarh, organized by Punjab Forest Department on 25th and 26th April 2006.

18. Dr. G. Singh, Scientist E participated in two days training programme on 'Concept and Approach to Combat Desertification' for Rajasthan Forest Department conducted by Indian Institute of Bio-Social research and Development (IBRAD) held at AFRI on 25th and 25th April 2006.

19. Dr. P. Chaudhry, GCR and Dr. V.P. Tewari, Scientist-E participated in the International Conference on "Planted Forests: Ecosystem Good and Services" organized at FRI, Dehradun from 13th to 15th December 2006.

20. Dr. R.L. Srivastava, Director, AFRI delivered a talk on the theme "Desert Bioresources" at Ashoka Trust for Research in Ecology and Environment (ATREE), New Delhi on 18th May 2006.

21. Dr. R.L. Srivastava, Director, AFRI made a presentation before screening committee of National Medicinal Plants Board, New Delhi on 19th May 2006.

22. Dr. R.L. Srivastava, Director, AFRI attended an International Conference on "Environment and Globalization" at City Palace, Udaipur on 5th and 6th January 2007 and chaired the valedictory session.

EXHIBITION

AFRI participated in the 'Paschimi Rajasthan Udyog Hastshilp Utsav-2007' from 5th to 14th January 2007 through a stall with mobile display exhibits about A.F.R.I., Jodhpur facilities, activities and services attributes.

AWARDS

Dr. Tarun Kant, Scientist D, FGTB Division was felicitated by the Botanical Society of India by awarding Dr. Y.S. Murthy Gold Medal for the year 2006.

DISTINGUISHED VISITORS

1. Shri D.D. Verma, IAS, Joint Secretary, Ministry of Environment and Forests, New Delhi visited the institute on 13th August 2006 and discussed about the research work related to management and improvement of desert ecosystem being carried out at AFRI and CAZRI, Jodhpur and various other aspects related to the UNCCD.

2. Mr. N.P. Nawani, IAS (Retd.), former Secretary (Information and Broadcasting), Government of India and currently Secretary General, Indian Broadcasting Foundation, New Delhi visited AFRI, Jodhpur on 26th December 2006.

3. Dr. Prabhakar Dubey, AIGF (R&T) visited the institute on 16th and 17th January 2006 and attended Friday presentation in Seminar Hall regarding tours undertaken by different scientists to project sites.

4. Shri Jagdish Kishwan, DG, ICFRE visited AFRI on 8th and 9th February 2007. He inspected various experimental research fields, visited AFRI model village in Jodhpur district and addressed Scientists/ other staff of the institute during the visit.

5. Shri B.S. Sajwan, Chief Executive Officer, National Medicinal Plants Board, New Delhi visited AFRI, Jodhpur on 20th February 2007. He visited AFRI model nursery, Medicinal Plants Germ Plasm Bank and Guggul field trials. He also chaired a consultative meet on Guggul (an endangered medicinal plant) held in seminar hall of the institute on 20th February 2007.

6. Dr. (Mrs) Kiran Soni Gupta, IAS, and Divisional Commissioner, Jodhpur visited the institute on 4th March 2007, visited experimental fields and labs and interacted with the scientists about the research work being carried out at AFRI.

MISCELLANEOUS

1. The year 2006-2007 was declared as International Year of Desert and Desertification (IYDD) by the United Nations Organization. In this connection the institute celebrated 'World day to Combat Desertification' on 17th June 2006. Prof. L.K. Shekhawat, Vice Chancellor, Jai Naraian Vyas University, Jodhpur was the Chief Guest in the function in which Director, CAZRI presided over. Logo, sticker and slogans were released on the occasion. A bilingual brochure containing information on deserts, their distribution, effects, significance of the day etc. was also released on this day. The pamphlets and brochures were sent to all government departments, universities, research institutions, NGOs, progressive farmers and public representatives up to village Panchayat level in Rajasthan state to generate public awareness and mobilize the masses for their active cooperation in combating desertification.

2. A Film on Khejri Mortality and its control measures was telecast on ETV, Rajasthan and Dr. S. I. Ahmed, Scientist-E, was interviewed as an Expert on the Khejri Mortality on 9th March 2007.

3. Dr. Pradeep Chaudhry, GCR, gave a Radio talk on “Cultivation of medicinal plants of arid region” at Radio Station, Jodhpur on 20th March 2007.

Himalayan Forest Research Institute Shimla

Himalayan Forest Research Institute (HFRI), Shimla, Himachal Pradesh was earlier, established as High Level Conifer Regeneration Research Centre during May 1977 for carrying out research on the problems 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 enlarged from Regeneration of Silver Fir and Spruce to Eco-Rehabilitation of Cold Deserts, Mined Areas Rehabilitation, insect-pests and disease management, besides studies on agroforestry practices in hills and Regeneration of Coniferous and Broad-leaved Forests. This Centre was re-designated as Himalayan Forest Research Institute, Shimla in 1998. The Institute caters to the forestry research needs of the States of Himachal Pradesh and Jammu and Kashmir.

The Institute has been declared as an Advanced Centre for Cold Desert Afforestation and Pasture Management by the Council for taking up advanced research in eco-restoration of these harsh sites. Research Station located at Tabo (Lahaul-Spiti) mainly caters to the specific research needs of cold deserts alongwith the arid zone conditions.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: Promotion of medicinal plant cultivation among rural communities for sustainable income generation [HPFSR/GIF/2006-2007]

Findings: After undertaking field surveys and in consultation with the state forest department, four sites viz., Didag: 2003 m (Rajgarh), Kaalath: 1252 m (Shree Renuka Ji), Salani: 370 m (Nahan) and Johoron: 360 m (Paonta) were selected for establishing the demonstration plots of medicinal plants. Twenty eight species of commercially important medicinal plants were raised and maintained in these demonstration plots for awareness and training purposes. In the project, eight trainings to popularize commercial cultivation of medicinal plants were organized where a total of 448 participants comprising of farmers, members of VFDCs, Mahila Mandals, NGOs and front line field staff of Forest Department of District Sirmour were trained. The course material for training was developed in simple Hindi language and was distributed to the trainees.

Performance of *Coleus amboinicus* and *Withania somnifera* in demonstration plots

Project 2: Standardization of nursery technology for mass propagation of selected medicinal plant species [HFRI-009/07(NWFP-01)/PLAN/2000-2007]

Findings: Germplasm of 33 species of medicinal plants of temperate Himalayas in Brundhar nursery (Manali), 30 species at Shilly nursery (Solan) and 10 species each at Shillaru Nursery (Shimla) and Model Nursery (Shimla) were maintained for research, training and demonstration purposes. Nursery trials were conducted for improving the agro-techniques of economically important medicinal plant species e.g. *Picrorhiza kurrooa* (Karu), *Aconitum heterophyllum* (Patish), *Valeriana jatamansi* (Mushkbala), *Angelica glauca* (Chora) etc. Nursery techniques were improved for the mass production of nursery stock of these four species viz. *Picrorhiza kurrooa*, *Valeriana jatamansi*, *Aconitum heterophyllum* and *Angelica glauca*. In case of *Aconitum heterophyllum* and *Angelina glauca* techniques for propagation through seeds were improved. Scientific shade requirements were standardized for the production of nursery stock of these species.

Project 3: Standardization of nursery techniques of raising containerized seedlings of conifers and their broadleaved associates [HFRI-016/05 (SFG-06)/PLAN/2000-2007]

Findings: Trials were conducted to find out the optimum size/type of root-trainers for nursery production of *Cedrus deodara, Picea smithiana* and *Abies pindrow*. The result thus obtained, revealed that the growth performance of all these three conifer species was found to be the best when raised in single cell root trainers. Similarly, for *Alnus nitida* and *Grewia optiva* nursery stock was found to be best when raised in different sized root-trainers. Research was also carried out on plug+2 in Spruce (*Picea smithiana*) and plug+3 experiments in Silver Fir (*Abies pindrow*) for raising nursery stock of these species first in containers and then as bare roots. Vegetative propagation trials of potential cold deserts species viz. *Elaeagnus umbellata*, *Colutea nepalensis* and *Rosa webbiana* were conducted.

Cedrus deodara in root trainers

Root trainer trial in *Grewia optiva*

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Introduction and performance trial of *Paulownia* species for agroforestry in different agro-climatic zones of Himachal Pradesh [HFRI-026/08 (AGF-02) PLAN/2003-2008]

Status: To mitigate the increasing demands of timber, fuel and fodder, systematic introduction trials of *Paulownia* species viz. *P. fortunei, P. fargessi, P. elongate* and *P. tomentosa* in different agro-climatic zones of Himachal Pradesh were established. Trial on inter-cropping of *Paulownia* spp. with tea is also maintained.

Raising of ETP's of *Paulownia* species in the nursery

Trial of *Paulownia* species at Johroan, Poanta (H.P.)

Flowering in *Paulownia*

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: After extensive diagnostic surveys, the existing agro-forestry systems in mid and high hill temperate regions of Kullu district of Himachal Pradesh were identified. Based on the size of operational land holdings, farmers were divided into four categories viz. marginal, small, medium and large. Socio-economic studies in different categories of farmers were carried out for structure of the family, education status of the head of family, land use statistics, status of the government employment and livestock status. Survey was conducted using Semi Structured Interviews (SSI) with the farmers and data on biological yield and economic return of different existing agroforestry systems are being collected.

Brassica rapa with Apple

Project 3: Standardization of nursery techniques of five dominant indigenous species (*Capparis spinosa, Colutea nepalensis*, *Caragana gerardiana*, *Ribes orientale*, *Cratagus songarica*) besides *Eleaegnus angustifoli, Hippophae rhamnoides* and *Rosa webbiana* of cold deserts [HFRI-019/03(EBC-08) PLAN/ 2002-2009]

Status: Trials to understand the (i) Effect of different concentrations of Indole-3 Butyric Acid on rooting in shoot cuttings of *Ribes orientale, Colutea nepalensis*, *Eleaegnus angustifolia*, *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 orientale*, *Colutea nepalensis, 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 orientale*, *Colutea nepalensis, 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 orientale, *Hippophae rhamnoides, Rosa webbiana* and *Capparis spinosa* were undertaken.

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. Data on various nursery trials revealed that hot water treatment for 24 hours in case of seeds of *Hippophae rhamnoides* gave maximum germination per cent.

It was seen that the experiments as laid out inside the poly tunnels are performing well over the plants than those growing in the open nursery. Field trials to assess the performance of *Eleaegnus angustifolia, Hippophae rhamnoides, Rosa webbiana* and *Colutea nepalensis* were established.

Nursery trials to assess the performance of seed germination in *Rosa webbiana, Capparis spinosa*, *Caragana gerardiana* and *Ribes orientale* were laid in under ground polyhouse, shade house and poly tunnels conditions. Besides this, effect of different concentration of IBA on rooting in *Eleagnus angustifolia, Ribes orientale* and *Crategus songarica* were also laid out in poly tunnels. Also, an experiment to assess the effect of different diameter classes of roots on rooting and growth in *Rosa webbiana* was initiated during the period.

Project 4: Studies on plant diversity in cold deserts of district Kinnaur, Himachal Pradesh [HFRI-029/02(EBC-11)PLAN/2004-2007]

Status: Carried out phytosociological studies at an altitude, varying from 3000-5000 m above msl, in Labrang valley of Pooh sub-division of Kinnaur district of Himachal Pradesh.

Analysed the vegetation data collected from Labrang valley (3000-5000 m) of Pooh sub-division of Kinnaur district. Out of 75 medicinal plant species recorded from the area, 16 species i.e. *Aconitum heterophyllum, Bergenia stracheyi, Betula utilis, Corydalis govaniana, Dactylorhiza hatagirea, Heracleum candicans, Hyoscyamus niger, Hyssopus officinalis, Juniperus communis, Juniperus macropoda, Lactuca macrorhiza, Pleurospermum brunonis, Rheum webbianum, Rhodiola heterodonta, Selinum tenuifolium* and *Thymus linearis* fall under the category of threatened plants.

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: Studies on the Life cycle of 'Indian Gypsy Moth' (IGM) was repeated and detailed morphometric study was conducted on the immature stages of the moth. Nuclear Polyhedrosis Virus (NPV) was extracted from the infected larvae of the IGM, purified and studied under TEM. Pupal parasitoid *Exorista rosica* was reported and as many as 21 species of predatory spiders were found among natural enemies.

The immature larvae of IGM collected from the oak forest were reared on natural diet (oak leaf) in the laboratory and adults thus emerged were allowed to mate in a mating chamber to study the life cycle.

NPV Study: The caterpillars reared in the laboratory were innoculated with viral suspension already purified from last year's infected larvae. The oak leaves were contaminated with viral suspension and the caterpillars were allowed to consume the leaves. Structural details of the virus were studied under Transmission Electron Microscope (TEM).

Parasitoids and Predators: *Exorista rosica,* a pupal parasitoid of the family Tachinidae was found to be the most effective in controlling the population of IGM.

Project 6: Survey, biology and control of insect-pests of important medicinal plants in Himachal Pradesh and Jammu and Kashmir [HFRI-033/06(FPT-07)PLAN/2005-2010]

Status: In total 32 insect species were recorded from 13 selected medicinal plants, being cultivated in this region. The status of these insects on the basis of damage caused and their abundance has been assessed and found that *Plusia orichalcea* Fab., is the most destructive pest. The biology of *P. orichalcea* on *Saussurea costus* was completed in the laboratory.

Different development stages of *P. orichalcea* and their morphological characteristic have also been studied in the laboratory. First time, mite infestation was recorded on *Valeriana jatamansi* Jones; in Himachal Pradesh and the infestation ranged from 30-80 per cent in nursery. The species of mites were identified as *Panonychus ulmi* (Koch), European Red Mites and *Tetranychus urticae* (Koch), Spider Mite and they are otherwise supposed to be the destructive pests of Apple.

Project 7: Diagnostic study of indigenous and institutionalized participatory forest management in Himachal Pradesh [HFRI-025/08 (PFM-01) PLAN/ 2005-2008]

Status: Survey of various village forest development committees and panchyats were carried out in Nahan, Rampur, Mandi and Dharmashala circles. Staff interviews were also carried out.

Moth of *Plusia orichalcea* pest of Kuth

Project 8: Planting stock improvement programme in *Cedrus deodara* [HFRI-028/05(SFG-08) PLAN-03/2003-2008]

Status: Based on the survey carried out to select best seed stands of deodar in the states of Himachal Pradesh and Jammu and Kashmir, selection of the seed stands was done on the basis of sample plot studies. These sample plot studies were carried out to supplement ocular selection of seed stands for their conversion into Seed Production Areas (SPAs). The two seed stands i.e., Cheog Forest (20 ha) of Theog Forest Division and Nankhari Forest (15 ha) of Rampur Forest Division were finally selected for complete enumeration.

The seed stand identified in Neeru range of Bhadrawah Forest Division in the state of Jammu and Kashmir in collaboration with State Forest Research Institute, Jammu were prepared and are in the process of submission to the authorities concerned. Cones were also collected from 52 Plus Trees identified in different forest areas and progeny trial raised in the nursery.

Project 9: Allozyme variation in natural populations of deodar (*Cedrus deodara*) [HFRI-030/05(SFG-10) PLAN-03/2005-2008]

Status: The genetic diversity and differentiation using isozyme techniques in different populations (15) of deodar are being studied by assaying five enzyme systems namely SKDH, MNR, IDH, GDH and MDH. Seven populations, six from the state of Himachal Pradesh and one from Jammu and Kashmir were electrophoresed for these enzyme systems.

Shikimic Acid Dehydrogenase (SKDH): One zone of activity with three single banded phenotypes was identified both for endosperm and embryos.

Malate Dehydrogenase (MDH): Gels stained for MDH showed four zones of activity. The system has been studied for three populations and would be studied for remaining populations this year.

During the year efforts were also made to score more enzyme systems and in this endeavour standardized the staining protocols for two more systems i.e., MDH and 6PGDH. These enzyme systems are now being assayed for the populations being studied for genetic diversity and differentiation in the species.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Standardization of methodology for seed collection, seed handling, storage and breaking seed dormancy in *Juniperus polycarpos* C. Koch and *Fraxinus xanthoxyloides* (Wall. ex G. Don) DC. [HFRI-036/03 (SFG-11)PLAN-2006-2011]

Status: Field visits to upper tribal areas of Kinnaur District were carried out and sites having seed bearing trees of *Fraxinus xanthoxyloides* were selected at Thopan (Akpa), Kirankhud, Spillow, Labrang and of *Juniperus polycarpos* at Labrang Kanda and Ropa Kanda. The processed seeds were put in to different pre-sowing treatments i.e., stratification in moist sand for different time periods and germination studies initiated. Moisture content of seeds was recorded in the laboratory. Seed storage trials were initiated by using different storage containers and environmental conditions.

Juniperus polycarpos seeds

Fraxinus xanthoxyloides seeds

Project 2: An ecological assessment of floristic diversity in Hemis High Altitude National Park, Ladakh, Jammu and Kashmir [HFRI-031/02 (EBC-12) PLAN/2006-2011]

Status: Developed liaison with the office of Chief Wildlife Warden and concerned officers. With the help of the wildlife office staff prepared outline maps and then marked trails to follow within the park area, in order to cover the major regions of the park for obtaining a true representative diversity of the area. Conducted surveys and ecological studies, starting from Marshelang to Hemis region.

Documented the vegetation types in the river valleys. Soil samples were collected for analysis. Ethno botanical records were initiated, along with the information obtained from local *Amchi* (traditional healer).

Project 3: Management of insect borer complex in chirpine forests [HFRI-035/ 06(FPT-08)2006-2011]

Status: Two forest sites viz. D- 113, Sairighat Forest (Solan Forest Division) and P-8 Santana Forest (Hamirpur Forest Division) were selected for observations/ experimentation and basic data on the status of tree health were recorded. Three plots of size 1000 sq m were marked in these sites and insect

fauna of Chirpine and their natural enemies were recorded from randomly selected trees. An experiment to study the efficacy of insecticides (Grownim and Edosulphan 35 EC) to control the insect stem borers in Sairighat has also been laid.

Project 4: Evaluation of soil fertility status and nutrient return from the important indigenous agroforestry systems in Himachal Pradesh [HFRI-034/08(AGF-04)/PLAN/2006-2011]

Status: Field surveys were undertaken for selection of important agroforestry systems in Shimla, Hamirpur, Bilaspur and Mandi districts of Himachal Pradesh. Soil samples were collected and analyzed for soil fertility status in important agroforestry systems. Laying of experimental trials for evaluation of nutrient returns from important agroforestry species are in progress.

Some important Agro-forestry systems in Himachal Pradesh

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Development of suitable model for inter-cropping of commercially important medicinal plants with horticultural plantations in temperate region of Himachal Pradesh [BT/PR4372/PBD/17/285/2003]

Status: Maintained different inter-cropping trials of selected medicinal plants viz. *Aconitum heterophyllum, Angelica glauca, Polganatum verticilatum, Picrorhiza kurrooa* and *Valeriana jatamansi* as intercropping with horticultural crops i.e. Apple and Cherry, orchards of these crops were established during 2004 and 2005 in high hill temperate region of both Shimla and Kullu District of Himachal Pradesh. Data were recorded for pre-harvest agronomic growth characteristics and porometer study of different intercropping trials. Utilizable parts of various medicinal plants harvested from different intercropping trial sites were studied for biomass and analyzed the cultivated samples for the change in level of active principles of medicinal plants under various models.

Project 2: Ecological and management studies in certain dry temperate and alpine pastures of Lahaul and Spiti, Himachal Pradesh [BT/PR/4102/ NBDB/51/ 027/2003/2004-2007]

Status: Sites supporting alpine pastures in each part of the district i.e. Miar Nallah, Triloknath, Dalang and Kwaring in Lahaul valley and Gue, Tabo and Kunjam in Spiti valley were re-surveyed for floristic

wealth. Detailed investigations on structural and functional aspects of the alpine pastures, including the assessment of floral elements at Khoksar (Lahaul Valley) and Kiyato and Gate (Spiti valley) were carried out.

Floristic Wealth in Alpine Pastures of Lahaul and Spiti Valleys

Primula reptens

Arnebia euchroma

Primula rosea

Pedicularis pectinata

Project 3: Development of ecologically viable and socio-economically acceptable integrated models for arresting willow (*Salix* spp.) mortality in Lahaul Valley of Himachal Pradesh [GBPI/IERP/04-05/34/861/2005-2008]

Status: Benchmark survey was conducted in detail in Tinan and Pattan valleys on site specific mortality, number of trees affected and other related ecological parameters were recorded. Propagating material of different species of *Salix* viz. *S. fragilis; S. vitellina; S. matsudhana; S. babylonica; S. alba* and *S. corrulea* from Jammu and Kashmir were collected. International clones (given by code names) viz. UWA-1; UWA-2; UWE-1; UWM-1; UWM-2; UWM-3; UWU-1; UWU-2; UWK; UWHY-1; UWHY-2; WO2-4 were also procured.

Established the nurseries at Sissu (Lahaul valley) and at Tabo (Spiti valley) where the above mentioned planting materials of Willow and Poplar were raised and maintained for further screening and production of planting stock for laying out the field trials. Also established demonstration plantations of willow and poplar in the forest lands over an area of 0.5 ha.

Two species of willow feeding aphids viz. *Tuberolachnus salignus* (Aphidoidea: Lachnidae): Giant Willow Aphid (GWA) and *Pterocomma salicis* (Aphidoidea: Lachnidae): Black Willow Aphid (BWA) were recorded.

The nursery stock was raised, demonstration plantations were established and maintained in the forest land at Sissu (Lahaul valley) during the period under report. Besides this 5000 planting stock of various provenances of *Salix* was also maintained at Tabo (Spiti valley).

Soil samples, as collected earlier, from the affected site were analyzed for physico-chemical properties in the laboratory.

Raising and Maintenance of Planting Stock of Willow

Project 4: Ecological assessment of forest areas falling under Kol Dam hydroelectric project in Bilaspur district of Himachal Pradesh [FT48-88/86(FCA) CATP Kol Dam Funding Agency: HPSFD]

Status: Selected the study sites in different catchment areas of Forest Division of Bilaspur, Suket, Kunihar, Shimla, Theog and Karsog. Detailed survey and ecological studies were carried out in catchment areas. Soil samples were also collected to know the chemical properties of the soil. Analysed the data collected from different catchment areas of Forest Division of Bilaspur, Kunihar, Theog and Karsog. Carried out phytosociological studies in Sunni and Hadaboi catchments of Shimla and Suket forest of Himachal Pradesh during the year 2006 and the vegetation data was analyzed altitude wise.

Project 5: Study on plant diversity in Rakchham, Chitkul Wildlife Sanctuary of district Kinnaur Himachal Pradesh [GBPI/IERP/04-05/15/862-Funding Agency: GBPI]

Status: Selected the study sites and carried out phytosociological studies at an altitude varying from 3000-3600 m in Doje Forest, Shone Khad and Kanasa Nala of Rakchham beat and 3300-4200 m in Hitch Pawang, Murti Panag area of Chitkul beat of the sanctuary. The data were analyzed to assess the diversity index.

Project 6: Screening of potential germplasm of *Hippophae rhamnoides* (Seabuckthorn) for raising quality planting stock in the nursery and establishment of demonstration plantations in cold desert areas of Spiti valley, Himachal Pradesh [DDP/Spiti/SBT/2006-11/ 2006-2009]

Status: Survey was undertaken throughout Spiti valley and performance of the populations growing in different locations was studied. Three major populations from Tabo, Shego and Mane were selected for collection of the planting material. During selection, variations within a population were also observed, recorded and planting stock was collected accordingly.

A demonstration plot over an area of 0.5 ha was established at Tabo Research Station. Besides this, nursery of SBT was also established where 15000 Nos of seedlings of the species are growing for their further multiplication and distribution for the people of the valley.

Project 7: 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- Funding Agency: DBT]

Status: To develop nursery techniques for mass propagation of identified elite clones/provenances of *B. aristata*, six provenances of *Berberis aristata* were identified in Himachal Pradesh. For seed germination studies, seeds collected from Sarahan provenance were subjected to different treatments.

During this year one provenance of *B. aristata* was identified in Mandi District. Extensive survey was conducted in Chamba district during August 2006; however *B. aristata* could not be located in the district. Seeds collected from Narkanda provenance were subjected to different treatments and the results revealed that seeds treated with sulphuric acid (2 minutes) have maximum seed germination.

Project 8: Inventorization, 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]

Status: The study aims to inventorize and document the plant diversity, assess the regeneration status of trees in comparison to the adjacent forest area, create awareness among the local people and to develop site-specific strategies for the rejuvenation and conservation of sacred groves through participation of local people.

During the current period, data on floristic diversity, ethnobotanical information and existing management practices of 11 sacred groves were collected. Plant samples have been collected from all the sacred groves and herbarium specimens were prepared for all the collected species. Data on GBH and height of trees in seven sacred groves have been collected. Traditional ethnobotanical information on 51 plant species was documented by interviewing the local people. A pamphlet in local language is being prepared for creating awareness among the local community for conservation of sacred groves.

Deodar trees in the sacred grove at Soeel

A view of sacred grove at Prini

Project 9: Promotion of medicinal plant cultivation among rural communities for sustainable income generation

Status: Three demonstration plots were established and trainings (8 Numbers) to about five hundred farmers, NGOs, mahila mandal representatives, members of village forest development committees and front line staff of Himachal Forest department were provided. The demonstration plots have been handed over to the Forest department for maintenance and further utilization. Trainings were provided to farmers and other stake holders.

Project 10: Production of quality planting material of *Picrorhiza kurooa* and *Valeriana jatamansi* and extension of their cultivation technology to local communities [GO/HP-2/2004-2007: NMPB]

Status: Established demonstration nursery of medicinal plants at Brundhar, Jagat Sukh, Manali (H.P.). Shade House and Poly-house were designed and installed in the nursery. Vermi-composting activities have been successfully commissioned at that nursery. Irrigation facilities were strengthened and were proved very useful for mass production of nursery stock of temperate medicinal plants. The production and maintenance of quality planting material of *Picrorhiza kurrooa* (Kutki) and *Valeriana jatamansi* (Mushakbala) were carried out at three nurseries of the Institute *viz.*, Brundhar medicinal plants nursery (Manali), Shilly nursery (Solan) and Shillaru nursery (Shimla).

The farmers have been sensitized through these open meetings and training programmes for adopting commercial cultivation of Kutki and Mushkbala in temperate areas. Two booklets as well as two pamphlets in Hindi were published for the benefit of local communities.

Training and Demonstration Programme for farmers at Gohar
(Nachan Forest Division of Himachal Pradesh)

Project 11: Suitability of *Jatropha curcas* L. seed sources in lower and mid himalayan regions of Himachal Pradesh [BT/PR/5094/AGR/16/429/2005-2008- Funding Agency: DBT]

Status: Produced 46,000 quality planting material of *Jatropha curcas* of various seed sources collected mainly from Himachal Pradesh. Experimental-cum-demonstration plantations at different sites in Himachal Pradesh on 18 ha area has been carried out to find out suitability of this species/seed sources in lower and mid Himalayan regions of the state. About 110 Kg of seeds of *Jatropha curcas* was collected from various seed sources from the state of Himachal Pradesh during 2005 and 2006 for

research and production of quality nursery stock under this project. Seed sources located in Himachal Pradesh have been identified for oil content. Production of quality nursery stock of these seed sources is being done in the nursery for ultimately establishing demonstration plantations for future seed resource. Published a booklet in simple Hindi titled, “Jatropha: Bhavishye Ka Biodiesel Podha” for the benefit of end users.

Nursery stock production

Seedlings ready for out planting

Field plantation

Project 12: 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 [27-114/NOVOD/2006-2007: NOVOD]

Status: Seeds of wild apricot were collected from selected areas of Kinnaur and Shimla districts of Himachal Pradesh. Pre-seed stratification treatment during winter months was provided to wild apricot seeds before sowing in nursery beds. About 10,000 quality planting material of this species were produced in the nurseries of the institute. Demonstration plantations on 10 ha area in Mandi and Kullu districts of Himachal Pradesh were carried out. Also maintained demonstration plantation of wild apricot. Two training and demonstration programmes on 'Wild Apricot - Nursery, Plantation, Oil Production and Its Uses' were organized for local communities and field functionaries of Himachal Pradesh Forest Department.

Training Programmes organized for the Forest Officials on popularizing wild apricot cultivation

Project 13: 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 - Funding Agency: DBT]

Status: The demonstration plots of *Dendrocalamus hamiltonii* is being raised at Dhadiyarghat in Solan Forest Division. The plants are being produced by Institute of Himalayan Bioresource Technology (IHBT), Palampur. The technical details of experimental plot and demonstration plot have also been provided by the funding agency i.e., DBT. The total target of 20.72 ha has been achieved. The area raised is being managed and maintained properly.

PROJECTS INITIATED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Production of quality planting material of *Aconitum heterophyllum* Wall. Ex Royle and *Angelica glauca* Edgew and extension of their cultivation technology to local communities [GO/HP-07/2006-2009: NMPB]

Status: About 1.60 lakhs quality nursery stock of *Aconitum heterophyllum* (Atish) and 6,000 nursery stock of *Angelica glauca* (Chora) have been produced. Out of that 30,000 *Aconitum heterophyllum* nursery stock was distributed to various end users, so far. A small polyhouse of size 10x4 m has been established at Shillaru nursery under this project for research, production and demonstration purposes. Rain water harvesting facilities were also created in this nursery under this project. Vermi-composting activities have been also successfully commissioned in the nursery. Organized one training and demonstration programme for the benefit of farmers. Two pamphlets in Hindi have been published for the benefit of local communities.

DG-ICFRE inspecting nursery stock of Atish

DG-ICFRE inspecting nursery stock of Atish

Abstract: No. of Projects

	No. of projects completed in 2006 2007	No. of ongoing projects in 2006 2007	No. of projects initiated in 2006 2007
Plan Projects	3	9	4
External Projects		13	1
Total	3	22	5

EDUCATION AND TRAINING

Education

1. Prof. S.L. Stephenson a world authority on Eumycetozoans from the University of Arkansas, United States of America, delivered a lecture on "Global Diversity of Eumycetozoans" on 25th May 2006 in the conference hall of the Institute.

2. Shri Frahad Vania-Advisor Change Management of HPFSR, Shimla delivered a lecture on "Impact Assessment of the Watershed Development Programme" in the conference hall of this Institute on 29th May 2006.

3. Twenty one SFS officer trainees from State Forest Service College, Dehradun visited Himalayan Forest Research Institute, Shimla on 12th June 2006 during their official trip to North India. They were apprised of the achievements and ongoing activities of HFRI through presentations. Discussion pertaining to forestry in general and forestry research in particular were also held with the officers and scientists of this Institute.

4. Dr. Oliver Springate, Bagniski, Advisor Implementation of Himachal Pradesh Forest Sector Reform Project visited the institute during August 2006 for necessary consultation and interactions with the director of the institute. Issues pertaining to sustainable forestry were discussed during the meeting.

5. Mrs. Vandana Thapliyal, Coordinator, WWF Shimla visited the institute on 22nd August 2006 alongwith 20 participants of the training titled "Training programme for local youth in guiding the tourists on eco-tourism" being organized by WWF. During their visit, the youth were exposed to scientific innovation in forestry research including the role that forests can play towards enhancement of eco-tourism.

6. A team comprising of 18 students of B.Sc. Forestry from Tamil Nadu Agriculture University, Forest College and Research Institute, Mettupalayam visited the institute on 8th September 2006 and interacted with the faculty of the institute on the issues pertaining to forestry in general and forestry research in particular.

7. Shri B.D. Suyal, Conservator of Forests (Policy and Law) on 21st September 2006, delivered a lecture on the Right to Information Act-2005 to the officers and staff of this institute. During the presentation, background behind the act, its history, evaluation and provisions were discussed in detail, which was followed by lot of discussion on the issue.

8. Ms. Reeta Kumari Sharma a trainee from Barkatullah University, Bhopal completed her dissertation work on "Isozyme Analysis in *Cedrus deodara*" under the supervision of Dr. Rajesh Sharma, Scientist-E of this institute.

9. Exposure visit of 50 farmers was organized on 20th December 2006 by this institute to Kalath nursery/ demonstration plots of medicinal plants of Jamta range of Renuka Forest Division.

10. Students of M.Sc. (Forestry) of Sher-e-Kashmir University of Agriculture, Science and Technology (SKUAST), Srinagar (Jammu and Kashmir) visited the institute on 21st February 2007. The students were apprised about the achievements and ongoing activities of HFRI through a presentation.

11. Ms. Sheetal Sandhu a student trainee from Kanya Gurukul Mahavidyala, Gurukul Kangri Vishwavidyalaya, Haridwar completed her dissertation work on "Eco-rehabilitation of lime

stone mined area and its impact on vegetation and soil status in Baldwa, district Sirmour" under the supervision of Dr. R.K. Verma, Scientist-D of this institute.

Training

1. A three days training programme on "Competence enhancement through auto suggestion and other exercises" from 2nd to 4th August 2006 was organized by the project director, Himachal Pradesh Forestry Sector Reform Project (HPFSRP), Himachal Pradesh State Forest Department, Tallend, Shimla in collaboration with Himalayan Forest Research Institute Shimla under Management Development Programme (MDP) in the conference hall of the institute. Shri Surinder Kumar, IFS, Director, HFRI, Shimla along with 15 officers and officials participated in the training programme.

2. Two training programmes of one day each were organized on "Cultivation of medicinal plants" and "Nursery and plantation technique" at Rampur on 13th and 14th September 2006. The trainings were externally aided under CAT Plan by Rampur Circle Forest Department.

3. Organized two training programmes at Nahan on 26th and 27th September 2006 on "Cultivation of medicinal plants" to farmers (50) and front line staff (50) of SFD of Nahan Forest Division.

4. Two days training and demonstration programme on "Commercial cultivation of Kutki and Mushkbala" was organized by the institute on 21st and 22nd November 2006 at Gohar Nachan Forest Division of Himachal Pradesh. The said training was conducted under NMPB funded project. 48 farmers including 50% women folk from Chachyot tehsil of Mandi District participated in the deliberations.

5. Two days training and demonstration programme on "Cultivation of medicinal plants" was organized by the institute on 20th and 21st December 2006 at Renuka, Himachal Pradesh. The said training was conducted under Good Idea Fund of Himachal Pradesh Forests Sector Reforms project. A total of about 50 farmers and 50 frontline field functionaries of Renuka Forest Division, district Sirmour participated in the programme.

6. Two days Trainers Training Programme on "Wild apricot nursery, plantation, Oil production and its uses" was organized by the institute on 27th and 28th December 2006 at Forest Training Centre, Sundernagar, District, Mandi, Himachal Pradesh. The said training was conducted under NOVOD Board funded project. About 50 frontline field functionaries of Himachal Pradesh State Forest Department participated in the programme.

7. Organized and imparted 3 trainings on "Cultivation of medicinal plants" to farmers and frontline staff of Rajgarh Forest Division and Nahan Forest Division of district Sirmour (H.P.) under Big Good Idea Fund (GIF) Project, on 6th, 7th and 9th February 2007.

8. Organized two days training-cum-demonstration programme on "Wild Apricot" at village Jari in Parvati valley of Kullu District on 12th and 13th March 2007 under NOVOD Board Funded Project. Training also covered other aspects like medicinal plants, composting, vermi-composting etc. and was attended by 67 farmers of the region.

9. Two training programmes of one day each were organized on "Cultivation of medicinal plants" for villagers and front line staff of SFD. 50 participants each of Renuka Forest Division at Renuka, attended the programmes held on 21st and 22nd December 2006.

10. Organized and imparted training on "Cultivation of medicinal plants" to the frontline staff of Jammu Forest Division at SFRI, Jammu on 21st and 22nd February 2007.

11. Imparted training on “Cultivation of medicinal and aromatic plants” sponsored by NGO named 'Organization for Ecology Conservation, Entrepreneurship, Education and Development' to the farmers at Karjain, Kullu on 27th and 28th January 2007.

LINKAGES AND COLLABORATION

National

1. Linkages were developed with IHBT, Palampur for carrying out active ingredient analysis of medicinal plants.
2. Linkages and collaboration were developed with NGO's and SFD's for organizing the various training programmes to different end users.
3. Collaboration has been initiated with CSK, Himachal Pradesh Krishi Vishvavidyalaya, Palampur for taxonomic studies. In addition, the institute/ universities in this region are contacted for exchange of ideas / informations.

PUBLICATION

Brochures/ Technical Bulletins/ Booklets/Pamphlets

1. Vijender P. Panwar, Jagdish Singh and K.D. Sharma (2007): 'Cultivation of Medicinal Plants'. Eds.
2. Atish: Ek Anmol Aushdhiya Paudha
3. Chora: Ek Mahatavpuran Aushdhiya Paudha
4. Kutki: Ek Bahumulya Ausdhiya Paudha
5. Mushakbala: Ek Bahuupyogi Jaributi

Research Reports

1. K.S. Kapoor, Sandeep Sharma and R. Singh (2006): Impacts of Deodar Stumps Removal on the Ecology of the Deodar Forests. Report submitted to the State Forest Department of Himachal Pradesh.
2. Sharma K.D, R. Singh, Vajinder Kumar and Pawan Kumar (2007): Mid term Evaluation Report of FDA Project for the state of Himachal Pradesh and Jammu and Kashmir.

CONSULTANCY

A report on “Sawara-Kuddu Hydroelectric Project: Status of Phyto-diversity: A Preliminary Analysis”, prepared after doing the preliminary survey of the flora of the project site, was submitted to the Superintending Engineer (CP and CM), Pabbar Valley Power Corporation Ltd., Anand Vas, Vasant Vihar, Khalini, Shimla.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. A Project launch workshop/meeting under project entitled “Promotion of medicinal plants cultivation among rural communities for sustainable income generation”- under GIF, an

externally aided project was organized by this institute on 19th April 2006 at Nahan, Sirmour. People from different fields viz. SFD's, NGO's and farmers of the region participated in the meeting.

2. Organized a one day workshop for Statistical and Socio-economic Evaluation of the Ongoing Research Projects on 16th May 2006. To accomplish the job in question Prof. Y.S. Negi, Head Department of Social Sciences and Prof. (Retd.) S.P. Dhall, Department of Sciences from Dr. Y.S. Parmar University of Horticulture and Forestry, Nauni, District Solan were invited as expert members.

3. Meeting of Research Advisory Committee of FRI, Deemed University, Dehradun was organized by this institute on 26th June 2006 to evaluate the Six Monthly Progress Reports of the Research Scholars doing Ph.D. under this centre. Pre-thesis seminar of the research scholar already registered with the Deemed University was also held besides a Pre-synopsis seminar of one research scholar. Director of the institute was the Chairman of the committee whereas Prof. Sarvesh Sood, Chairman, Department of Bio-sciences Himachal Pradesh university, Summer Hill, Shimla and Dr. V.D. Verma, Principal Scientist and Scientist Incharge, NBPGR, Phagli, Shimla were the Expert Member of RAC from out side the institute.

4. 'Farmers open meeting' was organized on 12th July 2006 at Nasogi for the farmers of Kullu valley to discuss about the prospects of commercial cultivation of medicinal plants in temperate region to diversify existing horticulture practices.

5. A one day workshop on “Forestry Research Need Assessment: Institutionalizing the Process in the State of Himachal Pradesh” was organized on 10th October 2006 at HFRI, Shimla, in which about 35 participants from Himachal Pradesh Forest Department, Research Organizations dealing in Forestry, Universities and NGOs participated. Input from the delegates was sought through presentations and discussions during the workshop. Shri Ashok Thakur, IAS, Principal Secretary (Forests), Government of Himachal Pradesh was the Hon'ble Chief Guest of this workshop.

6. Research Advisory Group (RAG) Meeting of this institute was organized on 18th October 2006 in which 15 ongoing research projects under PLAN and 14 externally aided on going research projects of the institute were evaluated by the Hon'ble members of the RAG. 4 new projects were presented before RAG by the concerned PIs, of which 2 were recommended by the RAG for the final approval of Research Policy Committee (RPC) of ICFRE. During this RAG meeting a presentation was also made on “Finding Economic Solutions through Natural Capital Enhancement” by Shri J.S. Walia, IFS, Chief Conservator of Forests (Sanjhi Van Yojna), HPFD, Shimla.

7. A workshop on “Status and Potential of Agroforestry in North-west Himalayas” was organized by HFRI, Shimla from 14th to 16th November 2006 in the Conference Hall of the institute in which about 60 participants from Himachal Pradesh Forest Department, Research Organizations dealing in forestry, Universities and NGOs participated. It was sponsored by State Land Use Board (SLUB) of Himachal Pradesh. Input from the delegates was sought on various aspects of agroforestry through presentations and discussions during the workshop. Shri Ashok Thakur, IAS, Principal Secretary (Forests), Govt. of Himachal Pradesh was the Hob'ble Chief Guest of this workshop. Shri R.A. Singh, PCCF, Himachal Pradesh Forest Department was also present.

8. Organized the workshop on '*Status and Potential of Agroforestry in North-Western Himalayas*' sponsored by State Land Use Board (SLUB), Himachal Pradesh Forest Department at HFRI from 14th to 16th November 2006.

Attended

1. After receiving invitation from the Joint Member Secretary, State Council for Science Technology and Environment, Himachal Pradesh, Shimla. Dr. Rajesh Sharma, Scientist-D from this institute attended one day meeting for Popularizing Bamboo Cultivation for Commercial Purpose in the State of Himachal Pradesh, which was held on 12th April 2006 at H.P. Secretariat.

2. Shri Surinder Kumar, IFS, Director, HFRI, Shimla alongwith Dr. K.S. Kapoor, Coordinator (Research), attended one day workshop on "Rain Water Harvesting, Artificial Recharge and Watershed Management" organized by Project Director, Himachal Pradesh State Forest Department in Consultation with Noble Institute for Premier Studies and Technologies Limited, New Delhi under Himachal Pradesh Forestry Sector Reforms Projects (HPFSRP) on 19th May 2006 at Jal Bhawan, Kasumpatti, Shimla.

3. Shri Surinder Kumar, IFS, Director, HFRI, Shimla attended one day International Policy Workshop on "Application of Space Technology for Monitoring of Natural Resources, Climate Change and Social Development" at Hotel Holiday Home on 31st May 2006 organized by Geo-informatics Research and Training, CSK, H.P. Agricultural University in collaboration with international Centre for Integrated Mountain Development, Kathmandu, Nepal and Department of Agriculture, Himachal Pradesh.

4. Shri Surinder Kumar, Director, IFS, HFRI, Shimla alongwith Shri K.S. Thakur, IFS, DCF, Head, Silviculture and Tree Improvement Division; Dr. Sandeep Sharma, Scientist-D and Shri Pitamber Singh Negi, Research Officer attended FRI-Centenary Celebration on 5th and 6th June, 2006 at FRI, Dehradun.

5. Shri Surinder Kumar, IFS, Director, HFRI, Shimla attended National Science Day 2006 on 20th July organized by Dr. Y.S. Parmar University of Horticulture and Forestry, Regional Horticultural Research Station, Mashobra, Shimla. During the celebrations he delivered a lecture on the "Role of Forests in Maintaining Good Environment".

6. Dr. K.S. Kapoor, Scientist and Coordinator (Research) attended Brain Storming Meeting for the formulation of Science and Technology Policy for Himachal Pradesh, which was organized by State Council for Science and Technology and Environment, Shimla on 21st July 2006.

7. Shri Surinder Kumar, IFS, Director, HFRI attended 8th Meeting of Management and Operation Committee of the Himachal Pradesh Forest Sector Reform Project held on 17th August 2006, where action taken report on the decision taken in the previous meeting and review of project progress was done besides other related matters pertaining to the project activities.

8. Dr. Sandeep Sharma attended and presented a paper during the National Workshop on 'Role of Forestry in Employment Generation and Rural Development' organized by FRI, Dehradun on 29th and 30th August 2006 at FRI, Dehradun.

9. Shri Surinder Kumar, IFS, Director, HFRI, Shimla attended Annual Day and Brain Storming Session on Institute's Vision Document of Govind Ballabh Pant Institute of Himalayan Environment and Development, organized by its Himachal Unit at Mohal, Kullu on 10th and 11th September 2006.

10. Dr. K.S. Kapoor, Coordinator (Research) of the institute attended an International Symposium on Breeding and Improvement of Asian Conifers during 20th Century, organized by University of Horticulture and Forestry, Solan and Forest Research Institute, Dehradun from 11th to 13th September 2006 at FRI, Dehradun.

11. After receiving invitation from Dr. Shashi Kumar, IFS, Director (Research) ICFRE, Dehradun, Shri Surinder Kumar, IFS, Director, HFRI, Shimla attended a meeting of Stakeholders on the Proposed Policy Reforms to remove the Barriers to CDM Afforestation and Reforestation Projects at ICFRE, Dehradun on 14th and 15th September 2006

12. Shri Surinder Kumar, IFS, Director, HFRI, Shimla attended ICFRE Society meeting, which was held under the Chairmanship of Shri A. Raja, Hon'ble Minister for Environment and Forests, Govt. of India on 22nd November 2006 at Paryavaran Bhawan, New Delhi.

13. Dr. K.S. Kapoor, Coordinator (Research) attended 2 days working group meeting for setting up of regional centre for Monitoring Glacial Environment and Climate Change in Himachal Pradesh, which was organized by State Council of Science Technology and Environment at Hotel Holiday Home on 23rd and 24th November 2006

14. Dr. R.K. Verma, Scientist-D of this Institute attended a National seminar/ meet of Stakeholders of Forestry Statistics, organized by Indian Council of Forestry Research and Education, Dehradun on 29th and 30th November 2006 under IITO-ICFRE collaborated project.

15. Shri Surinder Kumar, IFS, Director, HFRI, Shimla and Dr. R.K. Verma, Scientist-D of this institute attended the consultative workshop on "Impact Assessment of Himachal Pradesh State Roads Project on Forest, Wildlife and Bio-diversity Issues" held on 14th December 2006 at Hotel Holiday Home, Shimla as organized by the Himachal Pradesh Public Works Department.

16. Dr. Vijender P. Panwar, Scientist-B attended meeting of Nodal Officers, which was convened by ADG(M&E) at ICFRE, Dehradun from 27th to 29th December 2006 for devising format and other strategies, etc. for evaluation of FDA projects, the consultancy for which has been awarded to ICFRE by NAEB.

17. Dr. K.S. Kapoor, Public Information Officer for HFRI, Shimla attended a Technical Workshop on the "The Right to Information Act, 2005" held on 18th and 19th January 2007 at New Delhi. Institute of Socio-economic Research and Action (ISERA) at Hotel Cannaught, New Delhi, conducted the workshop in question.

18. Dr. Rajesh Sharma, Scientist-E of this institute attended three days National Conference on "Increasing Forest Productivity: Genetic and Breeding Options" as organized by Tropical Forest Research Institute, Jabalpur from 21st to 23rd February 2007 and presented a research paper titled " Various Studies in Provenances and Plus Trees of *Pinus roxburghii* Sarg".

19. Dr. Sandeep Sharma, Scientist-D of this institute attended DBT Steering Committee meeting held on 20th February 2007 at the Department of Biotechnoology, Govt. of India, New Delhi and presented the progress made by him as a Principal Investigator under the project titled" Suitability of *Jatropha curcas* L. Seed Sources in Lower and Mid Himalayan Regions of Himachal Pradesh".

20. Dr. K.S. Kapoor, Scientist-E and Head, Division of Ecology and Biodiversity Conservation delivered an invited lecture on "Climate do Influence Forestry/ Floral Diversity" in a workshop on "Climate Change and its Impact on Farming Systems and Natural Resources" on 3rd March 2007 at University of Horticulture and Forestry, Solan.

21. Dr. Ranjeet Singh, Scientist-D of this Institute attended two days' Regional Seminar on "Mortality in Agro-forestry Tree Species" from 21st to 22nd March 2007 at Chaudhary Charan Singh, Haryana Agriculture University, Hisar and presented a research paper titled "Drying off Tree in Forest Eco-systems of North-Western Himalayas An Entomologist's View".

22. Attended an International Seminar on "Soil and forest degradation in the Himalayan region" organized by Norwegian University of life sciences, Norway and Institute of Integrated Himalayan Studies, Shimla (HP) at Shimla on 5th and 6th April 2006.

23. Attended and actively participated in National Workshop on "Status and potential of agro-forestry in North- Western Himalayas" held at Himalayan Forest Research Institute, Shimla (HP) from 14th to 16th November 2006.

24. Dr. Ranjeet Singh attended a National Congress on Entomology, organized by Department of Zoology, Punjabi University, Patiala from 15th to 17th March 2006.

25. Dr. Ranjeet Singh attended a National workshop on "Status and Potential of Agroforestry in North-Western Himalaya" organized by Himalayan Forest Research Institute, Shimla from 14th to 16th November 2006.

26. Shri Surinder Kumar, Sh. K. D. Sharma, Dr. Rajesh Sharma and Dr. Sandeep Sharma attended and actively participated in forestry workshop on 'Package of Practices for forestry plants' at Dr. YSP University of Horticulture and Forestry, Nauni (Solan) H.P. on 7th and 8th November 2006.

EXHIBITIONS

Institute participated in Kisan Mela under the banner "Khushhali Ke Liye Alu" which was organized by Central Potato Research Institute on 15th June 2006 at Kufri, where activities of the institute were displayed for the benefit of people in general and for the farmers in particular.

AWARDS

1. Dr. Sandeep Sharma, P.S. Negi, K.S. Thakur and Surinder Kumar from HFRI were awarded with prestigious 'Brandis Prize' on the auspicious occasion i.e. Centenary Celebration Day of FRI at FRI, Dehradun on 5th June 2006 for the valuable contribution in the Indian Forester titled "Studies on Vegetative Propagation of *Colutea nepalensis* Sims through Shoot Cuttings: A Potential Species for Cold Desert Afforestation" in the field of Silviculture for the year 2004.

2. HFRI was awarded second best exhibition stall prize in Kissan Mela,organized by Central Potato Research Institute, Shimla at Kufri on 15th June 2006.

DISTINGUISHED VISITORS

1. Shri A.K. Wahal, IFS, Deputy Director General (Education), ICFRE, Dehradun visited the institute on 19th June 2006 and assessed the progress of ongoing research activities/ projects of the institute. He also held discussions with the officers and scientists of the institute.

2. Mr. B. Islam, IFS, Chief Conservator of Forests (Monitoring and Evaluation) visited this institute on 21st August 2006. During his visit, past achievement of the institute alongwith ongoing research activities were discussed.

3. Mr. Vinay Tandon, IFS, Principal CCF (Wildlife) visited this institute to discuss about the ongoing research activities of this institute. During discussion he was apprised of the work which has been/is being carried out by the institute towards assessment of floristic works in the wildlife sanctuaries of Himachal Pradesh.

4. Shri Ashok Thakur, IAS, Principal Secretary (Forests), Govt. of Himachal Pradesh and Shri R.A. Singh, PCCF, Himachal Pradesh State Forest Department visited the institute on 14th November 2006 for inauguration of National Level Workshop.

MISCELLANEOUS

In accordance with the instructions from Central Vigilance Commission, New Delhi, a 5 days Vigilance Awareness Week was observed from 6th to 10th November 2006 by the institute. During the week a specific pledge in this regard was also taken up.

Institute of Forest Productivity
Ranchi

The Institute of Forest Productivity (IFP), Ranchi was established in 1992 to cater to the forestry research needs of the States of Eastern India. The mandate is to undertake forestry research in addition to the activities of Lac development. The Institute has two centers, namely Forest Soil Vegetation Survey Station at Midanapore and the Environmental Research Station, Sukna, Darjeeling.The Institute has taken up a number of research and training programmes for the benefit of different stakeholders and user agencies, NGOs, research organizations, the States of Bihar, Jharkhand, Sikkim, West Bengal and the public at large.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: Trials on composting for specific afforestation needs and development of cost-effective packages in relevance to Chotanagpur plateau area and south West Bengal [IFP-003/SLR/2002-2007]

Findings: A low-cost, simple and quick technique has been developed for compost production. Compost has been prepared from shrubs and vegetable mixture within 60 days by remixing the material during decomposition with water along with 10 % soil dust and urea 0.5 % for faster decomposition. Addition of urea with the material mix enhanced decomposition rate and reduced the time from 90 days to 60 days.

Compost production

Project 2: Standardisation of suitable potting media and root trainer size for improved planting stock production of some mandate species of Jharkhand and southern West Bengal [IFP-002/SLR/2002-2007]

Findings: Root and shoot biomass of the seedlings of four species *Acacia mangium, D. sissoo, G. arborea* and *Eucalyptus camaldulensis* raised in 90 cc root trainers under potting media trial was estimated and recorded. Seedlings raised of all the 4 species in 90 cc hykopot were planted in the field.

Project 3: Development of agro-techniques for *Gymnema sylvestre and Embelia ribes* having high marketing potential [IFP-023/ERM/2004-2007]

Findings: *Gymnema sylvestre* seeds and *Embelia ribes* seeds have been obtained from Silviculture South Division of West Bengal.

Project 4: Exploration of lac cultivation on non-traditional host *Flemingia* sp. and its possibility in sustainable plantation forestry [IFP-007/BGT/2002-2007]

Findings: Jethwi - 06 lac crop harvested under control as well as experimental condition on host plants, *Flemingia macrophylla* and *Flemingia semialata*.

Exploaration of lac cultivation on *Flemingia* spp.

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Studies on variability of bamboo species, their performance, conservation and economics with reference to Bihar, Jharkhand and West Bengal [IFP-016/SLR/2002-2008]

Status: Field survey was conducted in forest and non-forest areas of Jharkhand and north and south West Bengal. During survey in north West Bengal, 35 bamboo species were recorded.

The clump and culm parameters of the bamboos show that many species attain height of more than 30 m. The thickest of all bamboos is the so far unidentified Dhori bans, found in Jalpaiguri, attaining girth of about 54.10 cm.

Soil samples collected from south West Bengal during field survey have been analysed and the growth parameters of bamboos have been correlated with soil attributes.

Nursery trials on development of bamboo propagation techniques: To standardise vegetative propagation technique of bamboo, trials were Conducted at Mandar field centre of the institute with different types of cuttings (double node, single node and single bifurcated node) and three types of growth promoting substances (GPS IAA, IBA & NAA) at different concentrations (100, 200, 500 and 1000 ppm). Sprouting and rooting in untreated culm cuttings of *B. tulda* was recorded, however, the number of propagules obtained were more with application of GPS.

Standardisation of vegetative propagation technique of bamboo

***Ex-situ* conservation of superior bamboo planting materials:** Rhizomes of the *B. balcooa* - Guri vulki/vulki *B. balcooa* - Hedua vulki/Dhamna vulki, *B. nutans* - Baria bans, *B. tulda* taral,

Chapati/Champati bans, *D. gigantea* - Bombay bans, Kanta champati, Kanta baria, Kaldhemni and Sonakani were collected from south West Bengal and the material were planted at Mandar Research Station, IFP Ranchi during July 2006.

Rhizomes being planted at Mandar research Station, IFP

Project 2: Development of appropriate silvicultural systems for selected medicinal flora of Chhotanagpur and Santhal Parganas [IFP-022/FRM/ 2003-2008]

Status: *Gloriosa superba* plants in polypots under polyshade were grown successfully.

Project 3: Creation of germ plasm resource bank of threatened medicinal plants of Darjeeling Himalayas [IFP-018/EBC/2003-2008]

Status: Over 9000 seedlings of medicinal plants consisting of 4000 Sarpagandha *(Rauvolfia serpentina)*, 2000 Bojo *(Acorus calamus)*, 1000 Dhotisara, *(Curruculigo orchioides)* and 2000 Dioscorea *(Dioscorea deltoidea)* have been raised for distribution among the farmers.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Standardisation of macropropagation techniques of *Schleichera oleosa* and their clonal fidelity studies

Status: Experiment on stem cuttings was initiated.

PROJECTS COMPLETED DURING THE YEAR 2006-2007
(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 (Funding Agency: NMPB, GOI) [IFP-027/NMPB/ 2004-2007]

Findings: A book on 40 species of medicinal plants has been prepared.

Medicinal Plants Gardens in different agro-climate zones in eastern Himalayas

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Identification, collection and genetic evaluation of important oil yielding trees of Jharkhand (Funding Agency: NABARD) [IFP-028/ NABARD/2005-2008]

Status: Plants are established in the field and performance on various growth parameters is satisfactory.

PROJECTS INITIATED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Documentation and inventorisation of indigenous traditional medicinal knowledge in selected districts of Jharkhand (Funding Agency: NMPB)

Status: Survey was conducted in the remotest area of Tholkobad and Tirilposi in Saranda Forests. Through discussions held with the Ho tribes living in forest villages valuable information was obtained on their traditional medicinal practices.

Traditional herbal medicine at Jharkhand

Project 2: Investigation on impact of climatic change on threatened and endangered orchids in Buxa Tiger Reserve, West Bengal, India (Funding Agency : EWI)

Status: A new approach to investigate the dynamics of distribution and colonization of Orchids is followed in this study. Here the environment is considered as constant variable while habitat gradient and vegetation distribution are considered as dependable variables. Based on these variable gradients, the orchids are evaluated as constants in three blocks and in 15 sample plots at Buxa Tiger Reserve. The colonization sequence, colonization preference, and intensity of colonization in respect of each individual orchids at the generic level, are evaluated in addition to density, frequency, and dominance studies. A new variety is found which has the potential to be named as new species.

A new concept of dynamic orchid ecology is being developed taking colonisation preference and intensity as varying variables.

Investigation being made on impact of climate change on threatened and endangered orchids in Buxa Tiger Reserve

Abstract: No. of Projects

	No. of projects Completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	4	3	1
External Project	1	**1**	2
Total	**5**	**4**	**3**

TECHNOLOGY ASSESSED AND TRANSFERRED

Institute of Forest Productivity (IFP) has developed technologies related to improving forest productivity and environmental conservation / reclamation for transfer to user groups.

Technology assessed

1. Macro propagation of bamboos.
2. Micro propagation techniques of important forestry species.
3. Laboratory analysis of soil and treatment for deficiencies.
4. Improved techniques for Lac cultivation.
5. Recycling of organic wastes by composting / vermicomposting.
6. Production of quality planting materials in hi-tech nurseries using root trainers.
7. Bio-reclamation of problem soils and mined over burdens.
8. Propagation techniques of selected medicinal plants.

EDUCATION AND TRAINING

Training

1. Training was organized on 'Lac Cultivation on Modern Techniques' for forest officers, villagers, forest guards of Jasipur, Orissa, farmers and forest staff of SFD, Chattisgarh, villagers and staff of East and West Garu and Baresand Range, Lac cultivators and staff of Dhanbad Forest Division, trainees sponsored by Shellac Export Promotion Council, Kolkata under the project "Development of Pilot Broodlac Farm and Lac Finishing Facilities" in Purulia, West Bengal. Lac cultivators and staff of State Forest Department, Daltangunj, Palamau, farmers and forest staffs of Jashpur Forest Division, Chatishgarh, Master Trainers and Asstt. Master Trainers of Pathergaon, Tapkara and Arayanpur Range under Jashpur Forest Division of Chhatisgarh State, Latehar Lamps, State Forest Department, Jharkhand, Forest Protection Committee of Bargaon and Ramgarh SFD, Chhatisgarh from 20th to 22nd February 2006, 21st to 22nd April 2006, 1st to 3rd May 2006, 18th June 2006, 19th to 20th June 2006, 21st to 22nd June 2006, 25th June 2006, 3rd to 7th July 2006,10th to 14th July 2006, 17th to 21st July 2006, 24th to 28th July 2006, 1st to 3rd September 2006, 14th to 17th October 2006 and 14th and 15th October 2006.

2. Organized training on 'Composting, vermicompost, macro-propagation of Bamboo, Propagation of Bamboo and Kusum through Tissue Culture' for Forest Guards of Hazaribagh Forest Guard Training School, Hazaribagh on 27th May 2006.

3. Training was organized on 'Bamboo propagation' for Range Officers and Asstt. Conservator of Forests of State Forest Department, Jharkhand from 12th to 16th February 2007 and 19th to 23rd February 2007.

Training on Bamboo propagation for Range Officers and Assistant Conservator of Forests, State Forest Department, Jharkhand

LINKAGE AND COLLABORATION

International

Earth Watch Institute (EWI), USA, Department for International Development (DFID) (U.K.) and International Development Research Centre (IDRC).

National

NABARD, National Medicinal Plant Board, Department of Biotechnology, Central Coalfields Limited, Damodar Valley Corporation, Indian Institute of Natural Resins and Gums (formerly Indian Lac Research Institute) (ILRI), Namkum, Indian School of Mines (ISM), Dhanbad, Horticulture and Agroforestry Research Programme (HARP), Plandu, Birsa Agriculture University (BAU), Kanke, Ranchi, State Forest Department, Jharkhand, State Forest Department, West Bengal, State Forest Department, Bihar, SI, Eastern Zone, Kolkata, TATA Steel, Hazaribagh, Planning Commission, Govt. of India, Ministry of Environment and Forests (MoEF), Govt. of India.

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. Research Paper - Variation studies in Eucalyptus V: Intraspecific variation in the leaves and developmental stability in the high yielding *Eucalyptus camaldulensis by* Sumita and H. C. Sindhuveerendra (2005) published in *My Forest*, 41(3) pp. 413-421.
5. Brochures / Booklets in Hindi on Gamhar, Kadam, Semul, Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojna (SASVPSY) of Bihar state and Bans Ki Kheti were prepared and published.

CONSULTANCIES

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 and FSI, eastern zone, Kolkata.

3. Development of green belt at Maithon right bank thermal power project, DVC and Chandrapura thermal power station, DVC, Chandrapura.
4. Development of bio-aesthetic habitat by Central Coalfields Limited over company's 5-hectare 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 of 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, Hazaribagh.

CONFERENCE/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. The VIII RAG meeting of the Institute was organized on 17th November 2006 under the chairmanship of Shri R. K. Zutshi, PCCF, Jharkhand.
2. A regional workshop on "Forestry Extension Strategy Review" was conducted by the institute on 23 March 2007. Participants from State Forest Departments, universities, central govt./state govt. organizations, NGOs, progressive farmers, and officers, scientists and research officers of IFP attended the workshop. The workshop was also attended by DDG (Extn.), ICFRE and former-Addl. I.G.F. (GoI).

Attended

1. Mr. P. Anand, DCF visited Patna on 1st May 2006 to attend meeting in connection with the project "Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojana of Bihar State" sponsored by Planning Commission, GoI.
2. Shri R. Krishnamurty, Director visited Patna and Vaishali on 9th and 10th June 2006 for attending meeting and for field visit under the project "Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojana of Bihar State" sponsored by Planning Commission, GoI.
3. Shri R. Krishnamurty, Director of the Institute visited Patna to attend the meeting of steering committee of Planning Commission, GoI - sponsored project "Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojana (SASVPESY) of Bihar State" with PCCF, Bihar on 25th and 26th September 2006.
4. Shri R. Krishnamurty, Director of the Institute, attended meeting with CGM, NABARD, Jharkhand on 3rd November 2006 in connection with formulation of research and extension projects.
5. Director, IFP, Ranchi attended XV Meeting of ICFRE Society held on 22nd November 2006 at New Delhi.
6. Shri R. Krishnamurty, Director, Shri Rameshwar Das, Conservator of Forests, IFP, Ranchi and Dr. Atul K. Srivastava, ADG (Admin), ICFRE, Dehradun attended the meeting of State Level Steering Committee of "*Samudai Adharit Samanvit Van Prabhandhan Evem Sanrakshan Yogna of Bihar State"* on 22nd January 2007 at Patna.
7. Shri R. Krishnamurty, Director, Shri Ravi Horo, DCF and Dr. Animesh Sinha, Scientist-C of the Institute attended RPC meeting held on 26th and 27th February 2007 as well as Directors' meet at ICFRE, Dehradun.
8. Shri R. Krishnamurty, Director of the Institute attended the core committee meeting on preparation of an "Optimum Afforestation Plan" for DVC command area held at DVC Tower, Kolkata on 25th June 2006.

9. Dr. B. N. Divakara, Scientist-B attended a two-day consultation on "Wastelands and Livelihoods: Problems and Prospects in Eastern India" organized by Society for Promotion of Wastelands Development (SPWD), New Delhi on 12th and 13th September 2006 at hotel Ashoka, Ranchi, Jharkhand.
10. A meeting was held on 10th November 2006 with CGM, NABARD regional office, Ranchi for discussion on formulation of extension project on "Improved method of Lac cultivation in Tribal areas of Jharkhand".
11. Director, IFP, Ranchi attended brainstorming session on "Biotechnological Interventions in Tasar Culture" organized jointly by Central Silk Board and DBT on 16th November 2006.
12. Shri Rameshwar Das, Conservator of Forests attended a working group meeting as nodal officer for the mid-term evaluation of National Afforestation Programme (NAP) schemes nationwide held on 7th December 2006 at ICFRE, Dehradun.
13. Shri R. Krishnamurty, Director attended a meeting of State Level Lac Committee under the chairmanship of Forest Minister, Chattisgarh State at Raipur on 3rd January 2007.
14. Shri R. Krishnamurty, Director attended a meeting for the Mid Term Evaluation (MTE) of National Afforestation Programme (NAP)- Forest Development Agencies (FDA) schemes held at ICFRE, Dehradun on 31st January 2007.

AWARDS

Mrs. Nabaneeta Choudhary, Ph.D. scholar enrolled by the Institute was awarded Ph.D. degree from Forest Research Institute University, Dehradun.

DISTINGUISHED VISITORS

1. Ms. Hannah Rooley, Programme Manager and Mr. Steve from Earthwatch Institute, Boston, MA, USA visited the Institute on 17th and 18th April 2006 for discussion on the research project entitled "Investigation on impact of climate change on individual threatened and endangered orchids in Buxa Tiger Reserve, West Bengal, India".
2. Shri Balbir Singh, ADG (Monitoring & Evaluation), ICFRE, Dehradun visited tissue culture lab., vermicompost unit, soil lab and field trials at Forest Research Centre, Mandar.
3. Dr. Shashi Kumar, Director (Research), ICFRE visited the Institute on 22nd August 2006.
4. Dr. A. K. Srivastava, ADG (Admin.), ICFRE visited FREC, Patna in connection with the field visit of Samudai Adharit Samanvit Van Prabandhan Evam Sanrakshan Yojna (SASVPSY) of Bihar State'.
5. Shri Subrato Biswas, Secretary, Damodar Valley Corporation and Shri S. Barari, Chief Environment Officer, DVC visited the Institute on 24th January 2007.
6. Dr. M. Banerjee, Senior Scientist, West Bengal State Council of Science and Technology, Kolkata visited Forest Research Centre, Mandar.
7. Chief Engineer, CCU, MoEF visited IFP, Ranchi from 9th to 11th March 2007.
8. Shri R. Krishnamurty, Director, IFP and Shri M.S. Garbyal, DDG (Admin.), ICFRE visited Patna on 15th and 16th March 2007 in connection with "SAVPES Yojna of Bihar State".

Officers of ICFRE visiting at the project site

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.

The important research activities of this Centre are in the field of Planting Stock Improvement Programme (PSIP); Wasteland reclamation; Development of Agroforestry Models; Reclamation of mined areas through Afforestation; Productivity of Ecosystem; Studies on Shisham mortality; Medicinal plants etc.

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: To develop medicinal plant nursery for generating awareness amongst local people [FRI/ 254/CSFER-2005]

Status: *Asparagus racemosus* (Satawar), *Vinca rosea* (Sadabahar), *Tinospora cordifolia* (Giloy), *Chlorophytum arundinaceum* (Safed Musli), *Rauvolfia serpentina* (Sarpgandha), *Barleria prionites* (Kalabansa), *Plantago ovata* (Isabgol), *Plumbago zeylanica* (Chitrak*), Aloe vera* (Gheequar), *Cassia aungustifolia* (Sanay), *Gymnema sylvestre* (Gudmar), *Acorus calamus* (Butch), *Abelmoschus moschatus* (Mushkdana), *Andrographis paniculata* (Kalmegh), *Psoralea cordifolia* (Bawachi), *Ocimum sanctum* (Tulsi) and *Mentha* sp. were planted in the herbal garden of research nursery and are being maintained and managed.

New demonstration plots of *Cyperus rotundus* (Nagarmotha) and *Rauvolfia serpentina* (Sarpgandha) were established and maintained for a training-cum-demonstration programme on Cultivation of Medicinal Plants for local people of Padila village. Literature on medicinal plants and seedlings of selected species were distributed to the farmers.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Development of Agroforestry models of *Bamboo* species in Eastern U.P. [360/CSFER-07]

Status: A questionnaire for surveying demand-supply gap of bamboos to select sites for development of agroforestry models of bamboos in randomly selected villages, was prepared and survey was conducted.

Nursery of *Dendrocalamus strictus* and *Bambusa bambos* was established in Padila village and the effects of seed grading on germination and seedling growth of bamboo species was studied.

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Research and development of *Jatropha* under National Network Programmme (Funding Agency: NOVOD Board)

Status: Survey of Superior planting material as per the guidelines of NOVOD Board was carried out for identification and marking of Candidate Plus Trees. Data recording with respect to morphological and phenological traits was done. Oil of *Jatropha* seeds from marked CPTs was sent to TERI, New Delhi for oil content analysis and report has since been received.

Provenance trail of *Jatropha curcas* in Padila nursery

Effect of pre-sowing treatments on the germination of *Jatropha* seeds was studied.

Provenance trial of CPTs was established at Padilla Nursery. Growth data (height and diameter) was recorded.

10000 plants were planted in block plantation at Jhunsi, Allahabad.

Agro forestry trial of *Jatropha* in combination with onion was established.

Abstract: No. of Projects

	No. of projects Completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	-	1	1
External Project	-	1	-
Total	**-**	**2**	**1**

EDUCATION AND TRAINING

1. Shri A.K. Pandey, IFS, Head of the Institute, attended four days training on 'New Trends and Experience in Human Resource Development' at IMTR, Goa from 9th to 13th October 2006.

2. Shri B. Chaudhary attended four days training programme in Agroforestry at Haryana Forest Development Corporation, Panchkula from 29th January to 2nd February 2007.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Organized

1. Training-cum-demonstrations pogramme on 'Medicinal plants' on 17th November 2006.

Training-cum-awareness programmes for cultivation of medicinal plants at CSFER, Allahabad

2. A month long Exhibition cum demonstration in January 2007 in Ardhkumbh Mela at Allahabad with the help of FRI, Dehradun.

Attended

1. Shri B. Chaudhary and Dr. Anubha Srivastava presented a paper entitled "Rural Employment Potential of *Jatropha* - New Dimensions for Development" in National Seminar on 'Rural Development Initiatives: A National Perspective' at National level at Rajiv Gandhi Institute of Information Technology, Amethi, on 28th August 2006.

2. Shri A.K.Pandey, Shri B.Chaudhary, Dr.Anubha Srivastava, Shri S.D.Shukla and Shri Awanindra Tewari (SRF), presented a research paper on "*Jatropha curcus* Oil-Its Potential Role as Bio-Fuel" in National Seminar on 'Jatropha Cultivation and Bio-Diesel Production' at UTTHAN, Allahabad (UP) on 27th January 2007.

3. Shri A.K. Pandey attended workshop on "Planted Forest Ecosystem: Goods and Services" at FRI, Dehradun from 13th to 15th December 2006.

4. Shri A.K. Pandey attended 2 days meeting of stakeholders on proposed policy reforms to remove the barrier to CDM afforestation and reforestation (A/R) project organized by ICFRE, Dehradun in partnership with Joanneum Research, Austria and Freiburg University and Institute of Silviculture, Germany from 14th to 15th September 2006.

MISCELLANEOUS

Monitoring and Evaluation works sponsored by MoEF under National Afforestation Programme (NAP) for FDAs of Agra, Allahabad, Meerut, Bareilly, Shahjahanpur, Mirzapur, Renukoot, Ballia, Jalaun and Kanpur under U.P. Forest Department were carried out by the nominated teams of CSFER, Allahabad.

Centre for Forestry Research and Human Resource Development Chhindwara

Centre for Forestry Research and Human Resource Development, Chhindwara, came into existence on 30th March 1995. It was declared on 3rd January 1996, a satellite Centre of Tropical Forest Research Institute, Jabalpur. 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, the centre has also been assigned the task to develop human resource in forestry sector by imparting vocational training leading to poverty alleviation through self employment.

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007

Project 1: Standardization of nursery technology and evaluation of various planting stocks of *Pterocarpus marsupium* an endangered leguminous tree [109/CFRHRD/ 2006-2(9) 2006-2009]

Status: Seeds of *Pterocarpus marsupium* were collected from healthy trees from Chattisgarh region and experiments were carried out in the nursery to study the effect of different seed treatments on germination of seeds and growth of seedlings. Seeds treated with cold water for 24 hours, showed promising results as compared to those treated with hot water and concentrated sulphuric acid for different periods. Seed size always affected germination and further growth of seedling in the nursery. Bigger sized seeds gave higher germination percentage and germination value as compared to the small sized seeds. Studies on time of seed sowing in beds showed higher germination percentage in the month of July and minimum percentage in the month of January.

Project 2: Studies on the seasonal variation in active chemical constituents of Hadjor, *Cissus quadrangularis* linn. [108/CFRHRD/2006-1(8) 2006-2009]

Status: *Cissus quadrangularis* (Hadjor) plant samples were collected from Chhindwara, Bhopal and TFRI, Jabalpur (Madhya Pradesh); Nagarjuna Botanical Garden, Akola, Valgaon, Amravati District (Maharashtra); Dabra (Janjgeer District) and Raigarh District (Chhattisgarh). Cuttings were also collected from the campus of National Research Centre for Agroforestry (NRCAF), Jhansi and planted in medicinal and aromatic plants (MAPs) nursery of the centre. Fresh stem samples were also collected from medicinal and aromatic plants (MAPs) nursery of the centre for estimation of active chemical constituents *viz.* total phytosterols and ascorbic acid. Total phytosterols content in the stem samples collected in January to March was estimated, it was found highest in the month of January (56.21mg/100g). Ascorbic acid was estimated in the hadjor stem samples, from November 2006 to March 2007, to study the monthly variation. The content was found highest in January (307.38mg/100g sample). Fresh stem samples were extracted for macroelements viz. calcium, magnesium, potassium and phosphorus content and trace elements (Boron, zinc, manganese, selenium, molybdenum, copper, vanadium and silicon)

Rauvolfia serpentina (sarpagandha) plantation at CFRHRD, Chhindwara

content. Macroelements were estimated from the hadjor stem samples at monthly intervals (July to March 2007). Calcium (1.12%) and magnesium (1.44%) contents were found highest in the month of March, and potassium content (0.72%) was found highest in the month of November.

PROJECTS COMPLETED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Standardization of production technology of some important medicinal plants under tropical climate of Madhya Pradesh (A component assigned to CFRHRD, Chhindwara 40% and TFRI, Jabalpur 60% work) (Funding Agency: NMPB, Govt. of India)[055 /CFRHRD- 2003/MHFW]

Findings: Five kg seeds of *Rauvolfia serpentina* (sarpagandha) were collected from the sarpagandha plantation of CFRHRD, Chhindwara.

Cutting of *Tinospara cordiffolia* (Gudbel) collected from Delakhari and Morghat forest range were studied for rooting in mist chamber by applying IBA in different concentration. IBA-500ppm got 100% rooting.

Seeds of Gudbel were sown in nursery beds and 95% germination was recorded in the month of October 2006. Cutting collected from Delakhari forest range under West Chhindwara forest division were studied for rooting by applying different concentration of growth regulator but rooting was not observed.

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Field trial on agro forestry model in farmers field with medicinal trees and herbs in Satpura plateau of Madhya Pradesh (Funding Agency: National Medicinal Plant Board) [110/CFRHRD/NMPB/10/ 2006-2009]

Findings: About 30,000 seedlings of various species of medicinal importance like *Andrographis paniculata, Asparagus racemosus, Rauvolfia serpentina, R. tetraphylla, Aegle marmelos, Moringa oleifera, Withania somnifera* etc. were raised in the nursery and about 800 grafted Aonla seedlings, and 1000 *Aegle marmelos* seedlings were procured and were used for raising demonstration cum research plot, agroforestry plantation and distribution to farmers.

Raised planting materials of medicinal species for establishment of agroforestry plantations in the farmers fields. *Emblica officinalis* and *Moringa oleifera* based agroforestry plantations were established with the crop like tomato and potato.

Andrographis paniculata, Asparagus racemosus, Rauvolfia serpentina, R. tetraphylla, Withania somnifera were established and maintained under the shade of *Aegle marmelos, Moringa oliefera* as well as in the open to study the effect of shade on growth of medicinal plants.

Abstract : No. of Projects

	No. of projects completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	-	-	2
External Projects	1	1	-
Total	**1**	**1**	2

EDUCATION AND TRAINING

The centre organized and conducted 10 training programmes during 2006-2007. 409 trainees participated in various training programmes.

LINKAGES AND COLLABORATION

Linkages were developed with State Forest Department, Forest Development Corporation and Agriculture Research Station, Chhindwara for conducting research/training, and Forest Survey of India, Nagpur for analysis of forest floor and soil samples.

PUBLICATIONS

Bulletins

Mk- ih-ch- eJke ,o 'kkfyuh Hkkor] 2006- nhed ,o lQn xhMkj dk fu;=.k% 4101-ICFRE-BL/CFRHRD-BL-2006.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

1. Shri Suneesh Buxy, Deputy Conservator of Forests and Shri. H.S. Awasthi, Forester participated in the training programme entitled “Laghu Van Upaj / Vanaspati Adharit Paudhon ke Prasanskaran Evam Vipanan” (Processing and Marketing of Minor Forest Produces) held at Barkheda, Pathani Bhopal on 13th April 2006.
2. Shri Suneesh Buxy, Dy. Conservator of Forests participated in “New Dimensions in Ecotourism in Madhya Pradesh” on 11th July 2006 at Bhopal (M.P.).
3. Shri Suneesh Buxy, Dy. Conservator of Forests attended the 14th Rashtriya Bal Vigyan Congress workshop on “Jaiv Vividhta Prakruti Bachaye, Bhavishya Sanvare” on 2nd September 2006 organized by National Public School Chhindwara.
4. Shri Suneesh Buxy, Dy. Conservator of Forests participated in the inaugural session of wildlife protection week at Conservator of Forest office and Samvad Bhavan, Chhindwara on 1st October 2006. Delivered lecture on endangered species of plants and animals.
5. Shri Suneesh Buxy, Dy. Conservator of Forests attended workshop on 'National strategies of conservation wildlife and medicinal plants' at Khirsadoh Parasia organized by DFO West on 10th October 2006. Delivered lecture on “Importance of medicinal plants and role of NMPB.”
6. Dr. A. Vijayaraghavan, Scientist-'B' and Dr. Vishakha Kumbhare, Scientist- 'B' attended the National Conference on “Natural Products and Biodiversity: Chemistry and Utilization” held on 2nd and 3rd November 2006 at FRI, Dehradun and presented “Effect of plant density on the yield of keokand (*Costus speciosus*) in a sandy loam soil of Chhindwara district of Madhya Pradesh” and “Bone fracture healing plants used by the tribals in India” respectively in poster presentation session.
7. Shri Suneesh Buxy, Deputy Conservator of Forest, CFRHRD, Chhindwara attended two day training workshop for IFS officers on “Operationalising the role of forests in ecological and economic security of the country-Current status and futurstrategies” on 16th and 17th November 2006 at Academy of Administration, Bhopal.
8. Shri Suneesh Buxy, Deputy Conservator of Forest participated in the workshop on “Biodiversity Conservation and Forest Law and their implications” organized by SFD and WWF on 29th and 30th November 2006.
9. Shri Suneesh Buxy, Deputy Conservator of Forest attended the seminar on “Importance of chemistry on medicinal plants” at P.G. College Chhindwara on 3rd December 2006.
10. Shri Suneesh Buxy, Deputy Conservator of Forest delivered a lecture on “Uses of medicinal plants” at P.G. College, Chhindwara on 4th December 2006.

11. Shri Suneesh Buxy, Deputy Conservator of Forest attended the workshop on “Lok Vaniki and Samajik Vaniki” at Khutama, Sillewani on 11th December 2006.
12. Dr. A. Vijayraghwan, Scientist- 'B' attended National Symposium on “Agroforestry for Livelihood Security Environmental Protection and Bio-fuel Production” held at “National Research Centre for Agroforestry” (NRCAF), Jhansi, U.P. State from 16th to 18th December 2006 and spoke on ”Cultivation of Ganwarpatha (*Aloe vera*) as an intercrop in plantations and in Sal Forest”.
13. Dr. D.L. Nandeshwar, Scientist-'C', Dr. A. Vijayaraghavan, Scientist B and Shri N.D. Khobragade, Research Officer attended the national conference entitled “Increasing Forest Productivity: Genetic and Breeding Option” at TFRI, Jabalpur from 21st to 23rd February 2007.
14. Shri Suneesh Buxy, Deputy Conservator of Forest CFRHRD, Chhindwara attended the “Rashtriya Shodh Sammelan- Janjatiya Vikas ke naveen aayam” on 26th and 27th February 2007 at Shaskiya Swashasi Snatakottar Mahavidyalaya, Chhindwara.
15. Shri Suneesh Buxy, Deputy Conservator of Forests attended the “Vindhya Herbal Utpad Shrinkhala - Introductory Meet” on 27th February 2007 at Hotel Abhimanyu, Chhindwara.

AWARDS

Shri R.S. Sahoo, Scientist-'B' was awarded first prize in Sixth Foundation Training for Scientists and Technologists (sponsored by Department of Science and Technology, Govt. of India) conducted by Indian Institute of Public Administration, New Delhi from 20th November 2006 to 25th January 2007.

DISTINGUISHED VISITORS

1. Shri R.G. Soni, Conservator of Forests, Chhindwara and Dr. Khare visited the centre on 2nd May 2006.
2. Shri P.K. Chowdhry, Chief Conservator of Forests, Bhopal and Shri A. Argal, Conservator of Forests, M.P. Corporation Bhopal and Dr. S.S. Bisen, Retd. Scientist visited the centre on 16th June 2006.
3. Shri R.G. Soni, Conservator of Forest Chhindwara visited the centre on 5th September 2006.
4. Shri Dinesh Rai, IAS, Vice-President Delhi Vikas Pradhikaran, New Delhi visited the centre on 15th October 2006.
5. Shri R.G. Soni, Conservator of Forest and Shri S. Shilawat, Conservator of Forest (Working Plan) Chhindwara visited the centre on 28th November 2006.
6. Shri R.G. Soni, Conservator of Forests, Chhindwara visited the centre on 19th February 2007.

Forest Research Centre Hyderabad

The Forest Research Centre (FRC), Hyderabad has been functioning under the administrative control of the Institute of Wood Science and Technology (IWST), Bangalore, since July 1997. The Centre was established to cater to research needs of the states of Andhra Pradesh, Karnataka and Goa in the field of forestry.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

Project 1: Assessment of the impact of forest fire on regeneration of forests in Andhra Pradesh [FRC-X01/EB-01/2002-2007]

Findings: Phyto-sociological 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 were analyzed to study the effect of fire on physical and chemical properties of soil.

PROJECTS CONTINUED DURING THE YEAR 2006-2007

Project 1: Performance of different agro-forestry systems in Semi-Arid Tropics of Andhra Pradesh [FRC-X02/AF-01/2002-2007]

Findings: On station trials of Teak + Sandal, Rosewood + Sandal, Eucalyptus + Sandal and Teak + Sandal + Rose wood have been established and castor as a rain fed crop was raised. The castor growth performance was monitored across different tree combinations. The allelopathic interactions for green gram, pigeon pea, jowar and castor were studied in combination with all tree species. All agricultural crops performed well in combination with Rosewood. Pigeon pea performed so well that the growth of sandal was negatively affected.

Project 2: Estimation of variability in *Pterocarpus marsupium* and germplasm collection [FRC-X03/TI-04/2003-2008]

Status: A number of population and trees in populations were marked in various parts of AP and Karnataka. The process of germplasm collection has been initiated by vegetative means.

Project 3: Screening of natural populations of *Lagerstroemia* spp. for domestication [FRC-04/TI-X04/2003-2008]

Status: The populations of two species of *Lagerstroemia* prevalent in AP and Karnataka were surveyed and several populations were identified. The processes of germplasm collection (seed) and multiplication (vegetatively) have been initiated.

Project 4: Reclamation of iron ore, limestone mine spoils in Andhra Pradesh and Karnatakaka [FRC-X05/EB-02/2003-2008]

Status: Nursery experiment was conducted for selection of suitable tree species for soil amendment of the iron ore mine spoil.

Project 5: Dynamics of insect populations in cotton based agroforestry systems of Andhra Pradesh [FRC-X06/EB-04/2003-2008]

Status: Data on incidence of insect populations on cotton in combination with bamboo (*Dendrocalamus strictus*), *Eucalyptus*, neem, custard apple, and aonla were recorded.

Eucalyptus + Cotton Agroforestry system

Project 6: Studies on phenotypic variation in *Pterocarpus santalinus* and collection of germplasm [FRC-X07/TI-01/2003-2008]

Status: Surveyed Kurnool, Cuddapah and Chittoor districts of AP and identified certain trees for collection of germ plasm.

Rooted stem cuttings of *Pterocarpus santalinus* under polyglobule conditions in winter season

Project 7: Natural variation studies in Rosewood (*Dalbergia latifolia* Roxb.) for tree improvement [FRC -X08/TI-02/2003-2008]

Status: Plus trees were marked in various parts of Andhra Pradesh and Karnataka. The process of germplasm collection has been initiated.

PROJECTS COMPLETED DURING THE YEAR 2006-2007

(Externally Aided)

Project 1: Impact of the clonal *Eucalyptus* plantations on soil, physical, chemical properties in farmers land in Andhra Pradesh

Findings: The project has been completed and report submitted to ITC Bhadrachalam, the sponsorer.

PROJECTS CONTINUED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Biomass estimation and carbon sequestration in urban forests, Funded by HUDA [2005-2006]

Status: Above and below ground biomass estimation has been done for the plantation created by urban forestry at 0.1 per cent sampling intensity. Data on pollution levels from different parts of the city were collected and biomass corresponding to them was recorded. The levels of biomass required to mitigate pollution levels were predicted.

Project 2: Estimation of Forest Carbon Pool in Western Ghats, Karnataka Development of biomass expansion factors for major forest types. Funded by NRSA [2004-2007]

Status: Above and below ground biomasses were estimated in respect of the moist deciduous forests in 1 ha plot. The expansion factors were developed based on this data. Estimation of shrub biomass, litter fall and floor quantification were also carried out.

Estimation of underground biomass in carbon pool project in NRSA collaborative project

NEW PROJECTS INITIATED DURING THE YEAR 2006-2007
(Externally Aided)

Project 1: Development of multi-tier cropping models for medicinal plants in A.P. Funded by NMPB [2006-2007]

Status: The project comprises establishment of 6 ha of plantation with species like Neem, Senna, Chandan, Amla, Tulsi, Kalihari, Satawar, *Momordica dioica* etc. *Asparagus* germplasm was collected from different parts of Andhra Pradesh and Karnataka. Similarly, *Ocimum sanctum* and *Withania somnifera* were collected for large scale cultivation.

Project 2: Bio-ecology and integrated management of insect pests of Aonla (*Emblica officinalis* Gaertn.) Funded by NMPB [2006-2007]

Status: Data on incidence of insect pests are being recorded at Hyderabad, Rajamundhry and Nandyal of Andhra Pradesh Experiments on yield loss studies have been initiated.

Abstract : No. of Projects

	No. of projects Completed in 2006-2007	No. of ongoing projects in 2006-2007	No. of projects initiated in 2006-2007
Plan Projects	1	7	-
External Projects	1	2	2
Total	**2**	**9**	**2**

CONSULTANCIES

1. Monitoring and evaluation work sponsored by the Ministry of Environment and Forests under National Afforestation Programme (NAP) for FDAs in Warangal, Nizamabad and Medak Districts of Andhra Pradesh were carried out by the Centre.

2. Impact assessment on Nagarjunasagar Srisailam Tiger Reserve (NSTR) and on wildlife due to diversion of forest area under Mahatma Gandhi (Kalwakurthy) Lift Irrigation Project (MGLIP) in Achampet wildlife division, Mahaboobnagar dist.

3. Study of existing flora and fauna and assessment of impact on flora and fauna due to diversion of forest land under Koyagudem opencast project by Singareni Collieries Company limited, Andhra Pradesh.

4. Mid term evaluation of FDAs in Guntur, Giddalur, Bellampally, Kagaz Nager, Paloncha, Markapur, Tirupathi and Rajampet of Andhra Pradesh approved by NAEB, New Delhi.

CONFERENCES/MEETINGS/WORKSHOPS/SEMINARS/SYMPOSIA/ EXHIBITIONS

Dr. G.R.S. Reddy participated in interactive Technical Session conducted by State Silviculturist at AP Forest Academy on 23 March, and delivered a talk on “Tree improvement and Silvicultural aspects of Pongamia pinnata” at AP Forest Academy, Dullapally, Hyderabad.

Chapter 4

Audited Annual Accounts

I.C. Sanghal B.Com (Hons.) LL.B. FCA | A.K. Jain B.Com FCA

J. 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 2007 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 2007,

ii) In the case of the Income & Expenditure Account, of the SURPLUS for the year ended on 31st March 2007.

For I.C. Sanghal & Co.,
Chartered Accountants,

17-Rajpur Road, Dehradun
Dated : 11-08-2007

(I.C. SANGHAL)
Partner
M.No. 70242

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
BALANCE SHEET AS ON 31ST MARCH, 2007

PREVIOUS YEAR	LIABILITIES	AMOUNT	TOTAL AMOUNT
	CAPITAL FUND		
1,387,438,257	Opening balance	1,387,438,257	
	Add : Transferred from General Reserve	55,500,606	
	Less : Depreciation	104,990,212	1,337,948,651
	GENERAL FUND		
195,028,551	(As Per Annexure 'A')		275,913,955
	PENSION FUND / GPF / GSLIS		
745,135,956	(As Per Annexure 'B')		982,321,282
	CURRENT LIABILITIES & LOANS		
	Amount Payable to Controller ICFRE		
31,969	(As Per Annexure 'C')		81,180
	Amount Payable to PAO, New Delhi		
24,764	(As Per Annexure 'D')		12,559
	Amount Payable to Other Units		
160,869	(As Per Annexure 'E')		166,124
	Amount Payable to Others		
5,224,293	(As Per Annexure 'F')		3,835,107
70,657,496	Project Balances		96,842,252
	EMD / Security		6,450,329
3,935,419	(As Per Annexure 'G')		
2,407,637,574	T O T A L		2,703,571,439

JAGDISH KISHWAN, (Director General, ICFRE)

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(A.D.G. Admin., Fin. Advisor & Chief Account officer, ICFRE)

VIJAY DHASMANA
(Establishment & Accounts Officers, ICFRE)

As per our Separate Report of even date.

I.C.SANGHAL & CO.
Chartered Accountants
17-Rajpur Road, Dehradun

11 AUG 2007

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
BALANCE SHEET AS ON 31ST MARCH, 2007

PREVIOUS YEAR	ASSETS	AMOUNT	TOTAL AMOUNT
	FIXED ASSETS		
	Fixed Assets		1,337,948,651
1,387,438,257	(As per Annexure 'H')		
39,938,000	Work In Progress		39,938,000
37,290,519	Advance for Capital Works		98,989,898
	(As per Annexure 'I')		
	INVESTMENTS		
	CURRENT ASSETS, LOANS & ADVANCES		
	A. CURRENT ASSETS		
	CASH & BANK BALANCES		
910,485,186	(As per Annexure 'J')		1,189,539,560
	B. LOANS & ADVANCES		
	Staff Advances		
18,688,850	(As per Annexure 'K')		21,795,427
	Recoverable from Controller ICFRE		
7,006,381	(As per Annexure 'L')		10,303,344
	Recoverable from PAO,New Delhi		
5,362,187	(As per Annexure 'M')		4,737,733
	Recoverable from Other Units		
1,428,194	(As per Annexure 'N')		318,826
2,407,637,574	T O T A L		2,703,571,439

JAGDISH KISHWAN, (Director General, ICFRE)

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11 AUG 2007

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

DETAILS OF GENERAL FUND AS ON 31ST MARCH 2007

ANNEXURE A	TOTAL
GENERAL FUND	
Opening	195,028,551
Add : Excess Of Income Over Expenditure	135,966,746
Add : Received from other units	27,882,589
Less : Transferred to Revenue ICFRE	27,463,325
Less : Transferred to Capital Fund	55,500,606
	275,913,955

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN
DETAILS OF PENSION FUND AS ON 31ST MARCH 2007

ANNEXURE B PENSION FUND / GPF / GSLIS	GPF	GSLIS	PENSION	TOTAL
Opening	179,493,856	240,219	565,401,881	745,135,956
Add : Excess Of Income Over Expenditure	35,482,368	12,795	231,078,542	266,573,705
Add :				
Saving Fund under GSLIS		332,602		332,602
Death Claim		535,841		535,841
Received from PAO	218,966			218,966
Subscription / contribution	40,527,552	1,579,356	13,326,115	55,433,023
Received from OthersDepartments			102,611	102,611
Refund of Excess Payment			273,180	273,180
	40,746,518	2,447,799	13,701,906	56,896,223
Less :				
Death Claim Paid		581,071		581,071
Saving Fund		334,931		334,931
Subscription to LIC		1,595,729		1,595,729
GPF Advance Reimbursement	12,692,769			12,692,769
GPF Part / Final Payment	21,165,156			21,165,156
GPF Final Payment	5,474,010			5,474,010
Pensionary Benefit paid			37,485,604	37,485,604
DCRG			6,955,332	6,955,332
	39,331,935	2,511,731	44,440,936	86,284,602
	216,390,807	189,082	765,741,393	982,321,282

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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 2007

INCOME	AMOUNT
GRANT IN AID	
Received through DDG(ADMIN)	30,000,000
Received from Revenue ICFRE	37,000,000
Interest	164,078,542
	231,078,542
EXPENDITURE	
Excess Of Income Over Expentiture	231,078,542
	231,078,542

GPF-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2007

INCOME	AMOUNT
Interest & Dividend	35,482,368
	35,482,368
EXPENDITURE	
Excess Of Income Over Expentiture	35,482,368
	35,482,368

GSLIS-INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31ST MARCH 2007

INCOME	AMOUNT
Interest	12,795
	12,795
EXPENDITURE	
Excess Of Income Over Expentiture	12,795
	12,795

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2007

ANNEXURE C	TOTAL
Amount Payable to Controller ICFRE	
GPF Subscription / Refund	29,286
GSLIS	557
Pension Contribution	51,337
	81,180

ANNEXURE D	TOTAL
Amount Payable to PAO New Delhi	
GPF Subscription/Refund	4,658
CGGEIS	5,155
Any Other Recovery	2,746
	12,559

ANNEXURE E	TOTAL
Amount Payable to Other Units	
Saving Fund	64,071
Death Claim	44,013
Advance Recovery	57,555
CGEIS	485
	166,124

ANNEXURE F	TOTAL
Amount Payable to Others	
LIC	713,772
Professional Tax	8,410
Payble to Conttroller ICFRE	2,096,838
Misc. Recoveries	624,897
TA Advance	391,190
	3,835,107

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

ANNEXURE 'H'

Details of Fixed Assets as on 31st March 2007

	OPENING BALANCE AS ON 01/04/06	ADDITIONS	ADJUSTMENTS	GROSS BALANCE AS ON 31/03/07	DEPRICIATION	CLOSING BALANCE AS ON 31/03/07
PLAN ASSETS						
Land	5,072,750		-	5,072,750	-	5,072,750
Scientific Equipments	83,158,020	22,638,907	-	105,796,927	14,171,621	91,625,306
Furniture & Fixtures	13,487,096	936,445	-	14,423,541	1,395,532	13,028,009
Books & Journals	47,648,012	5,107,910	-	52,755,922	7,530,295	45,225,627
Vehicles	19,116,242	-	-	19,116,242	2,867,436	16,248,806
Building & Road	1,053,053,423	10,481,000	-	1,063,534,423	52,914,696	1,010,619,727
Office Equipments	151,459,935	16,325,669	-	167,785,604	23,943,415	143,842,189
Tools & Equipments	8,658,071	10,675	-	8,668,746	1,299,511	7,369,235
Electrical Fittings	5,784,708		-	5,784,708	867,706	4,917,002
						-
TOTAL	1,387,438,257	55,500,606	-	1,442,938,863	104,990,212	1,337,948,651

NOTE: Depriciation on additions has been charged for half year

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2007

ANNEXURE 'G'	TOTAL
SECURITY/EMD	6,450,329
	6,450,329

ANNEXURE 'I'	TOTAL
Advance for Capital Works/Equipment	
CPWD	3,492,564
CCU	95,497,334
	98,989,898

ANNEXURE 'J'	TOTAL
Cash In Hand	764,932
Cash at Bank	209,410,122
FDRs	979,364,506
	1,189,539,560

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION, DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2007

ANNEXURE K :	TOTAL
STAFF ADVANCES	
> Forest Advance	5,221,638
> Festival Advance	796,680
> Car Advance	305,439
> Scooter Advance	2,617,610
> Cycle Advance	79,346
> House Building Advance (HBA)	8,419,019
> TTA Advance	348,061
> LTC Advance	423,087
> Pay Advance	102,850
> Medical Advance	1,235,497
> Other Advances	2,246,200
	21,795,427

ANNEXURE 'L'	TOTAL
Amount Recoverable from Controller ICFRE	
GPF Advance	3,710,703
DCGRG	4,829,097
Provisional Pension	188,880
GPFPart / Final Payment	1,574,664
	10,303,344

ANNEXURE 'M'	TOTAL
Amount Recoverable from PAO, NEW DELHI	
GPF Advance	1,805,098
CGEGIS	962,416
DCRG	1,661,683
Provisional Pension	282,136
GPF Part / Final Payment	26,400
	4,737,733

ANNEXURE 'N'	TOTAL
Amount Recoverable from Other Units	
DDOs (Premium for the month of March)	168,944
Deputation & Others	12,168
Service Tax	135,494
GPF Subscription	2,220
	318,826

INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31-3-2007

PREVIOUS YEAR	INCOME	AMOUNT	TOTAL AMOUNT
	GRANT IN AID		
	PLAN		
420,000,000	- GENERAL COMPONENT	485,300,000	
93,500,000	- EDUCATION & TRAINING	70,000,000	555,300,000
	NON PLAN		
150,039,000	- GENERAL COMPONENT	140,000,000	
11,070,000	- EDUCATION & TRAINING	18,500,000	158,500,000
	PLAN		
20,000,000	- NORTH EAST	50,000,000	50,000,000
2,000	Revolving Fund		2,000
4,130,980	Grant from IGNFA for KVS		1,959,350
2,135,577	Grant from Foreign Project		
41,088,022	Revenue Receipts & Others		41,118,092
741,965,579	TOTAL		806,879,442

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INDIAN COUNCIL OF FORESTRY RESEARCH & EDUCATION

INCOME & EXPENDITURE ACCOUNT FOR THE YEAR ENDING 31-3-2007

PREVIOUS YEAR	EXPENDITURE	AMOUNT	TOTAL AMOUNT
	NON PLAN (GENERAL COMPONENT		
77,474,763	Salary Research	74,949,955	
70,891,599	Salary Non Research	66,720,344	141,670,299
	EDUCATION & TRAINING		
11,070,000	Payment to KVS	18,500,000	
4,262,000	Payment to KVS (from IGNFA)	-	18,500,000
	PLAN (GENERAL COMPONENT)		
	Salaries		
118,922,415	Research Staff	146,197,344	
64,588,065	Non Research Staff	68,828,362	215,025,706
	Travelling		
4,940,487	Research Staff	6,179,132	
5,558,937	Non Research Staff	5,941,409	12,120,541
73,879,543	O.E. (Research Staff)		88,756,596
	Others		
508,864	Publication	1,308,838	
3,025,218	M & S (Lab. Contingencies)	4,356,822	
25,880,182	Minor Work / Maintenance	48,956,634	
4,381,274	Building & Roads	3,267,260	57,889,554
93,499,779	EDUCATION & TRAINING		69,950,000
36,000,000	Grant to Pension Fund	30,000,000	
30,000,000	Revenue Paid to Pension Fund	37,000,000	67,000,000
117,082,453	Excess of Income Over Expenditure		135,966,746
741,965,579	TOTAL		806,879,442

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INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION - DEHRADUN

Annexure forming part of the Balance Sheet as on 31st March 2007

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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I.C.SANGHAL & CO.
Chartered Accountants
17-Rajpur Road, Dehradun

11 AUG 2007

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2007

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
OPENING BALANCE AS ON 1-4-2006					
Cash	681892		Salary Research (Non Plan)	74949955	
Bank	183595610		Salary Non Research (Non Plan)	66720344	141670299
FDR	726207684				
		910485186			
			Salary Research (Plan)	146197344	
GRANT IN AID			Salary Non Research (Plan)	68828362	215025706
RECEIVED FROM MINISTRY			**By Travelling Expenses**		
PLAN			> Research Staff	6179132	
-General Component	480300000		> Non Research	5941409	12120541
-Education & Training	70000000				
-North East	50000000	600300000	**By O.E. (Research Staff)**		
NON PLAN			> Maintenance of Vehicle		
-General Component	140000000		- Fuel	5699506	
-Education & Training	18500000	158500000	- Repair	4419467	
			- Taxes	848122	
			> Electricity Charges	21466615	
-HP Forest Department Shimla		5000000	> Telephone charges	3917344	
			> Revenue Expenditure	349350	
-Revolving Fund		2000	> Maintenance of Equipments		
To Revenue Receipts from DDO'S		27882589	- Scientific	2504915	
To Revenue Receipts Payable to Own Account		14073259	- Office	5616268	
To Revenue Eamed		41118092	> Others		
To Transfer of Fund			- Water Charges	1455563	
To Sharing Cost of Facilities for KVS		1959350	- Stationery	1705711	
To Amt Recd by Controller from ICFRE Rev		37000000	- Contingency Expenditure	13916047	
To Grant in Aid through DDG (Admin)			- Legal / Consultancy charges	1382640	
To Reimbursement from Controller ICFRE			- Municipal Tax	3593011	
			- Medicines / X-ray	3408445	
> GPF Advance	13168521		- Liveries	431710	
> DCRG	6248518		- Postal / Stamp Charges	658799	
> Provisional Pension	107682		- Advertisement	611887	
> GPF Part/Final Payment	401905		- Field Research Expenses	13038799	
>GSLIS		19926626	- Seminar / Conference / HRD	2286934	
			- Newspaper Bill	405659	
To Reimbursement from PAO(F), New Delhi			- Extension	567310	
			- Rent building / Equipment	472494	
> GPF Advance	6290099				88756596
> DCRG	20000		By Others		
			> Publication	1308838	
			> M & S (Lab. Contingencies)	4356822	
> CGEGIS	52168	6362267	> Minor Work / Maintenance	48956634	
			> Others		
			> Building & Roads	3267260	
			> Service Tax		57889554

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2007

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
To Recoveries from Staff on behalf of ICFRE			By Advances		
> GPF Subscription	29650146		> CPWD		
> GPF Advance Refund	10727524		> CCU	72503000	72503000
> GSLIS	1575310				
> Pension Contribution	13532254	55485234	**By Equipment / Library Books**		
To Recoveries from Staff on Behalf of PAO(F)			> Scientific Equipments	22316286	
			> Office Equipments	16325669	
> GPF Subscription	10672001		> Furniture & Fixtures	936445	
> CGEGIS	141595		> Books & Journals	5107910	
> Pension Contribution			> Tools & Equipments	10675	44696985
> CGHS			> Advances		
> Other Recovery	68705	10882301	- Scientific Equipments		
			- Office Equipments		
To Recoveries from Staff on Behalf of Others			- Furniture & Fixtures		
			- Books & Journals		
> GPF Subscription	2668774		-Tools & Equipments		
> CGEGIS / GIS	74285		- Any Other (Specify)		
> Intt. On Car Advance					
> Other	13887	2756946	By Vehicles		
			> Vehicles Purchase		
To Recoveries of Advance from Staff on behalf of ICFRE			> Advance Payaments for Vehicles		
			By Revenue Receipt Refunded		
>Forest Advance	30063275		By Revenue Receipt paid to DG ICFRE		27463325
> Festival Advance	1561046		By EMD / Security Refunded		1930096
> Car advance	348665		By Revenue receipt paid to Controller ICFRE		37000000
> Scooter Advance	799939		By Revenue Receipits paid to own Revenue A/c		13885792
> Cycle Advance	49050				
> House Building Advance (HBA)	1867937		**By Payment made on behalf of PAO (F)**		
> TA Advance	15480308		>GPF Advance	5700050	
> TTA Advance	241851		> CGEGIS		
> LTC Advance	4029552		> DCRG	15000	
			> Provisional Pension	22763	
> Pay Advance	196106		> GPF Part / Final Payment		5737813
> Medical Advance	2863115				
			By Payment made on behalf of the		
> HLF		57500844			
			Controller (ICFRE)		
To Other Deduction & Recoveries			>GPF Advance	14888883	
			> DCGRG	7886744	
> TDS (Salary)	7430382		> Provisional Pension	78652	
> TDS (Contractor)	896010		> GPF Part / Final Payment	369310	23223589
> LIC	2083979				
> Professional	304661		**By Payment made to PAO (F) on Behalf of Staff**		
> Others	4718118	15433150			
			> GPF Subscription / Refund	10678001	
To EMD / Security		4445006	> CGEIS	142200	
To Sale of Assets			> Interest on House Building Advance	56705	
			> Scooter Advance	21600	
			> Any Other Recovery (Specify)		10898506

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2007

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**		
			> GPE Subsripiton	29525732	
Amount received from PAO (F) on			> Refund of GPF Advance	10840804	
account of GPF transfer		218966	> GSLIS	1575480	
			> Pension Contribution	13494007	55436023
Amount received from Various DDO'S on					
account of GPF Subscription		40527552	**By Payment made to Other Offices on Behalf on**		
			> GPF Subsription / Refund	2666224	
Amount Received from Others on account of refund of			> CGEGIS	73800	
refund of excess GPF Payments			> TDS	1101409	
Dividends on Govt. Securities			> Professional Tax	304211	
Bank & FDR Interest		35495163	> Income Tax	7228514	
			> House Building Advance	173496	
Amount received on account of Saving			> Car Advance	100467	
Fund Under GSLIS		332602	> Scooter Advance	10172	
			> LIC	2081037	
Amount received on account of Death			> Any Other Recovery (Specify)	5299986	19039316
Claim under GSLIS		535841			
			By Advances paid to Staff		
Subscription from various DDO'S		1579356	> Forest Advance	31833500	
			> Festival Advance	1468946	
Pro-rata Pensionary benefit received			> Car Advance	184979	
from PAO (F)			> Scooter Advance	2501528	
			> Cycle Advance	120500	
Amount received from Various DDO's on			> HBA	4079694	
account of Pension contribution		13326115	> TA Advance	13463560	
			> LTC Advance	3574482	
Amount recovere on account of excess			> Medical Advance	2578890	
payment of pension by bank		273180	> Pay Advance	143456	
			> TTA Advance	180739	
Amount Received from other Departments					
on account of Pensionery Benefits		102611	> Any Other Recovery (Specify)	85957	60216231
Govt. Securities			By Any Other Payments (Specify)		
FDR Interest		164078542			
			By Project Payments		103223316
Total Project Receipts		129408072			
			Amount paid by Controller ICFRE		
			By GPF reimbursement to DDO's		12692769
			By GPF Part Final payment		21165156
			By GPF Final payment		5474010
			Death Claims Paid		581071
			Saving Fund Paid		334931
			Amt of premium to LIC for GSLIS Subsrcription		1595729
			Pensionary benefit paid		37485604
			Rembursement of DCRG, Pension to Various DDOs		6955332

INDIAN COUNCIL OF FORESHTRY RESEARCH & EDUCATION, DEHRADUN
RECEIPTS & PAYMENTS ACCOUNT FOR THE YEAR ENDING 31st March 2007

RECEIPTS	AMOUNT	TOTAL	PAYMENTS	AMOUNT	TOTAL AMOUNT
			By KVS Expenditure		18500000
			By Traning & Education - Plan		69950000
			By Sharing Cost of Facilities for KVS		
			CLOSING BALANCE		
			CASH	764932	
			BANK	209410122	
			FDR	979364506	
					1189539560
		2354990850			2354990850

0

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(Establishment & Accounts Officers, ICFRE)

List of Abbreviations

A&R	Afforestation and Reforestation
AFLP	Amplified Fragment Length Polymorphism
AFRI	Arid Forest Research Institute
AMF	Arbuscular Mycorrhizal Fungi
APFDC	Andhra Pradesh Forest Development Corporation.
APFISN	Asia Pacific Forest Invasive Species Network
APMP	Alkaline Peroxide Mechanical Pulping
AYUSH	Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homeopathy
CCA	Copper Chrome Arsenic
CCB	Copper Chrome Boric
CDM	Clean Development Mechanism
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
CSIR	Council of Scientific and Industrial Research
CSIRO	Commonwealth Scientific and Industrial Research Organization, Australia
CSO	Clonal Seed Orchard
CTG	Cassia Tora Gum
DBH	Diameter at Breast Height
DBT	Department of Biotechnology
DST	Department of Science and Technology
ESF	Extension Support Fund
FIS	Forest Invasive Species

FRC	Forest Research Centre
FREE-P	Forestry Research Education and Extension Project
FRI	Forest Research Institute
FRLHT	Foundation for Revitalization of Local Health Traditions
FSI	Forest Survey of India
FYM	Farm Yard Manure
GACL	Gujarat Alkali and Chemicals Ltd.
GBPIHED	Govind Ballabh Pant Institute of Himalayan Environment and Development
GC-MS	Gas Chromatography-Mass Spectrometry
GEF	Global Environmental Facility
GHG	Green House Gas
GLC	Gas Liquid Chromatography
HFRI	Himalayan Forest Research Institute
HPLC	High Performance Liquid Chromatography
ICAR	Indian Council of Agricultural Research
ICFRE	Indian Council of Forestry Research and Education
IFFDC	Indian Farm Forestry Development Cooperative
IFGTB	Institute of Forest Genetics and Tree Breeding
IGNP	Indira Gandhi Nahar Pariyojna
IHBT	Institute of Himalayan Bioresource Technology
IIRS	Indian Institute of Remote Sensing
IPIRTI	Indian Plywood Industries Research and Training Institute
IPM	Integrated Pest Management
IPMA	Indian Paper Manufacturers Association
IPT	International Provenance Trial
IR	Infra Red
ISO	International Organization for Standardization
ISSR	Inter Sample Sequence Repeat

ITTO	International Tropical Timber Organization
IWST	Institute of Wood Science and Technology
JRF	Junior Research Fellow
KFD	Kerala Forest Department
LAN	Local Area Network
LOSP	Light Organic Solvent Preservative
MoEF	Ministry of Environment and Forests
MoU	Memorandum of Understanding
MPT	Multi Purpose Tree
NABARD	National Agricultural Bank for Agriculture and Rural Development
NAEB	National Afforestation and Eco-development Board
NFLIC	National Forest Library and Information Centre
NFT	Nitrogen Fixing Trees
NGO	Non-Governmental Organization
NMBA	National Mission on Bamboo Applications
NMPB	National Medicinal Plants Board
NMR	Nuclear Magnetic Resonance
NOVOD	National Oilseed and Vegetable Oil Development
NRDC	National Research Development Corporation
NRSA	National Remote Sensing Agency
NTFP	Non Timber Forest Product
NWFP	Non-Wood Forest Produce
PCR	Polymerase Chain Reaction
PFM	Participatory Forest Management
PGD	Post Graduate Diploma
PSB	Phosphate Solubilizing Bacteria
PSIP	Planting Stock Improvement Programme
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
SFD	State Forest Department
SHG	Self Help Groups
SP	Self Pruning
SPA	Seed Production Area
SPM	Suspended Particulate Matter
SRF	Senior Research Fellow
SSO	Seedling Seed Orchard
SSPA	Seedling Seed Production Area
TEM	Transmission Electron Microscope
TFRI	Tropical Forest Research Institute
TKP	Tamarind Kernel Powder
TLC	Thin Layer Chromatography
TNFD	Tamil Nadu Forest Department
UNFCCC	United Nations Framework Convention on Climate Change
USDA	United States Department of Agriculture
UV	Ultra Violet
VAM	Vasicular Arbuscular Mycorrhiza
VMG	Vegetative Multiple Garden
WAN	Wide Area Network

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